The impacts of conflict and climate change on food security and nutrition in Chad

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Preface

Acknowledgements

First and foremost, I need to express my thanks to Prof. Dr. Alfonso Sousa-Poza. As my primary mentor during the laborious years of writing this thesis, he provided invaluable scientific guidance that helped me to narrow my research topic and polish my papers; I frequently found myself looking at Alfonso's papers for structure and ways forward for my own work. Equally I must thank Prof. Dr. Christian Ernst, my second mentor, who was available to guide this thesis on last minute. My gratitude goes to Dr. Hamid R. Oskorouchi, an amazing mentor and co-author who was always available for questions and discussions on our joint project and beyond. His curiosity was infectious and always helped motivate me to dig deeper and drive analyses further, while his diligence in providing feedback helped me to refine papers and estimation procedures. Simon Albers has my thanks for his comments on spelling, grammar, and insistence on making overly long sentence short and digestible.

Without the World Food Programme (WFP)'s permission to access its data on food security in Chad, large swaths of this thesis would have been impossible. Madjoudal Allarabaye, Edgar Wabyona, and Matthieu Tockert from WFP Chad's country office were always there to answer my pestering questions on the dataset and I am thankful for this assistance. For their comments during our various research seminars, I thank the team from the Chair for Household and Consumer Economics at the University of Hohenheim. For their guidance in navigating the rules and regulations, processes and procedures, and forms and formalities that a university's bureaucracy presents to the uninitiated, I thank the team from the Graduiertenakademie.

Lastly, I would like to thank my parents, Gabriela Karnowski-Bachofer and Wolfgang Bachofer, who never tired to support me. Their availability to drop off documents at the University of Hohenheim, while I

was researching in Chad, facilitated much of this work. This thesis is dedicated to my wife Michelle. It was Michelle who encouraged me to send out the initial email proposing this thesis' topic to Prof. Dr. Sousa-Poza. Her patience with me during the years of research and writing going into this thesis was vital. I love you to pieces.

Bamako, Mali, 24.05.2023

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Overview of articles

In this cumulative thesis, the following articles are included:

The first article, "The Effects of the Boko Haram Insurgency on Food Security in the Lake Chad Basin: A Review of the Evidence", is based on a working paper-version finalized in November 2020 after having received feedback on a first draft a month earlier. It is presented in Chapter 2.

Bachofer, Robert P. (2020). The Effects of the Boko Haram Insurgency on Food Security in the Lake Chad Basin: A Review of the Evidence. *Working paper*.

Titled "Beyond Political Violence: Boko Haram's banditry and child health in Chad"[1], the second article is replicated in Chapter 3. After the research outline was presented at a seminar on 08.11.2019, it resulted in a finished working paper April 2023.

Bachofer, Robert P. and Oskorouchi, Hamid R. (2023). Beyond Political Violence: Boko Haram's Banditry and Child Health in Chad. *Working paper.*

Reproduced in Chapter 4, the third article, "The effects of Seasonal Drought on the use of Coping Strategies: Evidence from Chad", received inputs during a seminar on 09.11.2021, resulting in a finished working paper in September 2022.

Bachofer, Robert P. (2022). The Effects of Seasonal Drought on the Use of Coping Strategies: Evidence from Chad. *Working paper.*

Across all chapters, the numbering of headings, tables and figures are adapted to this overall thesis to display consolidated tables of contents.

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[1] The contribution of the author to this article includes Abstract; Introduction; Background; Results and Discussion; Conclusions. He also performed data cleaning, media review, and calculation of anthropometrics.

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1 General Introduction

In this introduction, the author's motivation to write this thesis is presented together with key background information on Chad. It entails a section on the overall approach of this document, which – despite being a cumulative thesis with various articles that investigate specific topics – aims to provide the reader with a better general idea about food (in)security and its driving forces in Chad. Lastly, it provides an overview of the next chapters, gradually introducing the key concepts and definitions required for the reader.

1.1 Food security in Chad and motivation

Chad remains one of the poorest countries in the world. In 2021, it ranked 190th out of 191 countries in the Human Development Index (HDI) and has done so consistently since HDI data on it exists. More tellingly, at the time of writing this document, it is the least-developed country within its own neighborhood, as the war-torn Central African Republic and Niger – two long-term contenders for the dubious title of the world's least-developed country – still have managed to overtake Chad. Today, only South Sudan scores lower on the HDI, after six years of civil war (UNDP 2021). Similar tendencies are observed when measuring proxies for hunger. In early 2023, Chad ranked 117th out of 121 countries in the Global Hunger Index (GHI) and – again – has made only piecemeal progress: Among the seven countries, which the index classified as "extremely alarming" in 2007 (Angola, Sierra Leone, Ethiopia, Zambia, Niger, Chad, and Afghanistan), Chad made the least progress in reducing its score (GHI 2022).

While working in the field for the World Food Programme (WFP), first in the capital N'Djamena in 2017 and then in the town of Mao, Kanem region, in 2019, the author can attest to all the little phenomena of living in one of the least-developed countries of the world: Temperature often above 40°C and generators constantly breaking down; a typhus infection, which the Chadian health system first misdiagnosed as malaria; and an evacuation from

my home and duty station, when a column of rebel groups advanced towards it. Yet, for most Chadians these still represent relative luxury, as they do not own a generator, are not able to access the health system, and do not possess the means to escape from armed conflict. While compiling information for WFP's country strategic plan 2019-2023 for Chad, the dearth of information of food security in this country became apparent, as did the fact that it has few national capacities to exploit WFP's datasets to analyze the causes of hunger. The motivation behind this thesis is to mitigate this dearth.

After all, Chad is also a land of opportunity: It possesses natural reserves of petroleum, uranium, natron, and gold; it can count on a population dividend, with 46.2 percent of Chadians being under the age of 14 years; and it has ample space to spare (CIA 2023). There is no indication that Chadians need to suffer from hunger until the end of times, if only the academic and international communities could understand the drivers of food insecurity and malnutrition better and tailor their responses. Indeed, the various mappings of the Integrated Food Security Phase Classification (IPC) reveal that the number of food insecure people in Chad is waxing and waning with the onset and end of the annual lean season, while hunger and malnutrition hotspots are unevenly concentrated in the country (IPC 2023). At least some of them overlap with conflict hotspots, notably the Lac province, where splinter groups of the terrorist organization Boko Haram operate. WFP calls this "Chad's Triple Challenge: Hunger, Conflict and Climate Change" (WFP 2021). Might there be a causal link between these challenges?

1.2 Study area, methodology, and limitations

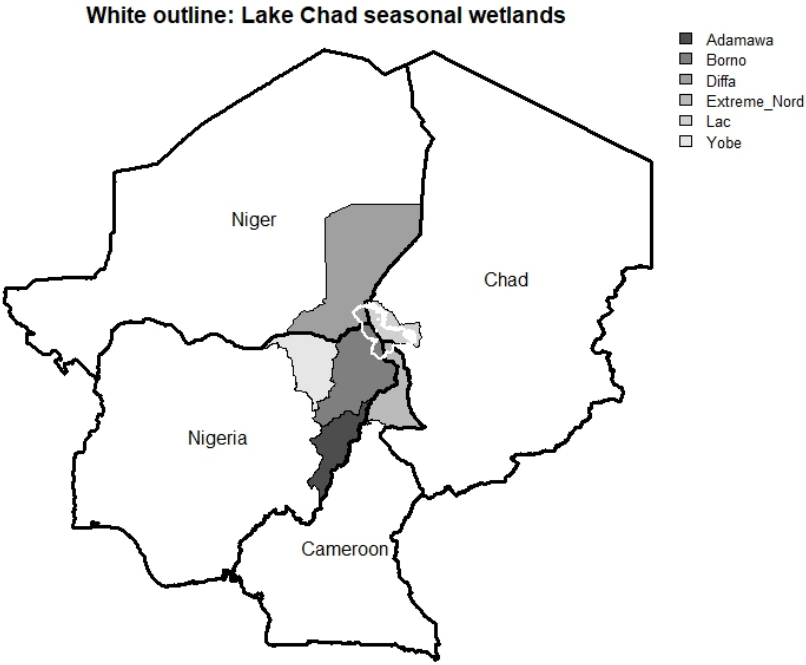
This thesis takes a deep look into the conflict-food security and climate-food security causal nexus. From it follows the research question, how conflict and climate impact food security and nutrition in Chad. However, taking into account the plenitude of insurgencies, armed uprisings, rebel incursions, droughts, floods, sandstorms, and other conflict- and climate-related phenomena that Chad faced in its recent history, a certain limit to the scope of this question is necessary. Specifically, by selecting first the conflict between the Chadian state and the Boko Haram insurgency and then the climate impacts of yearly recurrent droughts, resulting in the lean season, this thesis contrasts a high-impact, one-off, and very localized event with a

comparatively low-impact, recurrent and wide-spread one. This, in turn, permits an overview of short-term and long-term indicators associated with food security, hopefully providing the reader with a comprehensive answer to the full research questions, despite the thesis' limit to two specific phenomena.

Some parts of this thesis are looking beyond the country of Chad to locate the Boko Haram insurgency and the lean season in the broader regional context. To avoid confusion, the thesis will be using the word *Chad* (from the Kanuri word for *lake*) exclusively for the Republic of Chad, while referring to *Lake Chad* as such or as *the Lake*, with capital *L*. The Chadian administrative region *Lac* (French for *lake*) will be maintained in French. The littoral administrative entities of the countries bordering Lake Chad[2] are summarized under the chapeau *Lake Chad region*. Figure 1 provides an overview of these areas. *Lake Chad basin* refers to the geological area covered by Lake Chad in the Holocene, when it spanned as far south as the Central African Republic and as far north as Algeria and Libya (Armitage, Bristow, and Drake 2015).

[2] Extreme Nord in Cameroon, Lac in Chad, Diffa in Niger, and Borno, Yobe, and Adamawa in Nigeria.

Figure 1.1: Map of the study area



Notes: Drawn by the author from World Bank Data Catalogue, Africa - Water Bodies, and OCHA Humanitarian Data Exchange, West and Central Africa (World Bank 2018; OCHA 2023)

Methodologically, the thesis relies on a literature review, followed by a Difference-in-Difference (DID) approach to trace cause-effect relationships between the Boko Haram insurgency on underweight and wasting among children under the age of five years, and two-way fixed effects estimations on the impact of the lean season on five household-level coping strategies. Data for the first case permits a typical two-by-two DID, using individual-level data for its dependent variables and a binary treatment variable affecting them – or not, in the case of the control group – at the same time. The second case needs to rely on data aggregated at a low level of administrative regions (sous-prefetures, one level above the village), leading to a continuous depended variable. Sous-prefetures face changes in the intensity of the treatment at different times over the study period, and the treatment is waxing and waning. Consequently, this case uses a two-way fixed effects model to estimate treatment effects and then performs post-estimation tests to measure and reduce the risk of treatment effect

heterogeneity and other biases (de Chaisemartin and D'Haultfœuille 2020), arriving at a causal interpretation of the estimations results.

1.2.1 Food security and Boko Haram in the regional context

To understand how conflict, exemplified by the Boko Haram insurgency, is driving food security in Chad, first an overview of the insurgency's history and the food security environment in which it came onto existence, and which it ultimately affected, is in order. The first article of this cumulative thesis, reproduced in Chapter 2, provides this overview, including the climate context in the study area, thereby introducing the phenomena that will furnish the dependent and the independent variables for Chapters 3 and 4.

To a large extent, the evidence on the early history of Boko Haram is sparse and opinions are conflicting regarding the details. Most authors trace it to its founder, Mohammed Youssouf (Cook 2011; Roelofs 2014; Asuelime and David 2015), though some trace its ideological roots to the 1990's (Sani 2011). Further complication arises from some author's speculation on overlaps with the Nigerian Taliban (ibid.), them joining Boko Haram (Magrin and Pérouse de Montclos 2018), and with some treating both groups as identical (Agbiboa 2015). To a certain extent, even the name *Boko Haram* – roughly "western education is forbidden" (Pérouse de Montclos 2014) – exemplifies this fluidity of the group: It never was its self-chosen title and instead attributed, maybe mockingly, by the local population due to sermons rallying against such western education. Well-aware of this fluidity and consequently the futileness of trying to follow up on the different movements joining and splitting from the overarching group during different times, as well as the different names and associations to international terrorist organizations that these movements took on, this thesis is using the term *Boko Haram* throughout its chapters. For this thesis it matters little, under which brand the insurgents perpetrated violence; the impacts of this violence do.

Regardless, perpetrating violence soon became a mainstay of Boko Haram. Clashes with other religious groups in Maiduguri, then the center of the movement, and clashes with security forces led to hundreds of deaths in 2009. While these drove the organization out of the city, the group ultimately adapted to become a rural-based insurgency, able to employ a range of tactics and covering an ever-larger territory. Eventually, this came to include the

shores of Lake Chad, where the group came into contact with Chad itself and gained a foothold on the islands there (Pérouse de Montclos 2014; MacEachern 2018). In 2015, troops of the Multinational Joint Task Force (MNJTF) drove the insurgents back into Sambisa forest and the seasonal wetlands of Lake Chad, where the insurgency rages ever since (Magrin and Pérouse de Montclos 2018). The same year, Boko Haram perpetrated its first official attacks in Chad.

However, as Chapter 2 gives a broader overview of the insurgency, it goes beyond Chad to outline the food security and nutrition environment that was hit by the insurgency. This environment encompasses the administrative areas of Cameroon, Niger, Nigeria, and Chad, which border Lake Chad, termed here the Lake Chad region. In this environment, food availability largely depends on the fluctuations of rainfall patterns between years, resulting in large-scale droughts, and within years, leading to the yearly lean season, the time of the year when stocks from last harvest run out before the next harvest starts and livestock lacks pastures to graze – roughly April to August, with slight variations between crops and countries (van der Geest and Dietz 2004; WFP 2016; FAO 2019a). Even when food is available on the national level, many people are not able to access it. While varying by country, up to half of the population lives from less than USD 1.90 and food prices fluctuate immensely, with evidence that rural populations and women are worse off (FAO 2019b; World Bank 2019), thereby limiting economic access to food. Regarding physical access, seasonal flooding often cuts off villages in the Lake Chad region and trucks sinking into muddy roads drive transport and thereby food prices up. The lack of food availability and access contributes to childhood malnutrition, compounded by low levels of exclusive breastfeeding, access to clean water, and improved sanitation. While concerning across all four countries, the situation is often worst in the Chadian region bordering Lake Chad, Lac, if data on it is available at all (UNICEF and Republique du Niger 2000; Institut National de la Statistique 2015; INSEED 2016; National Bureau of Statistics (NBS) and UNICEF 2018). The overall situation had not been stable either, as the Sahel went through a series of below-average rainfalls in the 2000s and 2010s, and consequently a decrease in agricultural output and rising food prices until 2014 (Mitchell 2018; FAO 2019a).

To put it bluntly, the food security environment that was hit by Boko Haram was fragile to begin with. Thus unsurprisingly, this chapter outlines a plethora of aspects of food security affected by the insurgency, reported in Table 2.3. The articles and books reviewed stem from a systematic search of

key words, reproduced in Appendix A for articles available up until July 2020, in Web of Science, Scopus, Google Scholar, Springer.com, Tandfonline.com, Researchgate.net, Semanticscholar.org, and Academia.edu.

Of note among the findings of this chapter is the division between literature treating the general population and literature treating displaced populations – that is IDPs and refugees.[3] Research methodologies differ markedly between the two, with nationally representative surveys being much more prevalent among studies on the former, while for the latter researchers much more often administered their own surveys, likely because displaced populations are often concentrated in camps and thus easier accessible. Access also seems to influence on the geographic distribution of study areas, with a dearth of literature on Niger and Chad, both counting on the least-developed infrastructure and being the only exclusively French-speaking countries included in this analysis. Even within countries, access might play a role, with papers on displaced populations disproportionally treating camps close to Abuja, the capital of Nigeria, far from Boko Haram's actual area of operation. Effectively, extant literature provides a somewhat tilted picture of the situation. Notably, literature on Chad is largely non-existent, likely due to language and physical barriers.

1.2.2 Boko Haram in Chad

The second article of this cumulative thesis, displayed in Chapter 3, contributes to closing this gap. It covers the period from 2010 to 2014, that is when Boko Haram had already been driven out of Maiduguri and the insurgency was forming in the countryside. This is the time when insurgents were entering Lac and perpetrated criminal violence, but before they committed the first attacks of political nature on Chadian territory (compare to the full timeline of Boko Haram activity pre-2015 of the previous chapter).

During this period, Boko Haram used the porous border between Nigeria and Chad consisting of seasonally shifting wetlands to retreat into Chad from Nigerian military action, while not attacking Chadian forces themselves. Specifically, during this timeframe, it perpetrated its full range of violence in the rest of the Lake Chad region, but in Chad it only

[3] And very little attention paid to returnees.

perpetrated criminal violence and there only in Lac. Consequently, this environment provides for a suitable quasi-natural experiment for what happens when terrorist organizations do not engage in political violence, but in crime and extortion to resupply and perpetrate attacks elsewhere. Conceptually, the difference between the two forms of violence are their objectives: Political violence aims at shifts in power, often of one group or ideology over others; criminal violence aims at economic enrichment or personal vengeance (Krause, Muggah, and Gilgen 2011). For the Boko Haram insurgency, foregoing political violence in Chad before 2015 made sense, so not to provoke a response of those in power; after all, Chad possessed a feared fighting force at the time (Debos 2013). However, it did perpetrate criminal violence through extortion, pillaging, and partial control of the illicit trade prevalent in the Lake Chad region.

An expert interview, reproduced in Appendix B of this article, illustrates how such banditry is conducted in practice: A mobile, lightly armed force of insurgents speeds in pirogues from the Nigerian coastline over the shallow waters of Lake Chad towards a Chadian littoral village, the insurgents take what they can, including humans, and make off before anyone can even raise an alarm. Other sources report extortion of cross-border traders by Boko Haram or direct involvement in drug, human, and arms trafficking (Africa Center for Strategic Studies 2017). With no territory taken by the insurgency, no flags raised, and no challenge to the state authority, it was difficult for the Chadian security apparatus to identify these acts as the ones of a terrorist organization and not just ordinary crime, especially as this apparatus was at the time focused on the situation at its eastern border (Human Rights Watch 2011). Indeed, as Lac was traditionally a hotspot for illicit trade and related criminal activity even before the study period, we cannot exclude that some banditry occurring during the study period had not been related to Boko Haram and presented the usual background noise of criminal acts in the Lake region.

However, Chapter 3 clearly shows that the presence of Boko Haram in Lac made a difference. Estimating the impact of the insurgency's crimes on human development by using child underweight and wasting as proxies, the thesis finds a treatment effect on the treated (TOT) of -0.085 points on the z-score for underweight and a TOT of -0.305 for wasting, reported in Table 3.2 of this article. To put these values into perspective, it should be noted that a child with a z-score of -2 is considered as moderate underweight or wasting. Thus, an average decrease of 0.085 points and 0.305 points represents a non-trivial magnitude. As reported in the previous chapter, Lac

already had high prevalence of underweight and wasting, and this article visualizes this in Figure 3.1 by comparing it to other Chadian administrative regions in a parallel trends analysis, using Demographics and Household Survey (DHS) and Multiple Indicator Cluster Survey (MICS) data of waves 1997, 2000, and 2010 for pre-treatment and 2015 for the treatment period.

Beyond the reported TOTs, Chapter 3 analyses the insurgency's impacts on households' participation in agricultural activities and their dietary diversity, shown in Table 3.4. The data used here are the 2011, 2013, 2014, 2015, and 2016 waves of the Enquête nationale sur la Sécurité alimentaire des ménages ruraux (ENSA), administered by the Directorate of Agricultural Production and Statistics of the Government of Chad and WFP, aggregated on the level of administrative regions of Chad. The chapter shows that Boko Haram's criminal activities presented barriers to food production and to household access to a diversified diet. Meanwhile, in their placebo analyses, the authors found no statistically significant effect of the lean season on underweight and wasting compared to the control group; that is not to say that the lean season had no effect on these childhood nutrition indicators, but that the effect was not larger in Lac than in the control regions. Other tests, such as using a placebo sample, also confirm that it is indeed the Boko Haram insurgency's criminal activities that were responsible for the estimated TOTs.

The main findings of this article are alarming: Despite not perpetrating political violence, Boko Haram banditry had significant impacts on human development in its area of operation. Yet, due to keeping the associated violence purely non-political, the group managed to remain unchallenged for years. One has to wonder if early action could have prevented Boko Haram from adapting to the wetlands of Lake Chad and from supplying itself through pillaging villages. Ultimately, the group's capacities enabling it to mount large-scale attacks on Chadian soil from 2015 onwards could have looked very differently. Early action to curb this banditry certainly would have made a difference for the people of Lac and lessened suffering. However, even without Boko Haram, Lac has been traditionally a hotspot of food insecurity and malnutrition, with large seasonal effects of the yearly lean season.

1.2.3 Seasonal drought in Chad

The relationship of this seasonal drought and households' abilities to adapt to it to protect their food security is the focus of the last article of this cumulative thesis, replicated in Chapter 4. It provides a counterfactual to the previous chapter, by looking specifically into seasonal drought as a cause of food insecurity over the entire territory of Chad. Anticipating that such low-scale, recurring shocks will not impact short-term indicators of malnutrition, such as underweight and wasting which were used as dependent variables in the previous chapter, this chapter analyzes household coping strategies instead.

Coping strategies are the mechanisms through which different actors adapt to shocks and – while there is a tremendous variety of such mechanisms and actors (World Bank 2001) – this article focuses on the strategies that households use to protect their food consumption from the impacts of seasonal drought, while extant literature focuses on strategies to protect food production (Gautier, Denis, and Locatelli 2016). Seasonal drought in Chad is driven by north-south shifts of the Inter-Tropical Convergence Zone (ITCZ), leading to a single rainy season and a single harvest per year (compare the seasonal calendar displayed in Chapter 2), which households then stock until the next harvest. Households' food stocks often start running out between June and September, leading to the lean season before the next harvest is brought in.

As rainfalls are unreliable on the local level (van der Geest and Dietz 2004) and as the local geography of *wadis*, seasonal riverbeds, and other depressions (FAO 1997) add to this unpredictability, harvests can vary significantly between locations and from one year to the next. Using the ENSA dataset aggregated on the sous-prefeture level, one administrative level above the village, this article uses this quasi-randomness as a set-up of a natural experiment and estimates the effects of drought exposure on the prevalence of the use of five coping strategies. Two-way fixed effects estimations are employed to estimate the coefficients. As pointed out by recent literature, the causal interpretation of the coefficients of two-way fixed estimates as equivalent to TOTs is limited due to two-way fixed effects estimates being the weighted sums of average treatment effects (ATTs) per each time and unit combinations. As such weights can be negative, this can lead to a reversal of the direction of ATTs and thereby bias the overall estimate (Imai and Kim 2021). The article accounts for this risk through a variety of tests, chief among them by estimating the size of ATTs needed to

lead to a change in their sign (de Chaisemartin and D'Haultfœuille 2020). Furthermore, it performs placebo tests with alternative samples, alternative dependent variables, and an alternative treatment. All these tests confirm a valid causal interpretation of seasonal drought impacting the use of coping strategies.

However, the estimates reported in Table 4.2 defy expectations. Out of the five coping strategies used as dependent variables, Chapter 4 finds a statistically significant effect for only two: seasonal drought causes an increase of 7.1 percentage points in the prevalence of households selling non-productive assets, and an increase of 7.6 percentage points in the prevalence of using their savings. Conversely, drought does not cause any statistically significant rise in the prevalence of households purchasing food/non-food on credit, selling (non-productive) animals, and taking at least one of child out of school. This is in stark contrast to the wide array of coping strategies with which other authors have associated seasonal drought in Chad (Hutchinson et al. 1992; Sanoussi et al. 2015; Abraham, Mohamed-Brahmi, and Ngoundo 2019). In other words: Seasonal drought exposure causes households to enact only a very specific set of coping strategies, while the prevalence of other coping strategies is likely driven by other factors. In the broader context of this thesis, it should be noted that estimates and their statistical significance changed little when excluding Lac and other conflict-affected regions from the sample. Thus, while the previous chapter shows the impact of conflict on short-term, life-threatening forms of malnutrition in Chad, Chapter 4 highlights the longer-term effects of a seasonally recurrent shock.

1.3 Summary of the introduction

Summarizing the introduction briefly is necessary to lead to the articles in the next chapters. Chapter 2 was mainly motivated by the relative dearth of literature on food security, seasonal drought, and Boko Haram activities Chad. Thus, in the form of a literature review and providing a large section on the regional food security context, it aims to close this gap. It should provide the reader with all background information necessary to comprehend the key concepts and context of the following chapters. Importantly, it recommends readers of the broader literature on Boko Haram to consider that extant literature is biased due to linguistic and physical access.

Consequently, the overall understanding of the insurgency's impacts is skewed, with little information on Chad.

In turn, this finding motivated Chapter 3, to close the gap concerning literature on Boko Haram's effects on food security in Chad, specifically for the period before 2015. A two-by-two DID provides estimates for TOTs of the insurgency on childhood malnutrition indicators and proofs empirically that terrorist organizations do not need to perpetrate political violence to terrorize civilians and to bring human suffering. The reader should come away from this chapter with a better appreciation of not only the case of Boko Haram criminal violence in Chad, but also the danger that criminal violence poses, when perpetrated by groups with political goals.

Chapter 4, meanwhile, was motivated by the interest to complement the previous article with an example on how climate affects food security in this country. Through two-way fixed effects estimations, underpinned by various test of causal interpretability, this chapter shows empirically that seasonal drought, in the form of the lean season, causes an increase of the prevalence of only a limited set of coping strategies. Chapter 5 of this thesis discusses its findings. Lastly, Chapter 6 outlines the thesis' conclusions and locates them in the larger literature, hinting at further research topics and providing an answer to what are *the impacts of conflict and climate change on food security and nutrition in Chad*.

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2 The Effects of the Boko Haram Insurgency on Food Security in the Lake Chad Basin: A Review of the Evidence

By Robert Paul Bachofer

Abstract

To delineate – and inform policy makers on how to interrupt – the channels through which Boko Haram has used, caused, and exacerbated food insecurity and malnutrition across affected populations in Cameroon, Chad, Niger, and Nigeria, this review categorizes 29 qualitative and quantitative sources in English and French by food availability, access, utilization, and dimensional stability. In particular, it identifies different food security dynamics among both the general and displaced populations. Whereas the former has suffered insurgency-induced disruption of a wide range of food production, food market, and nutrition factors in an already fragile system, the latter have experienced widely varying situations exacerbated by the resilience levels of camp-specific conditions capable of either improving or worsening their circumstances. Although the availability of research on these populations in the various countries, as well as the research methods used, differ considerably, the literature review makes several useful recommendations for advancing research on the nexus between the insurgency and food security.

Keywords: Boko Haram insurgency; food security; nutrition; availability; access; utilization; stability; IDPs; refugees; transmission channels; Lake Chad; Nigeria; Cameroon; Niger; Chad.

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2.1. Introduction

Although being active for over a decade, the Boko Haram insurgency in the Lake Chad region has received unequal attention across time and across the areas in which it has been operating. It was not spotlighted internationally until the infamous Chibok kidnapping in 2014[4], Boko Haram had already been waging campaigns against the Nigerian state for 5 years, growing ever stronger through an environment of instability created both by itself and the heavy-handed response of the security forces (Thurston 2017). Even so, the insurgency received only sporadic attention beyond its core area of Nigeria, especially the Nigerian North-East. At the same time, even though Chadian and Nigerien nationals not only comprise the sect's rank-and-file (Campbell 2014) but – like Chadian national Mahamat Nour (Tran Ngoc 2012) – are now taking on leadership roles, the literature on Boko Haram's activities in these countries is sparse. Indeed, in Cameroon the group seemingly only received the spotlight after the 2013 kidnapping of seven French tourists, an event that – like the Chibok abduction – attracted both media and international attention (Le Monde 2013).

Yet if the outside world is to formulate effective humanitarian responses and address the socio-economic root causes of this insurrection, it needs a deeper understanding not only of the similarities, but also of the pronounced differences across countries and affected populations – in particular as they relate to food security and nutrition. This review thus aims to expand our understanding of the insurgency's impacts on food insecurity across affected countries and strata. Thereby, it takes a deep look into the different channels through which it affects different populations and the different types of suffering it causes. As a final step, it identifies gaps in the extant research and their implications for our understanding of the issues and thus for policy formulation and aid intervention.

The remainder of the paper is structured as follows: Part 2 describes the historical context of the Boko Haram insurgency and the socio-political environment that engendered it. Part 3 defines the entire study area, as well as the food security concept and its dimensions, which serves as the basis for literature classification throughout the analysis. Part 4 outlines briefly both

[4] In April 2014, Boko Haram abducted 270 girls from a school in Chibok, Borno State, Nigeria, and threatened to sell them into sexual slavery (ICMP, 2016). The international outcry under "#BringBackOurGirls" included supporters such as Michelle Obama and Hillary Clinton.

this classification and the review's analytical methodology. It then provides a literature-based delineation of the diverse transmission channels through which the insurgency has negatively impacted food security and nutrition, with a focus on how and for whom. Part 5 briefly summarizes these findings – particularly in terms of who was affected and through which transmission channels, which latter requires a broad differentiation of the general from displaced populations.[5] Lastly, Part 6, in addition to detailing differences in the geography and datasets used, derives practical recommendations from the findings while also pinpointing research areas in which more knowledge is needed to better inform policy making.

2.2. History of Boko Haram and socio-political context

Boko Haram, a militant group with a radical Islamist ideology, has operated since 2009 with varying geographical coverage across much of Nigeria, northern Cameroon, south-eastern Niger, and center-west Chad. Although the groups' origins are complex, its ideology is rooted more in Nigerian and Lake Chad basin history than in international radical Islamism (Pérouse de Montclos 2014). Stemming from historic affiliations with the Borno-Kanem Sultanate (Shillington 1995) together with a resistance to Christianization under British colonialism that is often connected to missionary boarding schools, the area in which Boko Haram has been most persistent is marked by a unique identity that prioritizes religious over ethnic ties and opposes western education (Osaghae and Suberu 2005). This area, which encompasses today's Nigerian states of Borno, Yobe, and Adamawa, also has strong religious and linguistic ties to border communities in Niger, Chad, and Cameroon (Menner 2014; Crisis Group 2017).

In this environment, several religious fundamentalist and extremist organizations thrived throughout history, with ideologies similar to that of Boko Haram. In addition to the religious fundamentalism spread by the Maitatsine uprising in the 1980s (Osaghae and Suberu 2005), Sani (2011) traces Boko Haram's ideological origin back as early as a 1995 Sahaba Muslim youth organization. What is known is that Boko Haram's organizational structure took shape in 2001 (Roelofs 2014) or 2002 (Cook

[5] I include both refugees and Internally Displaced Persons (IDPs) under the term *displaced populations*.

2011) under the appellation *Yusuffia*, so named for its leader Mohammed Yusuf (Asuelime and David 2015). Yusuf's inflammatory speeches – often directed against western culture and especially western education – resonated in the environment of northern Nigeria and soon earned the group the nickname of *Boko Haram*, meaning "western education is forbidden" (Pérouse de Montclos 2014).

During the following years, Yusuf focused primarily on increasing the size and indoctrination of his followership without perpetrating violence, although Sani (2011) speculates on his affiliation with the so-called Nigerian Taliban. In spring 2009, however, clashes between Boko Haram and competing religious groups turned increasingly violent and escalated even more due to the intervention of the Nigerian security forces. This intervention culminated in a heavy death toll of 700-900 individuals in July 2009, mostly among the ranks of Boko Haram. Mohammed Yusuf himself was arrested and died shortly after in custody of the security forces. Yet, instead of calming the situation, this confrontation motivated Boko Haram to subsequently develop and adapt both its stratagems and its operational basis, employing a range of tactics from select individual assassinations to wholesale bombings (MacEachern 2018), and expanding its Maiduguri-based operations to the countryside and beyond the states of Borno and Yobe (Pérouse de Montclos 2014). As a result – despite the splinter group Ansaru leaving the main branch in 2012 – Boko Haram steadily expanded its territory of operations, first into rural areas and then beyond Nigeria. It reached its maximum territorial expansion in 2015 but was driven back that same year to the shores of Lake Chad and Sambisa Forest by troops of the Multinational Joint Task Force (MNJTF, Magrin and Pérouse de Montclos 2018).

The area covered by this review therefore represents the maximum territorial expansion of Boko Haram's operations, which essentially encompasses the Nigerian states of Borno, Yobe, and Adamawa (often labelled the North East), as well as the border provinces of neighboring states; namely, Extreme Nord in Cameroon, Lac in Chad, and Diffa in Niger. Excluded, however, are territories in which Boko Haram perpetrated only very isolated – albeit high-profile – attacks: the Chadian and Nigerian capitals. Even with this exclusion, the study area adequately captures the insurgency's macro-economic effects on livelihoods and markets.

2.3. The Lake Chad region food security context

Over its history, the concept of food security has been applied to cover a wide range of issues: agricultural production, health and nutrition, farmers' well-being, food surplus management, and distribution to just name a few (Shaw 2007). Thus, while the definition of food security can be as simple as "a condition that exists when all people, at all times, are free from hunger" (WFP 2009), in practice it is an interdisciplinary field in which a multitude of different actors must collaborate to achieve results. To reflect this multidimensionality, this review adopts the Food and Agriculture Organization's (FAO 2008) approach of dividing the concept into four dimensions: (i) physical availability of food, (ii) economic and physical access to food, (iii) food utilization, and (iv) the stability of the other three dimensions over time.

It is important to note that this review uses the food security concept as a purely descriptive set of dimensions not as a set of normative guidelines – a practice criticized by proponents of the food sovereignty concept (Clapp 2014). It does, however, use insights from the food sovereignty literature and incorporates studies that employ aspects of small-scale food production livelihoods to reflect source use, access, and control. Additional definitions pertinent to the analysis are provided below.

2.3.1 Physical availability of food

Physical availability of food is defined here as the surplus, or lack thereof, of food through production, stocks, and trade (i.e., the supply side). Because food production livelihoods in the Sahel are vulnerable to between-year rainfall fluctuations induced by south-north shifts in the Inter-Tropical Convergence Zone (ITCZ), they often suffer food scarcity during the yearly lean season when food stocks are at their lowest right before the next harvest. These ITCZ fluctuations, however, are not the only cause of large-scale droughts within the study area (van der Geest and Dietz 2004). Rather, as Table 2.1 shows, within-year rainfall fluctuations limit the agricultural cycle to April-November during which time the main consumption crops planted are sorghum and millet, although maize, wheat, and rice are also cultivated along the Lake Chad seasonal wetlands for both local consumption and trade to urban centers (FAO 2019a). The pastoral cycle also follows rainfall

patterns, with herds moving south during the dry season and north during the rainy season, and with considerable cross-border trading of livestock (WFP 2016).

Table 2.1: The agricultural cycle in the study area, by country and crops

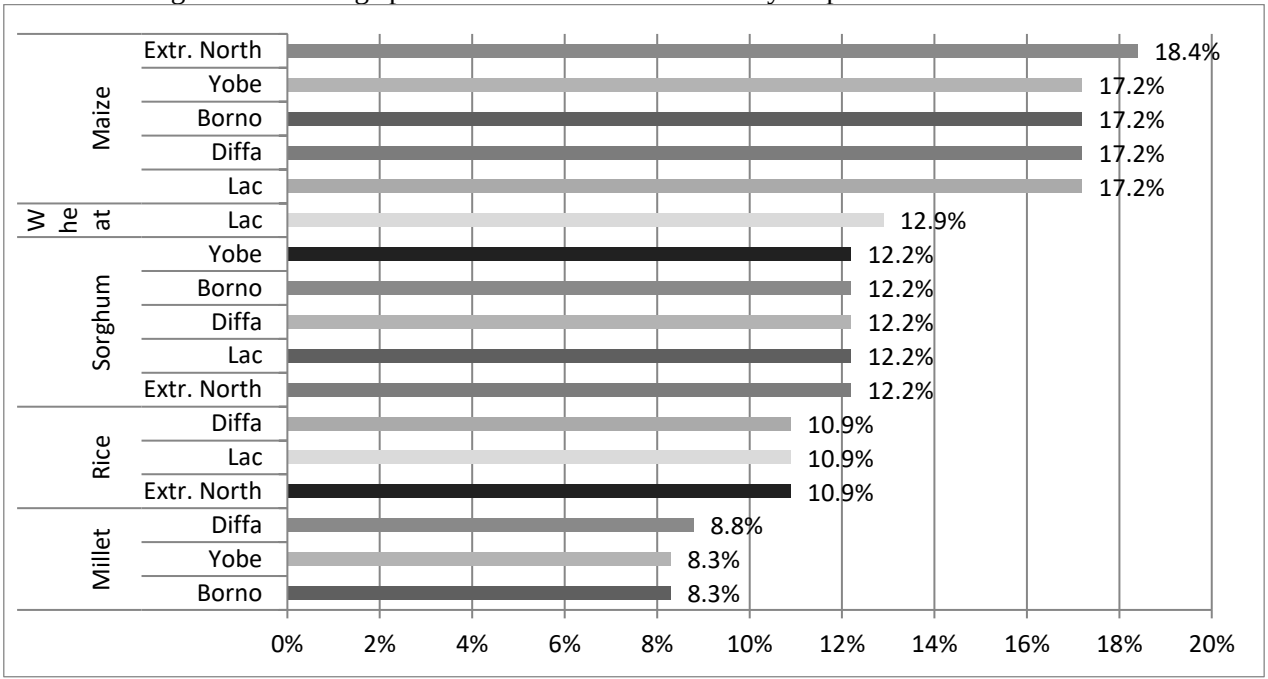
Country	Crop	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Cameroon	Millet		X	X	X	X	X	X	X
Cameroon	Sorghum		X	X	X	X	X	X	X
Chad	Millet		X	X	X	X	X	X	
Chad	Sorghum			X	X	X	X	X	X
Chad	Maize			X	X	X	X	X	
Niger	Millet			X	X	X	X	X	
Niger	Sorghum			X	X	X	X	X	
Niger	Maize			X	X	X	X	X	
Nigeria	Millet			X	X	X	X	X	
Nigeria	Sorghum		X	X	X	X	X	X	X
Nigeria	Maize	X	X	X	X	X			

X Sowing X Growing X Harvest

Notes: Compiled from the FAO GIEWS country briefs website (FAO 2019b)

Yet, as Figure 2.1 indicates, post-harvest losses in the study area are high, with average yearly losses across all countries in the 2000-2018 period of almost one-fifth of the total harvest for maize and over one-tenth for sorghum, rice, and wheat. Only for millet are post-harvest losses below one tenth (Aphlis.net 2019). In fact, the World Bank's WITS database (2019) shows that, out of the four countries studied, only Cameroon was a consistent food net exporter during the 2000-2016 period (the only years for which such data are available) as measured in current USD. Although no corresponding data are available for Chad, the FAO (2019b) country report for 2018 asserts that, as is true for Niger, Chad's ability to ensure sufficient food availability is dependent on food imports.

Figure 2.1: Average post-harvest losses 2000-2018 by crop and administrative area

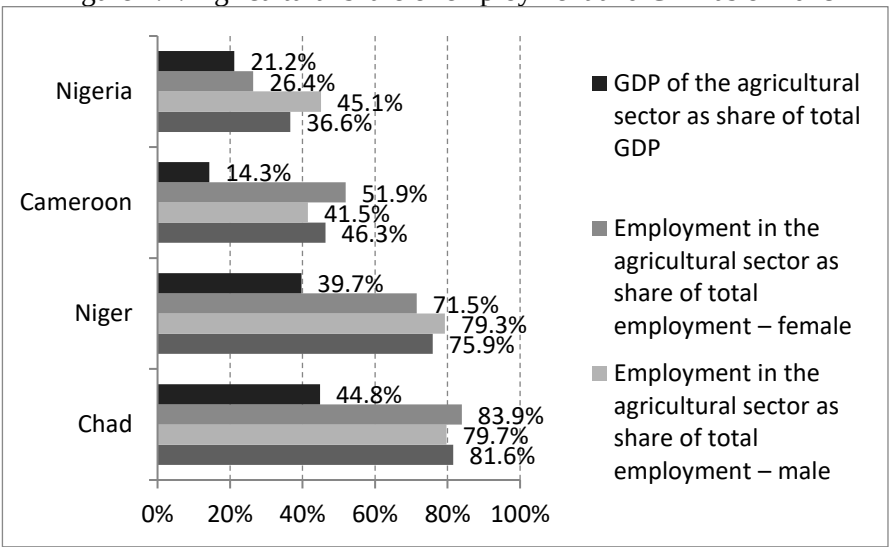


Notes: Compiled from Aphlis+ database (Aphlis.net 2019).

2.3.2 Economic and physical access to food

For the purpose of this chapter, economic and physical access to food is the ability of households to afford food and reach markets or other distribution points (i.e., the demand side). Farming, herding, and fishing not only support food availability: They also provide livelihoods and incomes for large parts of the population, giving the agricultural sector much weight in any assessment of economic access to food. Yet even though this sector accounts for 31.6 percent to 81.6 percent of the total employed population depending on country, as reported in Figure 2.2, it accounts for a disproportionately low share of Gross Domestic Product (GDP), from 14.3 percent to 44.8 percent. This discrepancy is a stark reflection of small-scale food producers' low per-capita incomes overall, which disproportionately affects women: Except for Nigeria, the agricultural sector accounts for over 50 percent of total female employment.

Figure 2.2: Agricultural share of employment and GDP as of 2018

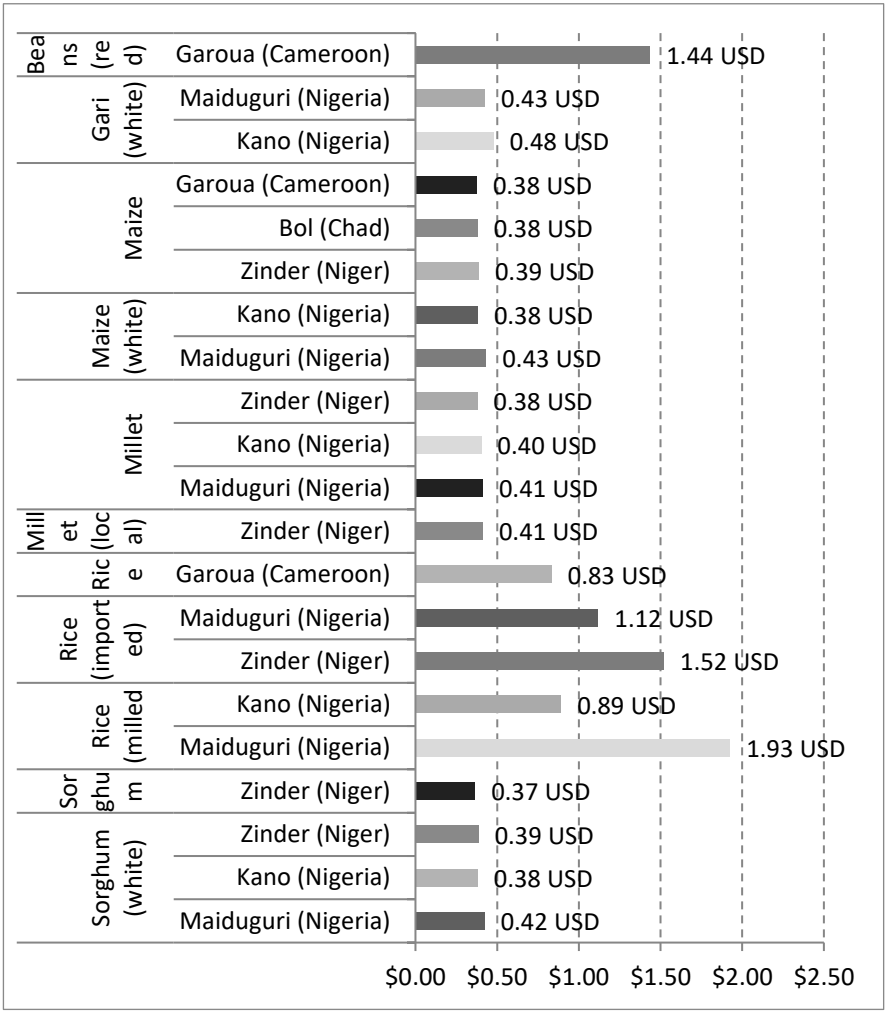


Notes: Compiled from the Word Bank's data website (World Bank 2019b); all data refer to 2018 as the last year available, except for the agricultural GDP of Niger, which refers to 2017.

Even beyond these low agricultural incomes, poverty is widespread in all four countries, further impeding economic access to food. Defining poverty as living on less than USD 1.90 in 2011 Purchasing Power Parity (PPP) per

day, 23.8 percent of Cameroonians are poor, as are 38.4 percent of Chadians, 44.5 percent of Nigeriens, and 53.5 percent of Nigerians (compiled from World Bank, 2019b). As Figure 2.3 shows, such purchasing power is also negatively impacted by wide fluctuations in staple grain prices in the main markets serving Boko Haram's area of operations, both within and between years (FAO 2019c).

Figure 2.3: Average staple food prices 2012-2017 by commodity and market



Notes: Compiled from FAO GIEWS tool (FAO 2019c)

Physical access to markets, on the other hand, is primarily impeded by lack of infrastructure, with only 6.6 percent, 20.7 percent and 30.8 percent of roads being paved in Cameroon, Niger, and Nigeria, respectively (CIA, 2019; data unavailable for Chad). During the rainy season, dirt roads turn to mud, while *wadis* (seasonal riverbeds) cut off access to entire areas. At Lake Chad, peaking water levels during November, fed by rainfall further south carried in by the Chari River, frequently turn peninsulas into islands, cutting them off from the mainland and thus from markets. In turn, the high transport costs produced by these physical access barriers present a particular challenge for small traders along the shores of Lake Chad, especially for women, 67 percent of whom cited insufficient capital as the main limit to their business, compared with 44 percent of men (WFP 2016). Commerce is likely regulated across the study area by the existence of social norms governing whom women and men may buy from and what types of commodities they may purchase. However, literature only mentions such norms for Niger (Sardan 2011).

Because these challenges to physical access – as well as poverty and price shocks – can be mitigated by social protection policies, Cameroon, Chad, and Niger have mounted targeted social programs to improve nutrition, school meals, cash and in-kind transfers, food emergency response, and food price subsidies. Cameroon and Niger also subsidize fuel and transport, while Chad provides free healthcare. However, not only do substantial parts of all these social safety nets depend on contributions from NGOs and international donors, but according to the latest available data, their funding is low by West African standards: only 7.4 percent of government spending in Cameroon, 0.8 percent of GDP in Chad, and 5.9 percent of government spending in Niger[6] (Aker et al. 2009; del Ninno and Tamiru 2012; Noumba et al. 2016).

2.3.3 Food utilization

Here, food utilization is defined as the ways in which the human body uses food nutrients, which relates to both biological capacity and food practices (i.e., the health and socio-cultural aspects). Although data on food

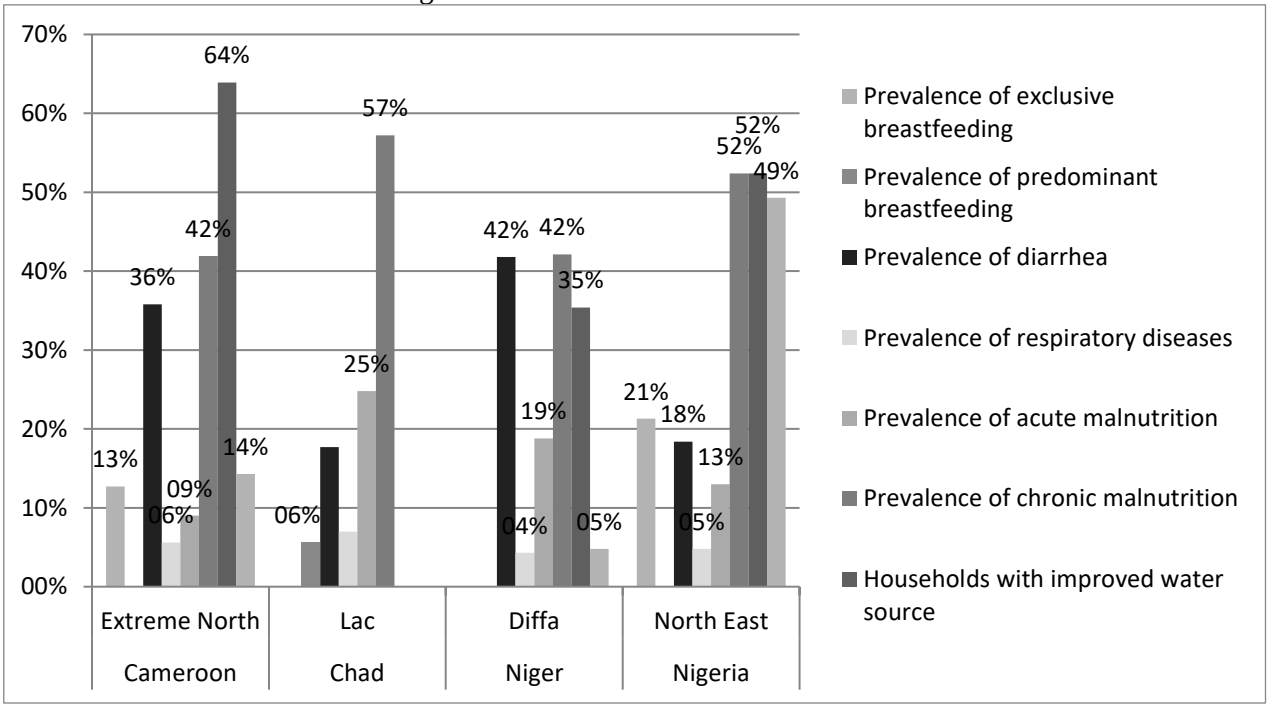
[6] Note that the report on Niger focused exclusively on social safety nets connected to food security and exclusively on state safety nets.

consumption habits of adults are not available, UNICEF's Multiple Indicator Cluster Surveys (MICS) shed light on infant feeding practices, as well as access to water and sanitation, and prevalence of infant diseases and malnutrition, reproduced in Graph 2.4. For example, in Cameroon's Extreme North, only 12.7 percent of children under the age of 6 months are exclusively breastfed, compared to 21.3 percent in Nigeria's North East. In Chad, exclusive breastfeeding is so rare that the MICS refer only to "predominant breastfeeding", measured at 5.7 percent in Lac (Institut National de la Statistique 2015; INSEED 2016; National Bureau of Statistics (NBS) and UNICEF 2018). In Niger's Diffa region, the surveys assessed only two children two decades ago (UNICEF and Republique du Niger 2000), which underscores the MICS data's major shortcomings of referencing not only different years but outdated information.

One of the causes most cited by local populations for food insecurity is lack of access to clean water, with only 63.9 percent of households in Cameroon's Extreme North having access to improved water sources, compared to 35.4 percent in Niger's Diffa region and 52.4 percent in Nigeria's North East. Also important for hygiene is improved sanitation, to which only 14.3 percent of households have access to in the Extreme North and 4.8 percent in Diffa (with no province-level aggregated data available for Chad). The resulting hygiene challenges, combined with insufficient feeding practices, contribute to infant diseases. For example, the prevalence of diarrhea in children under the age of 5 years is 35.8 percent in the Extreme North, 17.7 percent in Lac, 41.8 percent in Diffa, and 18.4 percent in the North East, while the corresponding numbers for respiratory diseases are 5.6 percent, 7 percent, 4.3 percent, and 4.8 percent, respectively.

All the above factors contribute to malnutrition, which can in turn be a contributing element to the factors themselves. As a result, the prevalence of acute malnutrition among children under 5 years of age reaches as high as 24.8 percent in Lac and 18.8 percent in Diffa, followed by 13 percent in the North East and 9 percent in the Extreme North. The tragic corollaries of these levels, even those that appear relatively low, is that 57.2 percent of under-fives in Lac, 42.1 percent in Diffa, 52.4 percent in the North East and 41.9 percent in the Extreme North are stunted. Although these regional data are not disaggregated by sex, such disaggregation at the national level suggests that girls seem somewhat better nourished on average. Based on field observations, I anticipate that this difference results from female children remaining closer to the source of food preparation (i.e. the mother) until a later age.

Figure 2.4: Nutrition-relevant MICS data



Notes: Compiled from Cameroon 2015 MICS, Chad 2016 MICS, Niger 2000 MICS and Nigeria 2018 MICS (Institut National de la Statistique 2015; INSEED 2016; UNICEF and Republique du Niger 2000; National Bureau of Statistics (NBS) and UNICEF 2018)

2.3.4 Stability of the other three dimensions over time

Given that a short-term lack of any of the previous three aspects can still have long-term effects on both household and individual well-being, this dimension is defined here as reflecting fluctuations in any one of them (i.e., it captures time effects). Food availability is subject to multiple types of strains in the study area, particularly given that agricultural production is largely rainfed or dependent on the seasonal swelling of Lake Chad and its tributary rivers. Although the observed shrinking of Lake Chad since the 1960s appeared to have stopped by 2007 (UNEP 2019), in the 2000s and early 2010s, the Sahel went through a series of years with precipitation levels below average (Mitchell, 2018), which led to plummeting agricultural output in 2010 and food crises up until at least 2014 (FAO 2019a). Because the poor infrastructure in the study area translates into high transport costs for food imports – whether driven by demand or provided by government programs – markets and state safety nets were unable to mitigate many of these climate impacts by improving access. Hence, international food aid to Cameroon, Chad, Niger, and Nigeria, although not always linked exclusively to drought response, increased by 69.7 percent for 2010-2012 compared to the previous 3 years, as shown in Table 2.2 (OECD 2019). Although it is hard to generalize over time and over the multiple regions in the study area, it is well-established that households compensate for lack of food by changing their food and other habits (e.g., temporarily eating less) or by migrating to areas with less food shortage (de Waal 2017), both of which impact child nutrition and care.

Table 2.2: Humanitarian aid (const. 2014 prices)

Country	**2007-2009**	**2010-2012**
Cameroon	USD 14.8 mio	USD 20.5 mio
Chad	USD 242 mio	USD 258.5 mio
Niger	USD 36.1 mio	USD 208.5 mio
Nigeria	USD 3.7 mio	USD 15.9 mio
Total	*USD 296.6 mio*	*USD 503.4 mio*

Notes: Compiled from OECD Creditor Reporting system (OECD 2019)

2.4. Boko Haram's impacts on food security

To delineate the ways in which the Boko Haram insurgency has impacted food security and nutrition in the study area, the following review of the literature is arranged around the primary food security and nutrition dimensions, but with each section structured on a geographic gradient from large to small. That is, for example when treating the availability dimension, it first examines studies covering multiple countries, then reviews those on specific countries and states, and concludes with papers on specific populations, such as traders or the displaced. This gradated structure, by revealing the insurgency's impacts on both a macro- and microlevel, ensures the identification of lower-level specificities that might remain hidden in a macro-level analysis.

2.4.1 Methodology

My review of the relevant sources across language borders began with a list of search terms (in English with French translations) for the standard topics included under the four FAO food security and nutrition dimensions. These terms formed the basis for a comprehensive search using Web of Science, Scopus, Google Scholar, Springer.com, Tandfonline.com, Researchgate.net, Semanticscholar.org and Academia.edu with no limitation placed on time frame (Appendix A). The articles and books identified were then systematized according to the food security dimensions and sub-dimensions addressed, countries and administrative areas covered, population(s) analyzed, and methodology employed, with each article's or book's main aspect summarized based on relevance to the analysis (Appendix B). The final compilation, in addition to being limited to findings on the study area, includes only those publications that enable a novel analysis – whether quantitative or qualitative – or at least provide an original data collection. For example, although it excludes studies on IDP camps outside the study area, it includes analyses of trade networks into the study area even when the data are based on traders outside this area. In the case of grey areas, inclusion is limited to content that fits the food security dimension; for instance, IDP women being asked for sexual favors in return for food is included, but sexual violence unrelated to food security is excluded. Also included are

publications that simultaneously address the same population group both inside and outside the study area (e.g. IDPs).

2.4.2 Effects on food production, imports, and access to agricultural inputs

With regards to food production, the effects of the Boko Haram insurgency have been felt even on the macrolevel, as the conflict has displaced agricultural food producers, cutting off their access to land and water, as well as forcing pastoralists to move their feeding grounds, sometimes across borders thereby increasing the risk of cattle rustling (Magrin and Raimond 2018). For Nigeria, the country most widely addressed by the research, Ojogho and Egware (2016) identify a 17.57 percent reduction in share of agriculture to GDP by applying a vector error correction model to a 1960-2011 time series. Descriptive statistics from Adebisi, Azeez, and Oyedeji (2017) similarly associate it with decreased agricultural output and productivity, as well as decreased wage labor and wages in the agricultural sector. These latter associations are confirmed by Adelaja and George (2019) using a pooled ordinary least squares (OLS) fixed effects estimator, which further reveals no insurgency effect on land use, but rather one of proximity to urban centers, probably because of access to input markets.

At the sub-national level, Sidney, Hayatudeen, and Kwajafa (2017) apply a logit model to primary data to confirm an association between the insurgency and reduced agricultural productivity in Adamawa state with access to credit as a mediating factor. For farmers in Yobe state, who had been replaced and returned, Babagana et al. (2018) identify physical restrictions to access fields and cattle rustling as primary motivators of their departure. Survey data from Awodola and Oboshi (2015) also indicate that Maiduguri traders see the agricultural sector as the most affected by the insurgency, with attacks on markets leading not only to price hikes, but also to transportation restrictions, hinting at impacts for food availability beyond production. With regards to regions outside the study area, survey-based descriptive statistics for Oyo state, Nigeria, suggest that its traders perceive their supply from Boko Haram-affected areas to be negatively impacted by a labor shortage in food production (Aluko et al. 2016).

Overall, these analyses – as focused on Nigeria as they are – reveal that the insurgency affects food production through limiting access to fields

and reducing the labor force willing to work on them. Beyond production, the interruption of food transport to markets and input transport from markets to producers also affects food availability.

2.4.3 Impacts on markets, incomes, and food prices

At the national level and even the international one, market function, infrastructure, food prices, and incomes are the most affected domains by the insurgency. Mapping the change of merchant routes in the study area, Magrin and Raimond (2018) highlight the insurgency's impact on trade at the regional level. For Nigeria and Chad, Awojobi (2014) identifies the impact of market closure, the repatriation of economically active foreigners, and the destruction of infrastructure as the major factors impacting incomes and physical access to markets by drawing on both descriptive statistics and the literature. For Nigeria specifically, van den Hoek (2017), using a linear regression approach, associates the Boko Haram insurgency with the reduction or outright cessation of market activities, reduced physical access and increased prices between 2014 and 2016. The same author also shows that, at the beginning of this period, high market activity is associated with high Boko Haram activity, indicating that the group specifically targeted markets. Using descriptive statistics and T-tests for Nigerian national level data, Adebisi, Azeez, and Oyedeji (2017) link the insurgency's impact on agricultural productivity to the reduction of smallholder incomes.

Specifically for Northern Nigeria, a probit analysis by Adebayo et al. (2016) associates the insurgency not only with increased food poverty related to decreasing incomes – which can be ameliorated by intervention from international organizations – but also with the use of theft and burglary as proxies which hints at broader trends of insecurity. Zooming in even further on the map to the Adamawa state only, Sidney, Hayatudeen, and Kwaifa (2017) apply a logit model and link the insurgency's impact on agricultural productivity to the reduction of smallholder incomes. These authors also show that in Maiduguri specifically, reduced supply, partially induced by decreased international trade, led to price hikes. As regards the impacts outside the study area, trader surveys suggest that insurgency effects were felt through the interruption of trade routes in both Abia (Onwusiribe, Nwaiwu, and Okpokiri 2015) and Oyo state (Aluko et al. 2016) –with limits

perceived to result from reduced food production, physical restrictions, and the collapse of personal relationships.

One specific strain of this literature addresses displaced populations, who not only suffer from the same impacts on markets as the general population, but also often lost large parts of their livelihoods, while not being able to count on the same infrastructure and state services pertinent for food availability. For example, based on a range of different measures, Iacoella and Tirivayi (2020) found in the camps which they surveyed that the displaced were considerably worse off than the general population and Djibo's (2019) survey of camps in Niger emphasizes the negative effects of both un- and underemployment on incomes, the scarcity – and lack of diversity – of food in markets and from humanitarian aid. For displaced in Nigeria, Badiora (2017) confirms the extent to which the insurgency has led to loss of income, but also of housing and food stocks, while Abdulazeez and Oriola (2018) report interviewees bemoaning both the irregular food delivery in camps and the exclusion of men from food preparation. On the other hand, focus group discussions and interviews with displaced Nigerian women by Olanrewaju, Omotoso, and Olaniyi (2018) outline how livelihood schemes can provide them with income. Additional interview and focus group data highlight the practice of exchanging food for sex (Odo, Musa, and Oladugba 2020).

As shown by these studies, both the general and displaced population have experienced loss of income due to the insurgency, limiting their access to food. However, reports on markets disfunction, prices spike, and limited physical access – partially due to a general decrease in security – only exist for the general population. On the other hand, lack of food diversity, be it in markets or through food aid, is reported only for displaced populations. The same is true for the loss of food stocks and sexual violence.

2.4.4 Influence on health outcomes, basic services, and infrastructure

Considering the entirety of Nigeria, both Dunn (2018), and Ekhator-Mobayode and Abebe Asfaw (2019) use a difference-in-difference (DID) approach to show that the Boko Haram insurgency has caused wasting and stunting, while Howell et al. (2018) employ logistic regression to associate Boko Haram activity with wasting prevalence and infant mortality. Across

all three studies, using caregiver and child characteristics as controls yields statistically significant results while employing household-level controls paints an inconsistent picture. Nwokolo (2015), using socio-economic factors and pregnancy trimester as controls, further associates the insurgency with low birth weight prevalence.

Specific to Nigeria's North East, the DID approach used by Bertoni et al. (2019) pinpoints not only the insurgency, but also a general sense of insecurity which in turn decreases school enrolment and years of schooling, i.e., factors mediating health and nutrition outcomes. These negative effects on education, as well as on work status and reduced health center visits by mothers, are further supported by logistic regressions from Solanke (2018). Worryingly, according to descriptive statistics compiled by Denue et al. (2018), the areas worst hit by Boko Haram are coincidentally the epicenter of North Nigeria's massive 2017 cholera outbreak, which may indicate an insurgency effect on health access. In fact, Adamu et al. (2019) note a reduction in the number of certain admissions in the University of Maiduguri Teaching Hospital, while their quadratic trend model links the insurgency to the prevalence of non-communicable diseases registered there.

Concerning displaced populations, Olanrewaju, Omotoso, and Olaniyi (2018) corroborate Abdulazeez and Oriola's (2018) claim that Nigerian IDP women in the camps and periods surveyed suffer from bad housing, imbalanced diet, and overpopulation. However, they rate general health and education infrastructure in the camps that they surveyed as "quite good", an evaluation not shared by Abdulazeez and Oriola for the camps which they assessed. The fact that Olanrewaju, Omotoso, and Alabi (2018) find limited access to basic services in other Nigerian camps, and that Djibo (2019) observes the same for camps in Niger, underscores how diverse the situation in camps can be. Nonetheless, Sanda, Hudson, and Buba (2016), based on descriptive statistics and interviews, demonstrate that health and education services are worse for IDPs in all the camps they assessed, than for the general population. Iacoella and Tirivayi (2020) find the same for the camps that they surveyed, additionally linking lower household wealth and worse maternal nutrition to worse child nutrition.

To sum up the insurgency's impacts on food utilization, it is important to differentiate between the general population and the displaced. For the former, existing health and education services have been weakened, not only lowering their positive direct impacts on nutritional outcomes, but also curbing their resilience to external shocks. For the latter, the loss of housing and livelihoods already presents a tremendous shock, but how

quickly and how well services in camps become established is different from camp to camp.

2.4.5 Instability of the first three dimensions over time

Whereas all the publications mentioned above to some extent address the Boko Haram insurgency effect on the stability of the first three food security dimensions, only a handful specifically examine the time dimension. In fact, Adebisi, Azeez, and Oyedeji (2017) use a T-test analysis to show that agricultural output in Nigeria decreased in the period 2004-2013, i.e., the period of the insurgency, compared to 1994-2003. This finding is corroborated by Ojogho and Egware (2016) who apply a Vector Error Correction Model (VECM) to a 1960-2011 time series and treat the insurgency as a shock to agricultural development in Nigeria, thereby showing that agricultural share of GDP, machine output as measured through CO2 output, food production, and infant mortality all are affected by the insurgency. Likewise treating the insurgency as a shock in Nigeria, but to health outcomes and using a DID methodology, Ekhator-Mobayode and Abebe Asfaw (2019) find that additional attacks by the insurgency increase the probability of wasting by combining time series of health indicators and of terrorism 2008-2013.

Also employing a DID methodology, but limited to Nigeria's North East and health surveys for the period 2008-2013 only, Dunn (2018) finds that the insurgency causes an increase of 13 percentage points in wasting. For the same area, van den Hoek (2017) likewise demonstrates that the insurgency impacted market function, including full market closures, 2014-2016. Looking exclusively at education in Nigeria's North East, Bertoni et al. (2019) exploit a 2009-2016 time series to show that school enrolment and schooling years are negatively affected by the insurgency. Using time series 1999-2017 from Maiduguri Teaching Hospital, Adamu et al. (2019) pinpoint increasing diagnosis and treatment for kidney disease, anemia, malnutrition, and end-stage renal disease during the period of the insurgency.

Lastly, however, Agri, Blessing, and Eneji (2019) provide evidence, though limited to Gombe state, that increased spending on security can mediate negative impacts of insecurity on agricultural output and – even though this is a single study – it shows that there are ways out of the crisis. While the studies mentioned in this section highlight that the insurgency has

been a shock to food availability, access to functioning markets, and state services relevant for food utilization, none of these components has been reduced to complete rubble.

2.5 Discussion of the findings

The above literature on the effect of the Boko Haram insurgency on food security, as summarized in Table 2.3, paints two distinct pictures: one for the general population and one for the displaced. For the latter, the situation in the camps seems generally defined by loss of livelihoods and scarce supply in markets or through aid, as well as major variations over time and between camps in access to education and health facilities. Although these latter deficits and variations in turn define how services for the displaced compare with those for host communities, the low-level unit of analysis used in most studies (i.e., the camp) makes it difficult to draw general conclusions.

For the general population, the insurgency affects food production by restricting physical access to agricultural land, displacing the labor force, and cattle rustling, as well as by reducing investment in agriculture and inducing a distortion of trade and migration routes, which negatively impacts food imports and labor availability. Not only do these factors affect food access via household and individual incomes, but attacks on markets, destruction of infrastructure, and general insecurity lead to price hikes or even outright cessation of market functioning. At the same time, destruction of infrastructure and insecurity curb access to health and education facilities, which together with the impacts on availability and access affects the prevalence of stunting, wasting, and non-communicable diseases. Although these latter are of course crucially linked to the issue of food security among women, and particularly mothers, not only is the number of articles addressing displaced women far greater than that examining the general female population, but most research related to women's food security seems focused on the utilization dimension; specifically, education and child and maternal health.

As regards geography, the majority of studies address Nigeria, followed with a wide margin by Cameroon. Geographical distribution seems also to be a driver of which methodological approach dominates for displaced versus general populations. Whereas author-conducted focus

groups, interviews, and surveys predominate for the former, studies on the latter draw far more often on large, nationally representative public surveys.

Table 2.3: Effects of the insurgency as evidenced by the literature

Population type	Transmission channels: How the Boko Haram insurgency affects food insecurity and malnutrition			
	Availability	Access	Utilization	Stability
Displaced	Loss of pre-displacement (often agro-pastoralist) livelihoods. Restricted access to land and water.	Lost livelihoods and food stocks. High un- or underemployment, thus low income. In some camps: Lack of food and food diversity, as well as irregular delivery. Gender and sexual violence dimension: Exchange of food for sex, gender responsibilities when it comes to food preparation.	Low-quality or lack of housing, overpopulation. In some camps: Bad health and education infrastructure, limited access to basic services.	Na

General	Displacement of food producers. Movement of feeding grounds / migration routes of pastoralists. Increased exposure to cattle rustling. Difficult access to fields and agricultural inputs. Transport restrictions on food to markets (incl. border closures).	Changes of trade routes and border closures leading to price fluctuations. Market closure and decrease in market activity. Destruction of infrastructure reducing incomes, increasing prices, and impeding physical access to markets. General insecurity also limiting physical access and reducing (especially smallholders) incomes.	Increase of wasting, stunting, and child mortality rate. Decrease of school enrolment and years of schooling (together with general insecurity). Curbed access to health centers (especially for mothers).	Insurgency as shock to agricultural output, development, and GDP, as well as schooling indicators. Attacks as (indirect) cause of increase in wasting prevalence and as shocks to market function. Long-term effects of malnutrition and curbed access to health.

2.6 Conclusions

As the Boko Haram insurgency, having splintered increasingly into factions, continues to affect the food security of hundreds of thousands of human beings, better approaches are needed to mitigate its impacts and address the root causes of discontent. Based on a broad literature review, this paper argues that any such approach must consider the distortion of food production and imports, limits to market function and access, as well as infrastructure, health, and education services. To this end, this discussion not only contextualizes the findings but examines the knowledge deficits in the existing literature in order to illuminate the most relevant directions for future research and advise policy makers to be weary of generalizing findings or following research not relevant to a specific population group.

2.6.1 Limits of extant literature

Although it is important to recognize the existence of different dynamics for the general versus displaced populations, neither of these groups is homogenous and research on the borderline case of returnees is scarce. Thus, for example, although the literature tends to treat Nigerian IDPs as one population, in reality, one sub-group tends to remain in camps in the conflict-affected area while another has moved to camps as far away as the capital Abuja.

The differences between the two populations are also probably largely responsible for the different methodologies that dominate the research on each. That is, whereas large-sample, nationally representative databases are readily available for the general population, the tendency of displaced populations to concentrate in camps gives researchers easier access to administer their own surveys. Even author-conducted surveys that do address members of the general population tend to focus predominantly on easily accessible (often geographically concentrated) groups such as food traders or local experts. Policy makers thus should not be misled into thinking that one study type is necessarily telling for all population groups, nor that aggregated findings fittingly reflect the situation across different regions or camps.

At the same time, the academic community could benefit from reflecting how, if at all, the Boko Haram insurgency literature addresses the

role of women, confining it mostly to child and maternal health, and focusing heavily on female IDPs, thereby centering it on protection issues. Not that women are not highly vulnerable in refugee settings, but the usefulness of academic research for informing policies is doubtful without a more differentiated view of women as important actors in agriculture and markets, rather than victims needing protection to fulfil their role for procreation and child rearing.

2.6.2 Recommendations

Not only is the literature limited in its approach to gender, but also in its failure to look beyond food security and nutrition outcomes to the mechanisms by which specific sub-groups cope with the insurgency. While the damage done by the insurgents is without doubt, the coping and mitigation strategies used by the affected populations are largely unknown. Not only in the context of these strategies, but also of the insurgency's general impacts, closer examination is needed of the different outcomes for the rural and urban poor versus the more affluent, for small- versus large-scale food producers, for youth compared with the elderly and/or disabled, and between different groups of the displaced. For researchers, the large socio-economic inequalities persistent in the study area provide many opportunities for detailed investigation of such phenomena, as well as how they relate to gender, while policy makers can improve targeting by looking deeper into such differences.

Another weakness in the literature – attributable to Boko Haram's gradual spread and the initial tendency of Cameroon, Chad, and Niger to disregard the problem – is the need for greater investigation into where and when the group became active even without direct attacks, such as in areas important for its recruitment. Not only may the group's supply runs and extortion attempts be obscured by the constant background noise of banditry, smuggling, and other criminal acts in the study area, but state structures may lack the resources to register and investigate such acts. Thus, field research probing the supposed temporal and spatial limits of the insurgency would add to our understanding of its impacts, while capacity building of security institutions might yield positive effects when informing emergency and development responses to the insurgency.

Lastly, given the paucity of material on Chad and Niger, and to a lesser extent on Cameroon, it would be worthwhile strengthening the literature beyond Nigeria, despite the latter admittedly being the most affected country. Even within Nigeria, certain areas are under-represented in the literature, with a plethora of articles on IDP camps around the Nigerian capital Abuja, but far fewer on camps in Boko Haram's area of operation (i.e., the study area), probably because of accessibility. Hence, neither academics nor policy makers should be misled by findings that too often stem from outside the area of insurgency, driven more by media coverage and access to sources than by the quantitative impacts of the insurgency or humanitarian needs. Extant literature might also be skewed by language given that among the four countries only Nigeria has English as a dominant tongue.

Such deeper understanding of the link between the insurgency and food insecurity and malnutrition could help policy makers formulate better interventions to protect lives and livelihoods by leveraging coping strategies, addressing the roles and needs of specific subgroups (especially women), and identifying where and when the insurgency's effects have been felt. In a context with scarce resources, identifying those most in need and what they need can make a large difference. In fact, knowing how the insurgency and food insecurity are linked might even suggest ways to curb the insurgency itself. Given the Boko Haram's ability to survive despite splintering, the need to analyze where and when it is active even in the absence of direct attacks becomes ever more important if states want to fully eliminate it; and while all these points are true for the entire study area, they are especially true beyond Nigeria, where policy makers must make do with far less information from the scientific community.

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Appendix A: Supporting Tables

Appendix Table A.1: Search words

English	French
boko haram food security	boko haram sécurité alimentaire
boko haram food production	boko haram production alimentaire
boko haram food availability	boko haram disponibilité alimentaire
boko haram food prices	boko haram prix alimentaires
boko haram food trade	boko haram commerce alimentaire
boko haram food market	boko haram marché alimentaire
boko haram poverty	boko haram pauvreté
boko haram infrastructure	boko haram infrastructure
boko haram income	boko haram revenue
boko haram displacement	boko haram déplacement
boko haram refugees	boko haram réfugiés
boko haram malnutrition	boko haram malnutrition
boko haram health	boko haram santé
boko haram sanitation	boko haram sanitaire
boko haram education	boko haram éducation
boko haram women	boko haram femmes

Appendix Table A2: Literature classification

Source	FNS dimensions treated	Sub-Dimension treated	Countries covered	Sub-area covered	Population covered	Type & controls	Data	Main findings
van den Hoek 2017	Access	Markets, Prices, Physical access	Nigeria	Study area	General	OLS	ACLED conflict data, FEWSNET market data; 2014-2016	BH attacks are associated with reduced marked activity, both in reduction and cessation. Vice-versa, initially high marked activity is associated with a high number of BH attacks, possibly indicating that BH specifically targeted very active markets.
Emmanuelar 2015	Access	Food consumption	Nigeria	Part of study area (Nigeria, IDP	Displaced	OLS	Own household survey in 3 IDP camps; N	Food insecurity, fatalities and displacement are significant variables

				camps, Borno and Adamawa states)			= 1,500 (500 per camp)	associated with the humanitarian crisis surrounding BH. Additionally, Government responses seem to have limited effect in mitigating the crisis.
Onwusiribe et al. 2015	Access	Physical access	Nigeria	Non-study area (Nigeria, Abia state)	General	Descriptive statistics	Own food dealer survey in 2 markets; N = 50	Food dealers attribute reduction of profits, local food production and limit of trade routes to BH
Djibo 2019	Access	Incomes	Niger	Part of study area (Niger, IDP camps)	Displaced	Descriptive statistics, focus group discussion	Own survey, 7 focus groups; N = 217	IDPs report un- or underemployment, poverty promoting petty crimes, lack of food diversity and amount of humanitarian assistance and social disruption as main problems

								in the camps to which they have been displaced due to BH. That they are also reporting lack of basic services indicates that response to mitigate the impacts of BH might be insufficient.
Adebayo et al. 2016	Access	Incomes	Nigeria	Study area	General	Probit; household and market controls	Nigeria Living Standard Survey (NLSS); 2010; N = 17,959	The vast majority households in the study area are food poor. Food poverty is associated with theft and burgling as proxies for insecurity brought by BH. Interventions of international actors are associated with

								reducing food poverty.
Badiora 2017	Access	Incomes	Nigeria	Part of study area (Nigeria)	Displaced	Descriptive statistics	NEMA data; 2014; N = 678,713	Loss of income, housing, food stocks due to the insurgency
Awodola and Oboshi 2015	Access, Availability	Markets, Food trade	Nigeria	Part of study area (Nigeria, Maiduguri)	General	Descriptive statistics, interviews	Own experts survey; N = 53	According to experts, attacks on markets and transport restrictions led to reduced supply and prices hikes. Experts feel that the agricultural sector is the most affected one by BH. Also impacts on international trade.
Aluko et al. 2016	Access, Availability	Physical access, Prices, Food production	Nigeria	Non-study area (Nigeria, Oyo state)	General	OLS; controls for age, ethnicity, education, and	Own trader survey; N = 110	Perceived problems of traders to access cowpeas is associated with the perception that the BH

						experience		insurgency having strong effects. Traders emphasize limits due to price instability and trade route and relationship collapse. Labor shortage in food production
Abdulazeez and Oriola 2018	Access, Utilization	Physical access, Health, Education	Nigeria	Part of study area (Nigeria, IDP camps; Borno state and Abuja)	Displaced	Interviews, Focus group discussion	Own survey; 2015; N = 75	Overcrowded camps, gendered food preparation practices, irregular food delivery, poor hygienic conditions in the camps, and poor education facilities. State responsibilities (or lack thereof) as driving force
Olanrewaju, Omoto	Access, Utilization	Physical access,	Nigeria	Part of study area	Displaced	Descriptive statistics,	Own survey; N = 116	Limited services for care and education are

so, and Alabi 2018		Health, Education		(Nigeria, IDP camps; Adamawa and Abuja)		focus group discussion		widely reported as key problems for IDPs.
Agri et al. 2019	Availability	Agricultural development	Nigeria	Non-study area (Nigeria, Gombe state, Balanga)	General	OLS; controls for unemployment, poverty, and crime rate	Central Bank of Nigeria (CBN reports), World Bank database; 1996-2018	Unemployment and crime rate are negatively associated with agricultural GDP, poverty however seems not to be the cause of poor performance of the agricultural sector, but the other way around.
Ojogho and Egware 2016	Availability	Agricultural development	Nigeria	Study area	General	Vector Error Correction Model; controls for ethno-religion, other conflicts	Central Bank of Nigeria (CBN reports), Food and Agriculture Organization	The BH insurgency (and other conflicts) is negatively associated with agricultural development through CO2 emissions, food production level

							(FAO) Year Book (2013) and World Bank development indicators bulletin (2012); 1960-2011	and infant mortality.
Babagana et al. 2018	Availability	Food production	Nigeria	Part of study area (Nigeria, Yobe state)	General	Descriptive statistics, interviews	Own household survey, expert interviews; N = 394	Crop and livestock production did pick up slowly after the return of displaced populations, as BH continued to prevent farmers to access their fields, caused displacement and rustled livestock.

Adelaja and George 2019	Availability	Food production	Nigeria	Study area	General	OLS; controls for market, climate and political, as well as household and year-fixed effects	ACLED conflict data, General Household Survey (GHS); 2010-2016; N = 3,048	BH is associated with decreases in agricultural output, per-capita productivity, hired work on farms and its wages, but not with land use or land productivity. Geographical proximity to input markets is a mediating factor, but infrastructure is not.
Adebisi et al. 2017	Availability, Access	Agricultural development, Livelihoods	Nigeria	Study area	General	T-test	World Bank database; 1994-2013	BH negatively impacted agricultural output and thereby smallholder incomes.
Sidney et al. 2017	Availability, Access	Agricultural development,	Nigeria	Part of study area (Nigeria,	General	Logit; controls for access to credit	Own farmer survey; N = 330	BH is associated with reduced agricultural productivity and farmer incomes.

		Livelihoods		Adamawa state)		and agricultural inputs	across 7 sites	Access to credit is a strong mediation factor.
Magrin and Raimond 2018	Availability, Access	Food production, Food trade	Cameroon, Chad, Niger, Nigeria	Study area	General	Literature, Secondary data	System and map analysis	BH caused distortion of trade and migration routes, kidnapping and cattle rustling, population displacement, reduction of agriculture and fishery.
Dunn 2018	Utilization	Wasting	Nigeria	Study area	General	Difference-in-Difference; controls for seasonal effects, altitude, urban/rural, household, caregiver	Demographic and Health Surveys (DHS); 2008-2013; N = 13,012	BH caused increases in stunting and wasting prevalence. Altitude and wealth were the only significant controls on the household level, with caregiver and child characteristics

						and child characteristics		being more important.
Howell et al. 2018	Utilization	Wasting	Nigeria	Study area	General	OLS; controls for household, caregiver and child characteristics	Social Conflict Analysis Database (SCAD), Demographic and Health Surveys (DHS); 2013; N = 57,009 (mortality), N = 29,418	BH is associated with wasting and child mortality, with children in urban areas being exposed to more conflicts. Caregiver education is mentioned as a significant control.
Bertoni et al. 2019	Utilization	Education	Nigeria	Study area	General	OLS, Difference-in-Difference; controls for household, regional	ACLED conflict data, Integrated Conflict Early Warning System (ICEWS)	General insecurity, not only BH activity, reduces school enrolment and schooling years. Effects increase, when fixed effects are included. Gender

						and individual fixed effects, as well as household and child characteristics	, General Household Survey (GHS); 2010-2016, 2015-2016 for DID; N = 5,000, N = 1,815 for DID	and religion are not significant, but age is.
Ekhator-Mobayode and Abebe Asfaw 2019	Utilization	Wasting, Stunting	Nigeria	Study area	General	Difference-in-Difference; controls for household, caregiver and child characteristics	Global Terrorism Database (GTD), Demographic and Health Survey (NDHS); 2008-2013; N = 60,129	BH causes wasting, but not stunting. It also has negative effects on vaccination and different effects by gender of the children, as well as by rural/urban.
Adamu et al. 2019	Utilization	Health	Nigeria	Part of study area	General	OLS, ANOVA, T-test	Hospital data;	Increase non-communicable diseases since BH

				(Nigeria, Maiduguri teaching hospital)			1999-2017	and drop of people registering for antiretroviral treatment, indicating impact on access to health
Nwokolo 2015	Utilization	Low birth weight	Nigeria	Study area	General	OLS; controls for household caregiver and child characteristics, as well as regional and time fixed effects	ACLED conflict data, Demographic and Health Survey (DHS); 2013; N = 38,522	Terror fatalities are associated with low birth weight, though this effect is mediated by socio-economic factors and different by during which trimester an attack occurs. Controlling for mother fixed effects through siblings suggests little difference.
Sanda et al. 2016	Utilization	Health, Education	Nigeria	Part of study area (Nigeria,	Displaced	Interviews, Descripti	Own women survey; N = 300	Health and education outcomes are worse for IDPs

				IDP camps; Borno state)		ve statistics		compared to general population
Solanke 2018	Utilization	Health	Nigeria	Study area	General	OLS; controls for individual and community characteristics	Demographic and Health Survey (DHS); 2013; N = 2,729	During BH insurgency, reduction of visits to health services by mothers, but education and work status also impact, while other factors relevant in non-conflict areas are not associated.
Iacoella and Tirivayi 2020	Utilization	Health	Nigeria	Part of study area (Nigeria, Yobe state)	Both	Descriptive statistics, Probit; controls for household characteristics	WFP survey data; 2016; N = 1,809	IDP households are poorer across most measurements than host community households, even though most IDPs move only very short distances. IDP children are much more likely

								to suffer from acute malnutrition, probably linked to lower household wealth and maternal nutrition.
Odo, Musa, and Oladugba 2020	Utilization	Health	Nigeria	Part of study area (Nigeria, Borno state)	Displaced	Descriptive statistics, focus group discussion	Own survey; 2019; N = 396	Reports of food being exchanged for sex
Denue et al. 2018	Utilization	Health	Nigeria	Part of study area (Nigeria; Borno state)	General	Descriptive statistics	Health data from Min. Health; 2017; N = 5,889	Area hit hardest by cholera is also most affected by insurgency.
Olanrewaju et al. 2018	Utilization, Access	Health, Education, Incomes	Nigeria	Part of study area (Nigeria, IDP camps; Abuja)	Displaced	Focus group discussions	Own women survey; N = 40	Respondents claimed there is a lack of balanced diet, leaky roofs, and bad housing, coupled with overpopulation.

								Health and education infrastructure are quite good.

3 Beyond Political Violence: Boko Haram's Banditry and Child Health in Chad

By Robert Paul Bachofer[7] *& Hamid Reza Oskorouchi*

Abstract

Although criminal violence carried out by terrorist groups is critical to the financing of such organizations, these actions are often ignored or confound with ordinary crime and thus their wider scope remains overlooked. However, curbing such criminal violence undercuts the supply network of violent groups and is essential to curtail their political violence – or even prevent it, if a group uses crime in one area to supply its political violence in another. In this study, by drawing on the case of the 2015 Boko Haram insurgency in Chad, we disentangle the effect of terrorist groups' political actions from ordinary crime. We show that the initial Boko Haram criminal activities in the Lac region pre-2015 caused sizable detrimental effects to the civilian population. We test this hypothesis by analyzing child anthropometrics, exploiting four rounds of harmonized cross-sectional DHS and MICS microdata collected before (1997, 2000, and 2010) and after (2015) Boko Haram's criminal phase in the country, but not during its political violence phase. We find that the insurgency's criminal violence is responsible for an average 0.085 points lower underweight and a 0.305 points lower wasting z-score in the treatment group. These results are supported by additional evidence linking Boko Haram with worse household diet diversity and impaired agricultural activity.

Keywords: Boko Haram insurgency; nutrition; difference-in-difference; transmission channels; criminal violence; Lake Chad.

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[7] The contribution of the author to this article includes: Abstract; Introduction; Background; Results and Discussion; Conclusions. He also performed data cleaning, media review, and calculation of anthropometrics.

3.1 Introduction

Despite ten years of military operations against Boko Haram, the terrorist group keeps operating and affecting people's lives in the Lake Chad region. In this paper, we trace the paths of how the 2013 Boko Haram-offshoot operating along the shores of Lake Chad caused human suffering for Chadians even before it launched its first political attacks on Chadian soil in 2015. Thereby, we link extant literature and local sources to a quantitative analysis showing the impacts of the group's criminal activities. We find strong evidence that Boko Haram has negatively impacted child health and livelihoods by raiding and extorting local communities, while staying below the radar of authorities. By being the first study able to disentangle the political violence effect from the ordinary crime component of terrorism, this research contributes substantially to the literature investigating the negative effects of terrorism on dimensions of human development.

We use four cross-sectional waves of nationally representative Chadian microdata for the period 1993-2015 within a two-by-two Difference-in-Difference (DID) empirical strategy that exploits Boko Haram's presence in the Chadian administrative region Lac – but not in the rest of the country – from 2013 to early 2015, before the beginning of its political violence phase in Chad. Our estimates are not only robust to the assumption of equality in pre-treatment trends, but a series of placebo tests corroborate the hypothesis that the detrimental effects of Boko Haram's early presence in Chad is due to resource grabbing and ordinary crime rather than the usual mechanisms pointed out in the empirical terrorism literature (e.g., death and disruption of infrastructures). For example, we find that Boko Haram presence affects neither the gender composition of the household (share of adult males over females), nor the gender of the household head. Conversely, households exposed to the treatment are statistically less likely to be involved in agricultural activities and have less diversified diets. Finally, we rule out that our results might be confounded by adverse climate, i.e., seasonal droughts in the treatment region.

Admittedly, the pre-2015 literature on Boko Haram in Chad is relatively meagre. This dearth is due to the fact that, historically, Boko Haram's violence took place mainly on Nigerian soil, whereas its presence in Chad is relatively recent and out of the public eye. To overcome this limitation, we rely on on-site expert interviews with security officials. We report the quotes from pertinent interviews conducted by Crisis Group and carried out one additional semi-structured interview (see Appendix B for

more details). Before the interview, we provided the participant with a written consent to audio-record and disclose the results (under the condition of keeping their identity strictly anonymous).[8]

3.2 Background

For the purpose of this paper, we divide the history of Boko Haram's operations into three phases: During the first phase, from it taking shape at the beginning of the millennium (Cook 2011; Roelofs 2014), the organization was firmly based in Nigeria's Borno state and its capital Maiduguri, until a crackdown by security forces drove Boko Haram into the countryside by 2009 (MacEachern 2018). Instead of calming the situation, however, this lead to Boko Haram evolving and adapting its operational basis in a second phase, until 2012, to the rural areas of Borno and thereby towards the shores of Lake Chad (Pérouse de Montclos 2014); already regarding this phase, a Chadian security officer stated that "Nigeria exports many members of the Boko Haram sect to Chad, fleeing army repression" (Crisis Group 2017). In a third phase, the one that we cover in this paper as the treatment period, it found itself confronted with the Lake Chad wetlands, defined by seasonal floods and fluctuating water coverage (Odada, Oyebande, and Oguntola 2006), which transforms terra firma into swamps, inundates islands and cuts off peninsulas from the mainland during parts of the year.

3.2.1 The long path of Boko Haram to Chad

Initially, Boko Haram was ill-adapted to this geography, with its "motorized cosackery" (Seignobos 2014), decentralized and highly mobile warbands on motorcycles. Consequently, its operations differed markedly between its

[8] Although our research could have gained much from local village chief interviews, we decided to not collect such information. In fact, because it would be impossible to survey any village chief in the field without being noticed, we considered the possibility that Boko Haram could have retaliated against village chiefs and their communities for sharing information with outsiders. The same problem would have applied if we were to provide the village chiefs with transportation to a safe UN compound in N'Djamena.

core in Nigeria and periphery in Chad: Motorcycles in Nigeria, boats in Chad; deep penetration into territory in Nigeria, assaults on littoral towns and immediate retreat in Chad; territorial control and attacks against political targets in Nigeria, hit-and-run tactics to carry away supplies and conduct forced recruitment in Chad. In the words of a former United Nations security officer:

> "[...] Ngougouba and Choukoutalia, these are the localities which border Nigeria. Thus, they [Boko Haram] come, they take the people, they arm them, they make them adepts. [...] on the Chadian side there is much more the desert and those [Boko Haram], they seek the forest. Next to Nigeria there is forest where they come from, on the Chadian side there is desert. And they do not really, especially on the Chadian side, they are not great at mobility. So, they wait, they wait for hours of the night to break into villages. They do damage and they quickly leave [...]. The guys leave in the morning hours on motorized pirogues, they come, they surprise you, they commit extortions, and when they leave – they are already in the forest." (Transcript in Appendix B)

During its adaptation to the geography and seasonality of Lake Chad, the insurgents also gained control over at least some of the illicit arms, counterfeit, and drugs trade for which the triangle Cameroon-Chad-Nigeria meeting at Lake Chad is a hub (Africa Center for Strategic Studies 2017). We speculate that smuggling as an economic factor increased in relative importance to legal trade in the Lake Chad area already in 2010, when Nigerian military offensives led to a border closure between Nigeria and Chad, disrupting livelihoods depending on cross-border trade and pastoralism, and leading to food prices hikes. During that time, it became apparent that Boko Haram had started taxing cross-border trade through roadblocks and that insecurity became the most important constraint for Chadian and Nigerian traders (WFP 2016).

3.2.2 Boko Haram's criminal and political violence

However, the question remains why the Boko Haram insurgency was permitted to have this adaptation period. The answer is that Boko Haram as a threat in the Lac administrative area in Chad – where the country borders Lake Chad – was detected only in 2015. The first press coverage relating to Boko Haram and Chad dates to the 19th of January 2015 and covers Nigerian refugees crossing Lake Chad to escape Boko Haram's violence in Nigeria. The first coverage of an attack of Boko Haram in Chad dates to the 13th of February 2015. We base these key dates on a systematical search for the keywords "Boko Haram & Chad/Tchad" in the online archives of The New York Times, Le Monde and Al Jazeera English and for violent actions by Boko Haram in the Armed Conflict Location and Even Data Project (ACLED)[9] database, the Uppsala Conflict Data Program Georeferenced Event Database (UCDP-GED) and the Global Terrorism Database (GTD), restricting the date range of our search to the period 1st of January 1993 to 31st October 2019.

That is not to say that Chadian security forces were not aware of insurgents in the border area. However, three factors contributed to the Chadian state's lack of attention on Boko Haram's operations: On the one hand, the Chadian state had few resources to spare. Following the Agreement on Normalization between Chad and Sudan in 2010 (UN Peacemaker 2010), Chad's security forces were downsized and by 2014 thousands of police officers and 14,000 soldiers had been discharged (OSAC 2014). Yet, Chad's eastern border regions remained a hotspot for insecurity (Human Rights Watch 2011) and already sparse security resources remained concentrated there. On the other hand, many of Boko Haram's activities during this period – raiding supplies, kidnapping, banditry – are difficult to distinguish from common criminal acts and thus might not have been linked to Boko Haram at all (Asuelime and David 2015). Lastly, the Lac region was too useful as a safe haven for Boko Haram to turn it into a battlefield (MacEachern 2018). Overall, Chad had very little resource to spare on a problem, which seemed more like habitual crime than an existential threat, and Boko Haram deliberately maintained its illicit activities on a level where these would not provoke a response.

Thereby, Boko Haram exploited the difference that criminal violence and political violence make for the Chadian state and for the

[9] ACLED data is publicly available through https://www.acleddata.com/.

international community, and the attention that they would pay to the problem. This problem faces many a state: While criminal violence is perpetrated for economic or personal aims, and political violence with political objectives in mind (Krause, Muggah, and Gilgen 2011), terrorism carries both dimensions (Policy Working Group on the United Nations and Terrorism 2002) and consequently the responses and forces deployed markedly differ. However, the threshold between them is fluid; in the case of Boko Haram, much of its armament was pillaged from Nigerian military supplies (Tran Ngoc 2012), i.e., constitutes an economic gain, but the aim of acquiring these arms is obviously political. We argue in this paper that the danger of Boko Haram gaining a foothold in Lac could have been detected earlier, as its criminal activities had a measurable and significant effect on human development, which we measure through malnutrition indicators.

3.3 Data and methods

The main data sources of this study are two rounds of DHS (1997 and 2014) and two of MICS (2000 and 2010). Because our identification strategy consists of a two-by-two standard DID framework, the employment of data collected in multiple periods is crucial, especially to test the pre-treatment parallel trend assumption between the control and treatment groups. It should be noted that pooling together these DHS and MICS rounds does not undermine the inferential properties of our final sample. In fact, the selected surveys are all representative at the national level and exploit the same two-stage cluster sampling design. The household listings employed are the Recensement Général de la Popolation et de l'Habitat 1993 and 2009 for the1997 and 2000, and 2010 and 2014 samples, respectively.

These surveys are also very similar in scope, in that they offer background socio-demographic information as well as child health measures and anthropometrics. Unfortunately, they do not offer measures that could be employed for a transmission channel analysis (e.g., food security). To compensate for this dearth, we rely on five rounds (2011, 2013, 2014, 2015, and 2016) of the cross-sectional Chadian Enquête nationale sur la Sécurité

alimentaire des ménages ruraux (ENSA).[10] This survey, designed and collected by WFP and the Directorate of Agricultural Production and Statistics of the Government of Chad, focuses on food security and agriculture. From these dimensions we derive a set of dependent variables to corroborate the Boko Haram non-political violence effect on child health. These surveys are representative at both the national and first-administrative level but include only rural households (80 percent of the total population), and the samples were constructed using a two-stage cluster design. Despite the ENSAs enjoying a response rate close to 100 percent, some originally selected households had to be replaced due to poor road conditions that limited the enumerators' access to certain areas. The data collection took place during the harvest season, and despite some household members having been in their fields, the survey investigators managed to interview them.

3.3.1 Dependent variables

The focus of this study is on Chadian child nutrition outcomes in relation to criminal, in contrast to political, violence carried out by the terrorist group Boko Haram. We thus construct a wide range of anthropometric-derived measures using the WHO Anthro macros for Stata (WHO 2019) together with our DHS/MICS pooled sample. The WHO Anthro macros compare the child anthropometrics of our surveys to an international reference dataset of healthy children to produce z-score scaled measures of stunting (height-for-age), wasting (weight-for-age), and underweight (weight-for-height). Additionally, we create a set of dummy variables that proxy moderate and severe stunting, wasting, and underweight by taking a value equal to one when a child z-score is lower than -2 and -3 standard deviations, respectively, and zero otherwise.

We construct a second set of dependent variables for the purposes of empirically investigating the underlying transmission channel of terrorist group criminal activities to child health. These measures are derived from several waves of ENSA data and include a household-level dietary diversity

[10] The ENSA data is co-owned by the Système d'Information sur la Sécurité Alimentaire et d'Alerte Précoce du Tchad (SISAAP) and the United Nations World Food Programme (WFP).

index (HDD) and a dummy variable that proxy whether a household is engaged in agricultural activities in the twelve months before the interview.

3.3.2 Control variables

We derive our control variables from the pool of comparable measures available in all DHS/MICS waves employed. Admittedly, the impossibility of using the full information provided by the single survey rounds applies to our study. This is a known shortcoming of pooling samples from different data sources, especially if a considerable temporal gap exists between their collection. For example, our ability to control for household wealth is constrained, as constructing a meaningful wealth index by means of Principal Component Analysis is challenging because a considerable number of wealth dimensions were not collected in the DHS 1997 and MICS 2000. To overcome this problem, we use single dimensions (available in all survey years), able to contextually proxy the level of household welfare, namely dummies and categorical variables for radio, motorbike, and bicycle ownership, and type of toilet facility and water source, respectively. We also use the standard set of controls employed in studies like ours, including variables measured at the child (age, gender, child being breastfed, and diarrhea occurrence), mother (mother's age and education), and household level (rural residency, number of household members, and gender and education of the head of household).

3.3.3 Identification strategy

Our identification strategy consists of a standard two groups-two periods DID approach which exploits the pre-2015 confined presence of Boko Haram to the Lac administrative region in Chad. We thus identify our treatment group by means of a dummy variable that takes a value equal to one for those households residing in Lac, and zero otherwise (control group). We also construct a treatment variable that proxies the arrival of Boko Haram in Lac as a dichotomous indicator taking a value equal to one for the observations in 2014 and early 2015, and zero otherwise (observations either in 1997, 2000, and 2010). It should be noted that our most recent survey data

(DHS 2014) do not cover the period when Boko Haram violence, criminal or political, reached regions other than Lac (e.g., the capital city N'Djamena). Excluding information collected during the above-mentioned period is crucial to avoid potential (downward) bias stemming from the inclusion of treated observations in the control group. The coefficient of the interaction (DD) between the two variables described above represents the treatment on the treated effect (TOT).

The identifying assumption for a DID estimation to be unbiased is that the average pre-treatment changes (trends) in the outcome variable(s) between treatment and control groups must be parallel. Failure to satisfy this parallel trend assumption would lead to a biased estimation of the TOT. When the parallel trend assumption does not hold, the control group does not represent a proper counterfactual. We thus test the equality in pre-treatment trends for each dependent variable considered in this study, including those for which the underlying theory predicts a null TOT, and all transmission channels. All models are estimated accounting for sampling weights and the standard errors are clustered at the first administrative level (15 clusters). However, because the number of clusters is lower than the usual rule of thumb of 40, we run a wild cluster bootstrap-t procedure (implemented by means of the "*cgmwildboot*" Stata ado with 1,000 replications) which allows us to estimate precise standard errors despite the small number of clusters (Cameron, Gelbach, and Miller 2008). Our results enjoy the same level of statistical significance when we (more) conventionally estimate a cluster-robust variance (using on a T(G-1) distribution) with 15 clusters.

Moreover, to interpret our DID estimates as the unbiased effect of Boko Haram criminal activities, it is crucial to exclude the occurrence of any shock other than the treatment that could have affected differently the control and treatment group post-treatment outcomes. We first consider that the violence perpetuated by Boko Haram in Nigeria forced civilians to take shelter on the Chadian shores of Lake Chad (our treatment region). A large influx of refugees into the treatment region would have probably determined worse living conditions for the locals because of possible competition over scarce resources, thus translating into an overestimation of the negative effect of Boko Haram on child health. However, according to both UNHCR and the Chadian Government, the number of Nigerian refugees in Chad remained considerably low until June 2015 (staying stable at less than 3,000 individuals until late 2014, and even falling to 652 in February 2015). A large influx of Nigerian refugees has been recorded only in August 2015 (13,010 individuals). It is worth noting that, in our main pooled DHS/MICS dataset,

households residing in the Lac region (half a million individuals) were surveyed not later than March 2015 (only 18 observations in April 2015), thus limiting the possibility that the estimated DD coefficients are driven by the presence of (few) Nigerian refugees (UNHCR 2021).

Second, because the surveys employed in this study are not seasonally representative, the different interview timing among regions could possibly drive our results, especially if control and treatment groups were respectively surveyed in different seasons. This is not the case in our sample as our treatment and control groups were interviewed from October 2014 to April 2015 (in the treatment data wave), whereas the lean season lasts from May to August. This is valid also for all pre-treatment periods with the exclusion of 2010, for which information on both groups were gathered during the lean season.

In principle, changes in the number of Internally Displaced Persons (IDPs) in Lac, similarly to the case of Nigerian refugees outlined above, could affect our TOT estimates. However, we do not consider this mechanism as a potential source of bias, but rather a transmission channel, as long as these IDPs did not migrate to the control regions. It should be noted that IDPs are not included in the sample (because not part of the household listing) and thus the only way in which they could influence the DD coefficient is indirectly by changing the socio-economic status of the host communities where they are displaced. That is, if IDPs originated from Lac moved to the control regions, or vice versa, our estimates would be understated or overstate the true negative effect of Boko Haram violence, respectively. Chadian IDPs, however, are mainly located in the west, i.e., in Lac, while the south-east and the eastern part of the country provide shelter for refugees and returnees from CAR and Sudan, respectively. However, beside the fact that IDP intra-migration among these regions does virtually not exist, the IDPs originated from Lac are registered in this region (UNHCR 2019; IDMC 2023).

A final concern for our identification strategy is the possible confounding role of local conflicts, mainly the violent disputes between farmers and migratory herders in Logone Occidental. We consider the risk of bias stemming from these conflicts unlikely. In fact, these local violent events persisted for the last ten years, albite at different intensities, and thus unlikely (cor)relate to the treatment. We confirm the goodness of our estimates with respect to this confounder by running a set of auxiliary regressions in which Logone Occidental is excluded from the sample. Once again, our main results remain stable in respect to direction, magnitude, and

statistical significance. Finally, even though controlling for the number of refugees and IDPs, and local conflicts occurrence/fatalities would increase the confidence in our DD coefficient, we are unable to do so because no database provides these measures disaggregated at the first administrative level or lower.

3.4 Results

In Table 3.1, we report the summary statistics of the DHS/MICS datasets. For underweight and wasting the average z-scores are -1.343 points and -0.673 points respectively, while 3.8 percent of the sample constitutes our treatment group. The average age of the children assessed is two years and a half, with 49.6 percent of them being male, 63.9 percent being breastfed, and 24.4 percent having suffered from diarrhea in the two weeks prior to the survey. Among their mothers, 78.7 percent are illiterate, 15.1 percent completed primary school, and only 6.2 finished secondary school. The average age of mothers is 28 years. Most households in our sample reside in rural areas, with only 36.4 percent living in cities. On average, 7.5 people live in one household, and 87.9 percent of heads of households are male with an average age of 40.4 years. The 1997 wave accounts for 17.3 percent of our sample, the 2000 wave for 15.4 percent, the 2010 wave for 43.7 percent, and the final wave (2014) for 23.6 percent.

Concerning our treatment group, households living in the Lac area, the ACLED database (Raleigh et al. 2010) indicates that between the 2010 and 2014 waves, only 2 people died in Lac in battles, explosions/remote violence or violence against civilians, accounting for 1.1 percent of fatalities in Chad over this timeframe. Partially this might be explained by underreporting – as explained before, the Chadian state and media had other priorities at the time – but based on the literature review and expert interview conducted, we believe that Boko Haram insurgents maintained a low profile, conducting non-lethal crime rather than attracting attention through attacks causing high numbers of fatalities.

Table 3.1: Descriptive statistics

Variable	N	Mean	SD	Min	Max
Underweight (z-scores)	33,501	-1.343	1.420	-5.99	4.86
Wasting (z-scores)	33,316	-0.673	1.387	-5.00	4.98
Treatment (Lac region)	33,501	0.0384	0.192	0	1
Child age (months)	33,501	29.478	17.703	0	59
Child is male (dummy)	33,501	0.496	0.500	0	1
Child breastfed (dummy)	32,937	0.639	0.480	0	1
Child has diarrhea (dummy)	33,432	0.244	0.430	0	1
Mother education: illiterate	32,842	0.787	0.410	0	1
Mother education: primary	32,842	0.151	0.358	0	1
Mother education: secondary	32,842	0.062	0.242	0	1
Mother age (years)	31,841	28.272	6.905	15	49
Household is urban (dummy)	33,501	0.364	0.481	0	1
Household size	33,501	7.509	3.966	1	40
Head is male (dummy)	33,501	0.879	0.326	0	1
Head age (years)	33,474	40.402	12.238	15	95
DHS 1997	33,501	0.173	0.378	0	1
MICS 2000	33,501	0.154	0.361	0	1
MICS 2010	33,501	0.437	0.496	0	1
DHS 2014	33,501	0.236	0.425	0	1

In Figure 3.1, a visual representation of the parallel trends, we compare the trajectories of our dependent variables between the treatment and control groups. The trends are parallel pre-treatment and diverge post-treatment for

wasting and underweight, though the figure does not depict this clearly for the latter, as the effect is small. Shown in Table 3.2, we further test this visual by estimating the coefficients of the lags of the treatment interaction two periods before the treatment and immediately before the treatment. The treatment interaction coefficient, the DD, two periods before treatment is associated with a decrease by 0.211 points, while the DD lag immediately before the treatment, as a measure whether the treatment group anticipated the treatment, is associated with a decrease of 0.185 points. For underweight, the associated decrease is 0.162 points and 0.196 points, respectively, and for stunting the estimated decrease is 0.021 and 0.089 points. Immediately before the treatment, the interaction is associated with a decrease of 0.065 points, the coefficient of the underweight is -0.104 points and the one of stunting -0.077 points. With the notable exception of stunting, these coefficients achieve considerable size, and we take this as further evidence that the parallel trends assumption is satisfied. For stunting, these findings are in line with expectations, as the relatively short treatment period should not affect this longer-term nutritional indicator; we thus do not report the estimates for stunting in the following sections.

Figure 3.1: Parallel trends for child wasting (left) and underweight (right)

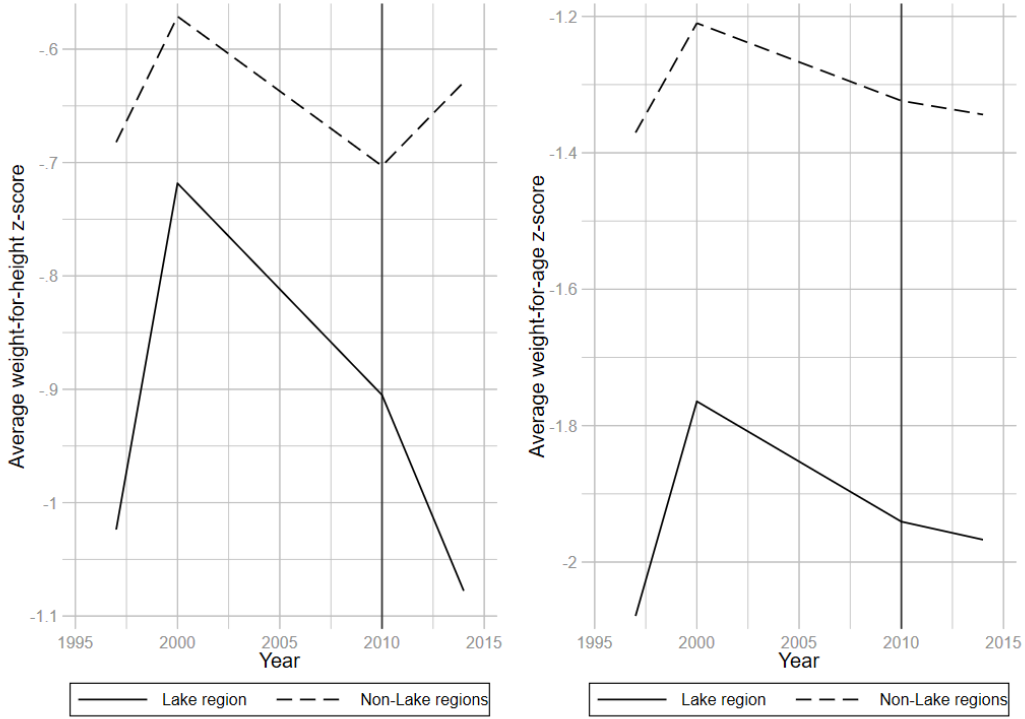

Table 3.2: Parallel trend and anticipation tests (OLS)

	Parallel Trends			Anticipation		
	Wasting	Underweight	Stunting	Wasting	Underweight	Stunting
	(1)	(2)	(3)	(4)	(5)	(6)
Lag 2	-0.211	-0.162	-0.021			
	(0.149)	(0.154)	(0.215)			
Lag 0	-0.185	-0.196	-0.089	-0.065	-0.104	-0.077
	(0.120)	(0.133)	(0.179)	(0.091)	(0.097)	(0.138)
Constant	-1.131***	-1.671***	-1.539***	-1.134***	-1.674***	-1.539***
	(0.040)	(0.042)	(0.060)	(0.040)	(0.042)	(0.060)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	25,429	25,585	25,472	25,429	25,585	25,472
R-squared	0.064	0.070	0.028	0.064	0.070	0.028
Model F-stat (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
Lag diff. F-stat (p-value)	0.261	0.336	0.847			

Notes: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Finally, we report the estimates of impacts of the Boko Haram insurgency in Lac on underweight in Table 3.3. Including no other controls but the wave and region fixed effects, the presence of the insurgency's TOT is -0.064 points on the z-score. When gradually including child-specific and mother-specific control variables, this coefficient decreases to -0.065 points and -0.084 points, respectively. In the full model, also including household-level regressors, we find that the insurgency causes a -0.085-points decrease of the underweight z-score. For wasting, the Boko Haram insurgency in Lac causes a decrease of the z-scores by 0.272 points when only including wave and region fixed effects, a decrease of 0.308 when including child-specific control variables, and the same decrease when including both child- and mother-specific variables. Under the full model, that is with household-specific control variables, the estimated treatment effect is a 0.305 decrease in z-score due to the Boko Haram insurgency.

Table 3.3: The effect of Boko Haram presence on child underweight (weight-for-age) and wasting (weight-for-age)

	Underweight (z-scores)				Wasting (z-scores)			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
Treated group	-0.395	-0.376	-0.366	-0.359	0.216	0.223	0.215	0.210
	(0.002)	(0.002)	(0.002)	(0.002)	(0.018)	(0.026)	(0.000)	(0.004)
Post	0.014	-0.018	0.169	0.070	0.160	0.126	0.107	0.102
	(0.698)	(0.624)	(0.006)	(0.162)	(0.012)	(0.016)	(0.044)	(0.100)
DD	-0.064	-0.065	-0.084	-0.085	-0.272	-0.308	-0.308	-0.305
	(0.020)	(0.040)	(0.010)	(0.018)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	-1.522	-1.066	-1.398	-1.309	-1.182	-1.386	-1.330	-1.318
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Child controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Mother controls	No	No	Yes	Yes	No	No	Yes	Yes
Household controls	No	No	No	Yes	No	No	No	Yes
Observations	33,501	32,874	30,763	30,746	33,316	32,693	30,587	30,570
R-squared	0.073	0.106	0.112	0.112	0.063	0.098	0.102	0.102

Notes: Robust bootstrap standard errors clustered at the region-level in parentheses *** p<0.01, ** p<0.05, * p<0.1

Assuming that the insurgents' presence in Lac held smallholder farmers back from toiling their fields and made access to markets to procure a diversified diet more difficult, we test whether agricultural activity and dietary diversity are potential transmission channels through which the Boko Haram insurgency impacted childhood anthropometrics. We also test whether another factor, the yearly recurrent lean season, could have caused the estimated TOTs. Applying the same parallel trends-methodology as above, Figure 3.2 does indeed show the same trends, indicating that the insurgency reduced work in agriculture and diet diversity. On the contrary, the trends concerning drought exposure shown in Figure 3.3 continue to run in parallel post-treatment, allowing us to exclude this alternative explanation for the decline in childhood malnutrition indicators.

Including only the treatment dummy and the first lead of the treatment year as a dummy, the presence of Boko Haram's TOT is a 29.7 percentage point decrease of households conducting agricultural activities at a statistically significant level. Including wave fixed effects and household-specific control variables, the TOT is a 31.7 percentage point decrease of the same indicator. Household dietary diversity meanwhile is estimated to decrease by 41.3 points with the reduced model and by 53.7 points in the full model, as reported in Table 4. Drought is not associated with the treatment to a statistically significant extent.

Figure 3.2: Parallel trends for household agricultural engagement and dietary diversity

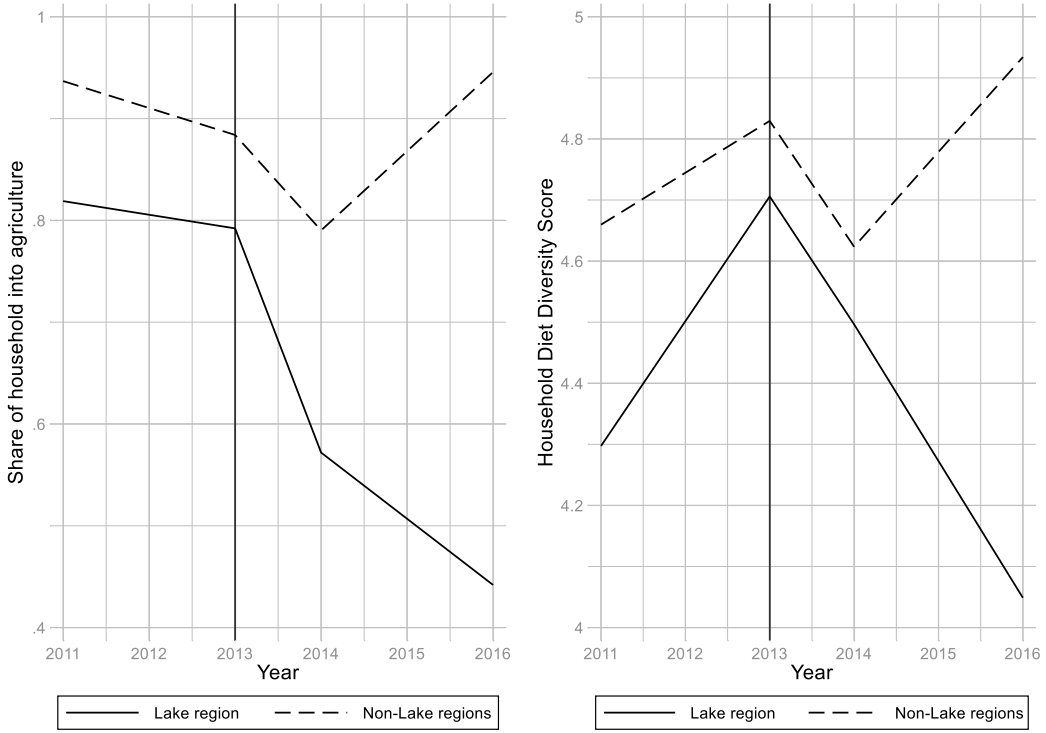

Figure 3.3: Parallel trend for drought exposure (falsification outcome)

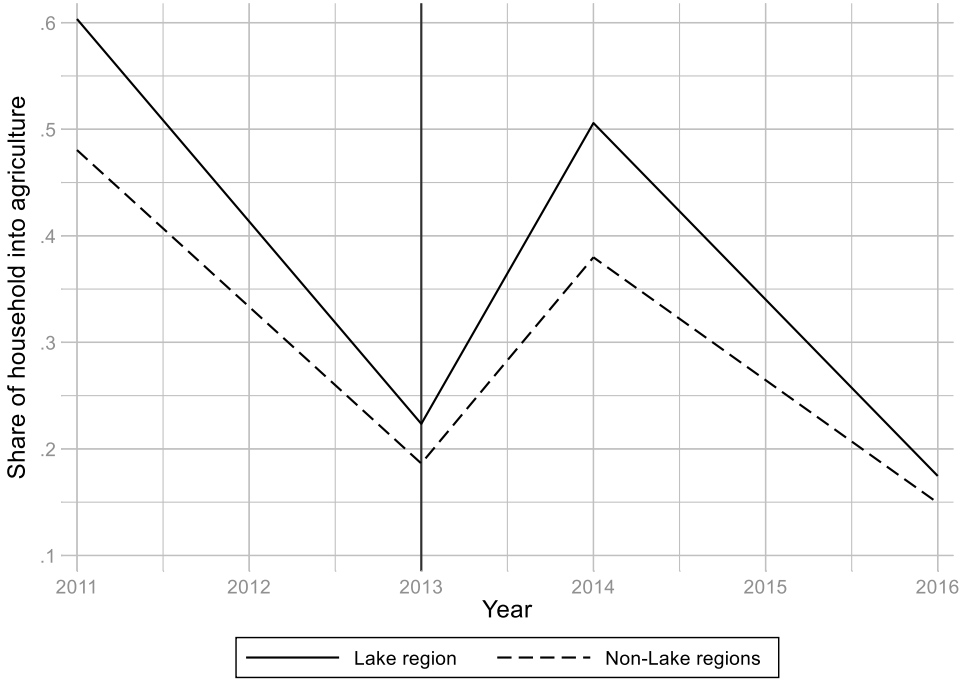

Table 3.4: Effect of Boko Haram presence on agriculture, dietary diversity, and drought, i.e., falsification (OLS)

	Dependent Variable:					
	Agricultural activity		HDDS		Drought	
	(1)	(2)	(3)	(4)	(5)	(6)
Lake region (dummy)	-0.105	-0.100	-0.234	-0.171	0.072	0.071
	(0.002)	(0.033)	(0.056)	(0.118)	(0.060)	(0.052)
Post 2013 (dummy)	-0.035	0.020	0.054	0.160	-0.131	-0.332
	(0.116)	(0.020)	(0.592)	(0.214)	(0.010)	(0.002)
DD	-0.297	-0.317	-0.413	-0.537	-0.047	-0.045
	(0.002)	(0.103)	(0.002)	(0.002)	(0.268)	(0.334)
Drought (dummy)		0.059		-0.304		
		(0.019)		(0.014)		
Head is male (dummy)		-0.111		-0.357		0.042
		(0.036)		(0.002)		(0.442)
Head age (years)		-0.001		-0.008		0.001
		(0.000)		(0.002)		(0.234)
Head is literate (dummy)		0.028		0.234		-0.045
		(0.014)		(0.000)		(0.034)
Constant	0.910	1.070	4.745	5.453	0.332	0.417
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	No	Yes	No	Yes	No	Yes
Observations	24,047	19,845	24,779	20,577	20,577	20,577
R-squared	0.073	0.134	0.012	0.072	0.023	0.106

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2011, 2013, 2014, and 2016); p-values in parenthesis. Standard errors clustered at the regional level (21 regions) and corrected for the small number of clusters using the wild bootstrap option of “cgmwildboot” and “clustse” Stata packages with 1,000 replications.

Excluding Logone Oriental from the dataset reported in Appendix A, we find that the insurgency's TOT amounts to a decrease in the underweight z-score of 0.060 points when only including fixed effects in the model and decreases of 0.064 points and 0.081 points when progressively including child- and mother-specific control variables, respectively. Including household controls too, the estimated TOT amounts to a decrease of 0.082 points. In a similar vein, the estimated TOT of the insurgency on wasting is -0.279 points, -0.315 points and -0.313 points when gradually introducing fixed effects, child- and mother-specific controls, and -0.310 points in the full model, when excluding Logone Oriental.

3.5 Discussion

There is no doubt that the presence of Boko Haram in the Lac region, even before the insurgency started to perpetrate political violence, had a negative impact on child development. As one would anticipate, we found this impact in short-term indicators of childhood malnutrition, underweight and wasting, but not in a longer-term indicator, stunting. Nevertheless, concerning both underweight and wasting z-scores, the impact was significant, not only in the statistical sense, but also for the population suffering from it. Our supporting analysis of transmission channels showed that livelihoods and household food security suffered to large extents. The extend of the former transmission channels, participation in agriculture, also is a clear hint that the insurgency had penetrated Chadian territory at this time.

Three different placebo tests further support the causal interpretation of our results. First, having used seasonal drought as a potential alternative explication of the worsening of childhood nutrition indicators, we found that it has no significant effect on them; in fact, drought exposure trends of the treatment and control groups run in parallel pre- and post-treatment. Secondly, having used the lags of the treatment interaction as alternative predictors, we found no significant effect either. Lastly, having applied an alternative sample, we find that it does not change the coefficients much, nor affects statistical significance.

3.6 Conclusions

As our research has shown, Boko Haram managed to fly under the radar in Chad for years, largely due to its actions having been indistinguishable from criminal violence and thus not seen as a fundamental threat to the state, as opposed to the group's political violence in Nigeria. However, criminal violence has no less impact on human lives and livelihoods than political violence, and the activities conducted by Boko Haram in Lac between 2010 and 2014 led to a deterioration in human development indicators. This should have been a warning sign to the Chadian state and the international community, together with the reports of the Chadian security forces of at least some insurgents infiltrating Lac.

Our research also emphasizes that distinguishing between criminal and political violence is not always practical and that the effects of these dimensions on human development might be the same anyway. It is understandable that state actors prioritize reacting to political violence over reacting to criminal violence; after all, political violence threatens the positions of power of these actors, if not even the existence of their state and their very lives. However, early action against Boko Haram's criminal activities could have not only prevented human suffering, but also prevented the insurgents from adapting their operational capacities to the Lake Chad geography and ultimately being able to perpetrate political violence in Chad's territory. In other fragile contexts, closely watching the trends of human development indicators might reveal the criminal activities of politically motivated armed groups and thus can help to face them – maybe even before they start committing political violence.

Lastly, our research shows how important the cooperation between different state and non-state services is to detect and respond to any kind of violence. In the case of Boko Haram in Chad, we showed that malnutrition indicators from the health sector could have been an important piece of information to alert security forces about the criminal activities and their magnitude. Similar arguments could be made regarding agricultural extension, education, or other services with a presence in remote areas, where security forces usually have limited intelligence. Beyond state services, village chiefs and civil society actors hold important information. Linking these structures to security ones is a straightforward way to improve their effectiveness and efficiency to counter extremist groups entrenching in peripheral areas.

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Appendix A: Supporting tables

Appendix Table A1: The effect of BH presence on child underweight (weight-for-age) OLS, full-results

	Underweight (z-scores)			
	(1)	(2)	(3)	(4)
Treated group	-0.395	-0.376	-0.366	-0.359
	(0.002)	(0.002)	(0.002)	(0.002)
Post	0.014	-0.018	0.169	0.070
	(0.698)	(0.624)	(0.006)	(0.162)
DD	-0.064	-0.065	-0.084	-0.085
	(0.020)	(0.040)	(0.010)	(0.018)
Child age (months)		-0.013	-0.013	-0.013
		(0.002)	(0.002)	(0.002)
Child is male		-0.069	-0.073	-0.073
		(0.002)	(0.002)	(0.002)
Child breastfed		0.100	0.082	0.082
		(0.000)	(0.004)	(0.000)
Child has diarrhea		-0.411	-0.418	-0.419
		(0.002)	(0.002)	(0.002)
Mother's educ. (primary; ref. illiterate)			0.220	0.210
			(0.006)	(0.010)
Mother's educ. (secondary; ref. illiterate)			0.327	0.304
			(0.000)	(0.000)
Mother's age (years)			0.006	0.007

			(0.000)	(0.000)
Urban residency				0.074
				(0.070)
Household size				-0.001
				(0.664)
Household head is male				0.004
				(0.922)
Household head age (years)				-0.000
				(0.768)
Constant	-1.522	-1.066	-1.398	-1.309
	(0.002)	(0.002)	(0.002)	(0.002)
Region FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	33,501	32,874	30,763	30,746
R-squared	0.073	0.106	0.112	0.112

Notes: Robust bootstrap standard errors clustered at the region-level in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table A2: The effect of BH presence on child wasting (weight-for-height) OLS, full results

	Wasting (z-scores)			
	(1)	(2)	(3)	(4)
Treated group	0.216	0.223	0.215	0.210
	(0.018)	(0.026)	(0.000)	(0.004)
Post	0.160	0.126	0.107	0.102
	(0.012)	(0.016)	(0.044)	(0.100)
DD	-0.272	-0.308	-0.308	-0.305
	(0.002)	(0.002)	(0.002)	(0.002)
Child age (months)		0.013	0.013	0.013
		(0.000)	(0.000)	(0.000)
Child is male		-0.065	-0.064	-0.064
		(0.016)	(0.010)	(0.010)
Child breastfed		-0.108	-0.126	-0.126
		(0.002)	(0.002)	(0.002)
Child has diarrhea		-0.270	-0.268	-0.268
		(0.002)	(0.002)	(0.002)
Mother's educ. (primary; ref. illiterate)			0.158	0.158
			(0.000)	(0.000)
Mother's educ. (secondary; ref. illiterate)			0.186	0.188
			(0.026)	(0.008)
Mother's age (years)			-0.001	0.000
			(0.164)	(0.864)
Urban residency				-0.007

				(0.852)
Household size				-0.002
				(0.528)
Household head is male				0.038
				(0.198)
Household head age (years)				-0.002
				(0.150)
Constant	-1.182	-1.386	-1.330	-1.318
	(0.002)	(0.002)	(0.002)	(0.002)
Region FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	33,316	32,693	30,587	30,570
R-squared	0.063	0.098	0.102	0.102

Notes: Robust bootstrap standard errors clustered at the region-level in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table A3: The effect of BH presence on child underweight (weight-for-age) OLS, excluding Logone Occidental

	Underweight (z-scores)			
	(1)	(2)	(3)	(4)
Treated group	-0.396	-0.376	-0.366	-0.359
	(0.002)	(0.002)	(0.002)	(0.002)
Post	0.014	-0.010	0.063	0.175
	(0.708)	(0.764)	(0.210)	(0.002)
DD	-0.060	-0.064	-0.081	-0.082
	(0.026)	(0.028)	(0.030)	(0.036)
Constant	-1.525	-1.068	-1.295	-1.408
	(0.002)	(0.002)	(0.002)	(0.002)
Region FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Child controls	No	Yes	Yes	Yes
Mother controls	No	No	Yes	Yes
Household controls	No	No	No	Yes
Observations	31,684	31,074	29,092	29,075
R-squared	0.075	0.107	0.114	0.114

Notes: Robust bootstrap standard errors clustered at the region-level in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table A4: The effect of BH presence on child wasting (weight-for-height) OLS, excluding Logone Occidental

	Wasting (z-scores)			
	(1)	(2)	(3)	(4)
Treated group	0.174	0.177	0.177	0.173
	(0.000)	(0.000)	(0.000)	(0.000)
Post	0.178	0.144	0.125	0.096
	(0.002)	(0.014)	(0.036)	(0.070)
DD	-0.279	-0.315	-0.313	-0.310
	(0.002)	(0.002)	(0.002)	(0.002)
Constant	-1.151	-1.332	-1.291	-1.248
	(0.002)	(0.002)	(0.002)	(0.002)
Region FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Child controls	No	Yes	Yes	Yes
Mother controls	No	No	Yes	Yes
Household controls	No	No	No	Yes
Observations	31,508	30,902	28,925	28,908
R-squared	0.065	0.098	0.101	0.102

Notes: Robust bootstrap standard errors clustered at the region-level in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix B: Transcript of expert interview

Intervieweur :
00m00s Autre fois merci beaucoup pour ta disponibilité pour cet entretien et c'est par rapport au contexte du Lac et la situation avec Boko Haram dans le Lac du Tchad. Je voudrais commencer avec l'histoire de Boko Haram dans cette région. Première, ce n'est pas une organisation originaire tchadienne, mais car même il y'a des nationaux tchadiens dans l'organisation. Donc je voudrais savoir un peu sur la première étape de Boko Haram : Est-ce qu'il y'a des liens entre la région originaire de Maiduguri et la du Lac et après comment ça fait le lien entre Boko Haram et des personnes tchadiennes ?

Interviewé :
01m05s Premier il faut noter d'abord que le phénomène Boko Haram ne fait pas parti du Tchad. Ça, c'est venu du Nigeria, c'est pourquoi on parle de l'organisation de l'Etat islamique a l'ouest, c'est Nigeria. Déjà il faut encore cherche le contexte du côté Nigeria. On dit « Boko Haram », l'éducation des blancs c'est ça. Le problème c'est un peu basculé. C'est vrai on a des déplacés internes et aussi les refugies de Nigeria. Ce phénomène, avec l'avenu de Boko Haram, les gens son venu de Nigeria.

02m20s Mais ce que beaucoup plus a accentue c'est la riposte – parce qu'il y'a une coalition des états comparent le Lac Tchad, Niger, Nigeria, on a le Cameroun et évidement le Tchad. Donc ces états on conjugues leurs forces, parce qu'aujourd'hui, si le Tchad décide intervenir, c'est par mesure de mitigation, parce que c'est un phénomène que ce ramifie. Donc le gouvernement tchadien a décidé d'intervenir à l'autre cotes des forces Nigériennes pour construire cette secte.

03m10s Donc, la motivation première est déjà connue, les refugies sont venu à cote du Tchad. Le Tchad a ouvert ses portes, il y'a eu des refugies, il y'a eu des déplacés internes. Pourquoi les déplacés internes ? C'est vrai ce phénomène a fait une proposition, c'est-à-dire c'est une idéologie les gens atériens ce dedans. Donc, si on a des gens du Lac, on sait que c'est spécifique au Lac. Par exemple, l'angle Boko Haram se vise beaucoup plus il faut prendre Choukoutalia, qui faut frontière à Nigeria et du côté quand tu reviens du côté nigérian il y'a Kaika, Kindjeria, qui sont dans la zone insulaire. Mais quand on dit que Boko Haram s'est transposé ici, c'est vrai il y'a des Tchadiens. Ça, la cause principale c'est la pauvreté. Parce que

les gens vivent dans des conditions de que : ils n'ont pas accès a aux centres de santé, ils n'ont pas accès a beaucoup d'infrastructure. Donc tout cette situation pousse les gens, les jeunes, à se rallier à Boko Haram. Pourquoi, parce que Boko Haram ils proposent : On vous arme, on vous invite l'argent. Dans le moment que les jeunes sont défavorisés, ils peuvent aller. Donc quand on prend le contexte du Lac, c'est beaucoup plus c'est-à-dire que le Tchad a une certaine maitrise sur le plan sécuritaire par rapport à Boko Haram, mais également il y'a des complicités internes. Donc, comment j'avais souligné avant : aujourd'hui, si tu n'as pas les moyens nécessaires, tu veux labourer, tu n'as pas de la monnaie pour aller à l'hôpital, pour les besoins primaires, ça pousse les gens à opter pour le radicalisme. Donc cela, quand on le propose des espèces trébuchant – je parle de l'argent, des trucs que des armes – et alors, on vous dit : Allez-y vous tuez.

06m22s Mais on va centraliser notre entretien beaucoup plus sur le Lac. Comme je l'ai dit : Il y a les déplacés internes. Quand j'étais au Lac, c'est vrai, il y'a les membres de Boko Haram qui sont rendus. Ce qu'on appelle « les rendus », parce que déjà quand les gens sont en bouse, ils n'ont pas mangé, ils n'ont rien. Y le gouvernement a engagé une bonne politique : Vous pouvez rentrer, il ne faut pas s'inquiéter, on va vous réinsérer dans la vie sociale. Cela il est bien, mais ont peur de se rendre, parce qu'il n'avait pas des garanties. Ils avaient peur pourquoi ? Se disent : « Mais quand on rend, on serait tué ». Bon, le gouvernement a laissé cet approche-là, pour beaucoup plus prôner la mette en tu : « Dites-nous ce qui ne va pas et nous allons vous aider, vous serait pardonné ». Alors ce que passe à cote tchadienne.

07m45s Les gens qui sont venus du Nigeria parce que si je parle de Gougouba, le Choukoutalia, ce sont les localités qui jouxtent le Nigeria. Donc ils viennent, ils enlèvent les gens, ils les arment, ils les font des adeptes. Donc ils disent au gens « il faut tue », raison laquelle pour ils partent. Mais ce phénomène, comme j'ai soulevé encore, c'est la pauvreté qui pousse les gens à se donner à cette pratique. Parce qu'aujourd'hui, quand on prend la plupart des rendus, les PSR – les personnes rendues – on trouve que ce sont beaucoup plus des gens de l'alentour du Lac même : Les Bourdouma, les Kousor, beaucoup plus qui sont dedans. Quand on les pose des questions, ils disent « no ». Ils vivent dans les conditions de vie trop précaires, raison pour laquelle ils sont parti et quand ils sont partis on a les dit que on doive les pousser à l'extrémisme de long.

Intervieweur :
09m20s Donc, tu as mentionné que ce sont spécifiquement des gens qui vivent sur les iles, n'est pas ?

Interviewé :
09m25s Il y a eu qui vive sur la terre firme. Parce qu'il y a la zone insulaire et il y a la terre firme. Mais il faut comprendre que la plupart des attaques – je parle du mode opératoire – il faut noter qu'au début ces gens, le Boko Haram surtout, du côté tchadien il y beaucoup plus du désert et ceux-là, ils cherchent le foret. A cote de Nigeria il y a le foret de là où ils viennent, par contre a cote du Chad il y a du désert. Et eux ils n'ont pas vraiment, surtout dans le côté tchadien, ils ne sont pas une grande mobilité. Donc ils guettent, ils attendent à des heures de la nuit pour s'introduire a des villages. Ils connaissent des dégâts et rapidement ils partent. Donc, c'est spontané.

Intervieweur :
10m40s Donc, il y a beaucoup de mouvement d'un côté a l'autre de la frontière. J'ai une question : tu as dit que les villes frontalières c'étaient facilement touchées par Boko Haram et facilement pour la radicalisation à cause de la pauvreté. Est-ce que tu as une idée, quand ça a commencé ?

Interviewé :
11m10s Du côté tchadienne, c'était à 2015. Il y a eu les attaques à N'Djamena et même à Baga Sola.

Intervieweur :
11m27s Donc tu dis que la radicalisation n'a pas commencé avant des attaques, mais basiquement a même temps ?

Interviewé :
11m34s La radicalisation, parce que j'ai bien précisé, de cela, vante de cette date. Mais c'est beaucoup plus du côté nigérian. Parce qu'il y a des gens qui attende ce moment, il y a de gens qui attend demain et des gens qui ont pris la force. Mais comme j'ai soulevé, ce qui a poussé maintenant, ce qui a poussé Boko Haram, c'est amener les frappes sur le terrain tchadienne, tout spécifiquement dans le Lac. Il faut reconnaître qu'il y a souvent des

situations qui se produisent ; beaucoup plus je parle sur les zones insulaires que la terre firme. Je croix récemment tu as vu cela, atour de Bol. Si tu prends la zone de Melea, c'est pourquoi on a dit ces gens on a mode opératoire parce qu'ils savent que quand ils arrivent sur la terre firme ici, c'est difficile. Ils mènent les attaques et ils disparaissent. Mais à l'autre cote du Lac, quand je parle de la mode opératoire, de fois ils viennent, ils élèvent les entrepôts. Et pourquoi ils élèvent les entrepôts ? Et parfois, quand ils viennent, ils viennent et ils pillent les magasins pour ramasser les vivres, tous là. Et de fois, ils enlèvent les femmes, les enfants, les hommes. Les femmes, ils les utilisent aux effets sexuels. Les hommes, on les enrôle avec force.

Intervieweur :
13m49s D'accord. Merci beaucoup. J'ai un peu plus des questions sur l'histoire et je croix plus tard on va entrer dans les impacts sur la population même. Première, pour l'histoire : Comme géographiquement la région du Lac est à cote du Tchad et justement a cote du Nigeria de la zone originaire de Boko Haram, j'ai lu beaucoup de la littérature sur le rôle du Lac Tchad, comme il y'a des mouvements transfrontaliers, trafique d'armes et tout ça. Quelle était, de ton point de vue, pas le rôle du Lac, mais comment Boko Haram a profité de cette frontière et du trafique avant qu'ils soient même entré au Tchad ?

Interviewé :
14m54s Sur cette table, on parle sur la porosité de la frontière, parce que regarde : Le Lac Tchad est vaste, puis que c'est une organisation qui n'a pas dicté ces méthodes, ce qu'il veut faire. Donc, eux ils viennent et leur tactique c'est surprendre toujours. Ils vous laissent le temps, vous oubliez, ils viennent, ils frappent, ils repartent. Donc, c'est une zone difficile de contrôler. Comme j'ai dit, ce sont des gens qui vivent beaucoup plus dans le foret. Mais dans le foret, eux ils maitrisent le foret. Ils connaissent les chemins par ou bouger à tout moment. Quand ils sont sur l'eau ou la terre firme, les gens peuvent avoir un regard là. Ils peuvent voir. Les gars quittent le matin à bord des pirogues motorisés, ils viennent, ils vous surprennent, ils commentant des extractions, et quand ils repartent – ils sont déjà dans le foret. Tu vois ?

16m22s Il y'a eu un problème de maitrise, de contrôle de cette portion. Parce que si les gens sont sur la terre firme, on n'aurait plus le

problème de Boko Haram, parce qu'ils changent leur mode opératoire à tout moment ils changent. Comme aujourd'hui tu veux aller d'ici au PAM. Il y'a plusieurs accès pour aller là-bas, pour repartir. Donc aujourd'hui tu sais que sur cet axe on peut te localiser. L'autre parti va penser te trouver là, jusqu'à une fois que tu as changé ton itinéraire. Pour ça on dit le mode opératoire change. Mais à l'autre cote du Lac, comme j'ai souligné, j'ai parlé de la pauvreté. Quand les gens entrent dans un village, ils viennent, ils prennent les tetes de bœufs ou bien de chameaux, ils cassent les magasins, ils prennent et ramassent les vivres et ils repartent, parce qu'ils sont en difficulté également. Leur ravitaillement a débilité le moment ou la coalition a commencé à opère dans la zone du Lac, ça veut dire le Tchad, le Nigeria, le Niger et le Cameroun. Leur ravitaillement certainement ça passe par la route. Donc ils le coupe comme nous sommes à plain foret. Comment ils vont faire pour se nourrir. Pour ça raison, ils infiltrent les zones. Ils viennent rapidement, ils commettent des infiltrations et puis ils attendent quand vous ne parlez pas d'eux, ça veut dire ils laissent un temps d'accalmit. Mais quand ils vous mettent en confiance, après ils viennent et ils frappent. Quand vous réveillez, ils partent, ils laissent le temps passer. Après ils viennent, ils vous frappent.

18m57s Donc il faut souligner que ce sont des gens qui également ont étudié les failles sécuritaires, raison laquelle pourquoi parfois il y'a des attaques dans l'armée et tout et tout. Ils étudient les failles : Quand vous dites « rien se passe », à ce moment ils viennent frapper – quand vous étés en alerte, ils ne font rien. Ils jouent sur la morale.

Intervieweur :
19m33s Merci, je voudrais revenir un peu sur la question des Tchadiennes. Comme il y'a ce mouvement transfrontalier, et comme Maiduguri est un centre culturelle même religieux, qui a d'influence même au Tchad, j'ai lu un rapport sur les enfants qui partent du Tchad pour des études religieuses à Maiduguri et qu'une centaine sont revenues vers 2012 au Lac du Tchad et la peur était que beaucoup étaient radicalises. Donc, ma question est plus générale : Le rôle de ces Tchadiennes pour le recrutement du Boko Haram.

Interviewé :
20m41s je vais clarifier une chose : Ce n'est pas dit que ces enfants sont partis dans le but de s'allier à Boko Haram. Ils sont allés pour étudier le

Coran, n'est pas ? Mais une fois là-bas, ils sont surpris. Mais, ils sont des enfants. On leur inocule des idées radicales, c'est trop difficile de transformer la mentalité d'un enfant. Donc, si les parents à ces enfants savaient d'avance que ces gens, ils font ça, ils font ça, ils avaient enlevé leurs enfants, ils n'ont pas envoyé. Raison pour laquelle, ce gens quand ils mènent des attaques, ils font des incursions, ils enlèvent les enfants, les femmes, les hommes.

Intervieweur :
21m58s Donc maintenant je voudrais bien bouge à temps. Quand exactement à Boko Haram a commencé être dans le Lac, mais pas nécessairement avec ces opérations militaires. J'ai lu beaucoup que – nous savons que les grandes attaques, c'était 2015, la première attaque au final de 2014 – mais beaucoup de littérature parle sur Boko Haram, c'était déjà avant de 2015 dans le Lac, mais ils ne sont pas opérés là-bas de forme militaire, c'était plus une forme de retraite de Nigeria pour être dans les iles sans que l'armée nigérienne les peut toucher. Donc je voudrais bien savoir quelles étaient les facteurs qui là-bas ont poussé Boko Haram au Lac, mais aussi les facteurs qui étaient attractive pour le faire venir au Lac.

Interviewé :
23m20s Raison pour laquelle j'avais dit déjà. J'ai parlé sur le phénomène de la pauvreté. Quand les gens ils vivent dans les conditions précaires et à l'autre cote on les dit « ok, venez à notre mouvement et vous aurez tel somme, vous aurez ceci, vous aurez cela ». Mais dans le moment que tu vives dans une condition précaire, tu manques des moyens – pour toi, c'est un bordel. Mais déjà, si tu ne connais pas vraiment l'idéologie, tu ne la connais à l'avance. Donc, si tu viennes la, d'abord on te faire voir la vraie face des choses. Mais quand tu es déjà là-dedans, tu ne peux plus reculer. On te transforme la tête et donc tu es déjà dedans tu ne peux plus reculer. Parce que quand tu recule, tu as déjà perte ton du. Raison pour laquelle, ce qui étaient parti au là-bas, c'est parce qu'ils ne connaissent pas. Et il y'on a qui sont partis parce qu'ils ont ce gout, cette idée du radicalisme. C'est le suivisme, parce que d'abord le phénomène de Boko Haram tombe sur la jeunesse. Donc celui-là ils sont allés.

25m10s Mais quand on s'institue beaucoup plus au côté nigérian, je dis si aujourd'hui, les gens – il y'a des refugies et il y'a des déplacés, le

facteur c'est l'intervention du Tchad sur le plan militaire a cote du Nigeria, qui a poussé ces gens-là à frapper également au Tchad.

Intervieweur :
25m45s Ils n'y'a pas eu avant que le Tchad avait intervenu ?

Interviewé :
25m51s Il y'a eu, il y'a eu. Beaucoup plus du couté nigérienne. Mais comme tu as eu des interventions du Tchad, comme ça on va semer le terrorisme au Tchad. Donc ici du coté tchadienne, comme j'ai dit, c'est été des enlèvements. C'est pourquoi j'ai dit que Boko Haram a des modes opératoires qui changent de temps en temps. Quand tu prends Gougoua par exemple – je suis allé les voir, j'étais là-bas, j'ai vu – donc, tu vois, ils viennent, ils égorgent les hommes. Pour les hommes, ils les égorgent, parce que travailler la mentalité d'un homme de la nature, c'est difficile. Il est plus facile de la mentalité d'un enfant. Tu vois. Donc, raison pour laquelle les enfants, les jeunes garçons, ils ne les tus pas. Ils les travaillent. Ils viennent difficile pour ceux-là de revenir, mais il y'a eu qui sont revenus y ont tué mêmes leurs propres parents. Donc, c'est quand on travaille la mentalité d'un enfant on peut tout facilement l'utiliser à l'autre, a s'a aiguise.

27m19s Mais déjà dans le contexte du Lac, quand tu vois beaucoup plus – c'est vrai, quand je parle des réfugiés – ceux-là, ils subissent les atrocités chez eux là-bas. Ils sont futs ici. Mais dans les zones à côté tchadienne il y'a également des atrocités. Mais comme j'ai dit, à côté tchadienne les gens sont beaucoup plus sur la terre firme et sur la terre firme Boko Haram a des moyens limités, des moyens de frappe, parce que tu ne peux pas traverser 50 km sur le dessert pour venir frapper. Parce que tu vas te faire prendre. Et ils, ceux qui frappe beaucoup plus du côté tchadien, ils n'ont pas les moyens requis comme eux qui sont au Nigeria, c'est-à-dire les véhicules, les motos. Mais ceux d'ici, ce sont des gens qui sont à d'où le cheval

Intervieweur :
28m29s Tu as dit que ce sont plus tôt les communautés frontalières qui étaient touchées par Boko Haram avec des attaques mais aussi avec la radicalisation, n'est pas ?

Interviewé :

28m45s Déjà il y'a un travail qui est en train d'être fait. Le gens – c'est vrai, l'état, les ONG, les institutions internationaux – pourquoi la communauté internationale intervienne ? C'est pour chercher améliorer la situation parce que déjà, quand on laisse trainer cet extrémisme violente, cette radicalisation, ça continue, ça reste. Parce qu'aujourd'hui, quand on prend par exemple les jeunes localises au lac, quand on veut les créer des activités génératrices de revenu par exemple.

29m37s On sait que le lac Chad est une zone agricole. Ils ont de l'agriculture. Crier des hommes et pus les organiser les jeunes en groupement, ils trouvent un petit chose, ceux qui veulent opter pour cette activité, soit dans le domaine de la maisonnerie, dans le domaine de maçonnerie et ci de suit c'est ça l'approche pour parler à cela. Mais quand il n'y a pas d'approche, quand il n'y a pas vraiment des trucs spécifiques – no ! La radicalisation va toujours continuer, parce que plus, si la personne vive dans la pauvreté, la personne n'arrive pas à se nourrir.

Intervieweur :

30m26s Comme tu as dit, de toute façon, ce que Boko Haram a fait aussi comme stratégie, c'est frapper enlever les entrepôts, enlever les bétails, enlever les aliments.

Interviewé :

30m44s Je parle du mode opératoire. Mais quand j'ai te dit que le mode opératoire change – quand tu prends par exemple en 2015, ils viennent, ils tuent, ils brulent les maisons. Mais ils se sont rendu compte à la suite ils changent. Ce sont des techniques qui faire tous les moments les updates. Tu vois ? Donc, quand j'ai te dit que ceux qui opèrent du côté tchadien sont beaucoup plus des Tchadiens. Donc ceux-là. Mais quand les sources de ravitaillement, déplacement, sont coupées – ils vont faire quoi ?

31m36s Ils sont peur de se rendre, parce que quand ils rendent ils vont dire « bon, tu as tué ». Tu vois ? Donc il faut toujours rester dans son cachou. Tu vois un peu ? Donc, il faut toujours rester dans le cachou, mais les gens ont besoin de vivre et pour vivre – le moment quand eux, ils sont rejetés par la famille, la société. Parce que dans les villages les gens qui partent, des gens Boko Haram, ils sont connus de leurs parents. Parce que

ceux-là, ils peuvent venir à tous moments venir tuer les-le. Donc, ils sont rejetés.

32m14s Mais ils vont faire comment pour manger ? C'est venir à voler les tetes des bœufs, de bétail, casser les magasins, ramasser les vivres – voilà, bruler les maisons et repartir. Soit d'enlever de fois les femmes, parce que tu vois, les gens qui sont là, ils veulent à satisfaire leurs désirs sexuels également.

Intervieweur :
32m48s Une question : Combien de contrôle est-ce que Boko Haram a – ou avait eu – vraiment sur le territoire dans le lac ?

Interviewé :
33m02s Le contrôle du côté tchadien ? Le gouvernement tchadien, surtout l'armée, a un net contrôle sur Boko Haram du côté tchadien. Mais quand j'ai te dit qu'il y a des attaques, ce sont des trucs spontanés, ils soulèvent qu'ils viennent à tout moment. Il faut reconnaitre que sous ce que passe avec Boko Haram, le Tchad a ne certaine maitrise. Il a une certaine maitrise de cette situation.

Intervieweur :
33m54s D'accord. Merci beaucoup. En termes de l'idéologie : Nous avons parlé qu'il a eu une certaine radicalisation – quelle était l'impact de cette radicalisation sur le comportement des personnes ? Par exemple, dans une village frontalière Boko Haram a un certain impact, pas à travers d'une attaque, mais tu as parlé sur l'infiltration – donc il y a l'infiltration, il y a certains messages, une certaine radicalisation. Quelle est l'impact sur le comportement de la population ?

Interviewé :
35m20s No, il faut noter que ce gens se base du coté tchadienne de Boko Haram. Et si je dis qu'ils se base, ici on ne parle pas trop de la radicalisation. La radicalisation c'est beaucoup plus au Nigeria. Ici, on ne parle pas de la radicalisation. Parce-que le gens qui sont enroulés, ils ne connaissent pas au tour de peu. C'est plus facile travailler d'une mentalité d'un enfant que travailler de la mentalité d'un adulte. Travailler de la mentalité d'un enfant c'est plus facile. Si tu dis à un enfant : Fait ça, prend cette arme, tire là-bas.

L'enfant le fait à l'instant, mais toi, tu es un adulte. Et quand je parle de la pauvreté, les gens propose des trucs. Aujourd'hui, ils vont te proposer, on te donne de l'argent, on te donne des trucs, et en contrepartie, tu nous pousse des informations sur le mouvement des militaires. Ça prend beaucoup plus à l'armé qu'a la population. Mais pour se faire remarquer, il faut frapper à une communauté. Pour frapper, il y a – l'armé va venir et quand l'armé vienne, ils savent comment s'arranger.

Intervieweur :
37m34s D'accord, très intéressant. Deux dernières questions : Première, on a déjà dit que Boko Haram contrôle du territoire dans la zone du Lac.

Interviewé :
38m05s Ils ne contrôle pas.

Intervieweur :
38m08s Donc, comment est-ce ce groupe réussite avoir son matériel, son stock, dans cette zone.

Interviewé :
38m25s Moi, je reste dans le contexte tchadien, parce que ce que se face à Nigeria, je ne connais pas comment Boko Haram se ravitaille. Qui fournit la logistique, je ne connais pas. Mais quand on dit ici, le gouvernement tchadien a une certaine maitrise sur la situation. Mais les attaques sont des trucs spontanés. Ce ne sont pas forcément des gens qui sont venue du Nigeria ; no, ce sont des gens de la localité. Les PSR, ce sont des gens de la localité. Mais quand je dis les personnes-là, les rendues pour exemple, quand tu les vois, ces tous des tagués, des gens de la zone insulée. Pour te dire, ils ne sont pas allés eux-mêmes, ils sont étés enlevées de force. Et certains, à cause de la pauvreté, ils sont partis. On te donne ci on te donne ça, et tu viennes. Il y a tous ces aspects-là, qu'il faut prendre en compte.

Intervieweur :
398m51s Dernière question : Maintenant, il y a les déplacées, les refugiées, et toute une situation d'insécurité et ça, cette une situation des plusieurs années. Qu'est-ce que tu penses va être l'impact en long-terme sur la

situation de la population visant son comportement d'une communauté a l'autre.

Interviewé :
40m26s Il faut ressortir la résilience de la population. Quand on soulève les gens, le coté pauvreté : Quand les gens sont là, ils n'ont pas accès au soin, de quoi vivre, ils n'ont pas d'emploi – c'est tous des facteurs qui poussent des gens à être successibles. Mais dans le cadre du Lac, ça ne serve rien de bloquer des sommes astronomiques sans des mesures d'accompagnement. Nous, on ne sait pas comment ce type de chose sont gérés, parce-que la, c'est un lobby. Si aujourd'hui, tu viennes et tu disperses de l'argent, mais s'il n'y a pas des mesures concrètes pour stimuler et puis peut-être prévenir éventuellement ce gens de situation, il n'y a pas une approche ave la communauté locale. Ce n'est pas sûr venir et dire : On a tel et tel problème. Mais peut-être, construire des écoles, des centres de santé et organiser des gens en coopératives. Au Lac, c'est une population qui vive de la pêche, pourquoi pas organiser des gens en coopératives. On vous donner les matériaux, on vous enseigne comment les garder, c'est tous ces aspects. Il faut voir les choses objectivement.

42m57s END

4 The Effects of Seasonal Drought on the Use of Coping Strategies: Evidence from Chad

By Robert Paul Bachofer

Abstract

To show the effects of seasonal drought on the use of coping strategies by affected populations in Chad, this paper exploits the quasi-random exposure to drought at the country's sous-prefeture level between 2016 and 2020. In line with descriptive statistics from extant literature, one would assume that households react to drought with a plethora of coping strategies. Defying expectations, however, I find that an increase in drought exposure leads to a statistically significant treatment effect only regarding a small set of coping strategies: a 7.1 percentage point increase of households selling non-productive assets and a 7.6 percentage point increase of using their savings. Underpinned by additional estimations supporting a causal interpretation, these results suggest that affected households react to drought by engaging coping strategies related to financial resources, but no other coping strategies. This finding has implications for researchers relying on descriptive statistics and practitioners designing projects aiming to minimize the negative effects of drought on households.

Keywords: Chad; food security; coping strategies; drought; two-way fixed effects; FE weights.

Working paper: September 2022

4.1. Introduction

After decades of progress in reducing food insecurity, hunger is on the rise. Up to 811 million people face hunger, a rise of up to 161 million since 2019. Sub-Sahara Africa in particular is home to over 264 million hungry people, 75 million of which live in West Africa. While hunger can be linked to various factors, climate events are one of the main drivers of food scarcity across many contexts (FAO et al. 2021). When faced with such climate events, households naturally adapt their behavior to protect their members from hunger. Extant literature suggests a vast swath of adaptation mechanisms, which are classified by the World Bank (2001) along two axes: the level of the implementation entity (i.e., individual, household, community, market, or public level), and the type of strategy (i.e., risk reduction, risk mitigation, insurance, and coping with shocks). Poor households are especially vulnerable to covariate shocks, while these shocks might in turn also drive poverty (Günther and Harttgen 2009).

Chad is one of the poorest countries in the world. Almost one third of its population lives below the poverty line of USD 1.90 in 2011 purchasing parity prices (World Bank 2022), 31.7 percent of Chadians suffer from undernourishment (FAO et al. 2021), and an estimated 1.7 million Chadian children face acute malnutrition (IPC 2021), with indicators of acute hunger and malnutrition peaking during the annual lean season. In this context, one would expect that households engage in a plethora of coping strategies when faced with shocks to their livelihoods. Indeed, as the next section shows, extant literature on coping strategies in Chad demonstrates that the use of a wide variety of coping strategies is prevalent among drought-affected populations. However, to my knowledge, no study on coping strategies in Chad has conducted a comparative analysis between drought-affected and drought-unaffected populations. The present analysis aims at closing this gap.

Methodologically, it adds to the literature by leveraging a quasi-experimental setup for a two-way fixed-effects estimator and it applies a number of econometric specifications to test for robustness to treatment effect heterogeneity and placebo effects. The key finding of this paper is that researchers, and humanitarian and development practitioners should be careful when relying on descriptive statistics to inform project design that aims at breaking the causal links between drought and coping strategies, as such statistics might suggest links that are confound by unobservable or omitted factors.

4.2. Background

Drought is a natural hazard that West Africa has long lived with. Evidence of droughts goes as far back as the 17th century (Tarhule and Woo 1997), suggesting that they are driven by natural causes, though climate change might have aggravated their frequency and intensity (Hulme 2001). The impacts of drought in the region are mostly framed in the context of food production and consequently how affected populations respond to drought is mostly studied in the context of agricultural responses, with diversification of agricultural production and pastoralism being the most-reported adaptation strategy in extant literature (Gautier, Denis, and Locatelli 2016).

In Chad, drought is a seasonal phenomenon due to the Inter-Tropical Convergence Zone's (ITCZ) north-south shifts, defining the country's dry and rainy seasons and thereby agricultural and pastoral cycles. Most importantly for Chadians, it delimits the yearly recurrent lean season (June-September), when households slowly run out of food stocks from the previous harvest. While these events are recurrent at the macro level, at the micro level – such as villages and small administrative areas – unreliable rainfall patterns between years can produce largely different agricultural outcomes (van der Geest and Dietz 2004). These patterns further interact with the river system of the Lake Chad basin, which is defined in Chad by two permanent rivers, the Chari and Logone, and several seasonal rivers. These rivers feed either into Lake Chad itself or into minor other lakes; similarly, *wadis*, depressions that might fill with water during the rainy season, can form reservoirs and seasonal flows, and thereby impact water availability both downstream and over the year (FAO 1997).

All flows have in common that their upstream water volume depends on downstream rains and thus on their inter-annual fluctuations. With water availability depending on complex factors and varying significantly between years on the local level, household food security is largely reliant on it. The importance of water is evidenced by over 95 percent of farmers surveyed in Chad perceiving precipitation decreasing over time as their greatest challenge (Sanoussi et al. 2015), though it should be noted that a large share of determinants of actual crop production remains unexplained (Nilsson et al. 2020). Nevertheless, the food security outcomes of failing rains are all too clear: In 2020 alone, over 1 million people in Chad – out of a total population of 16 million – were estimated to be in need of humanitarian food assistance during the lean season (SISAAP 2020).

When faced with high variations in water availability, failing harvests, diminishing stocks, and ultimately the prospect of hunger, households implement a variety of cooing strategies to protect their food consumption. Shocks have been shown to have a number of potential impacts linked to coping strategies, including child school attendance and attainment, and changes in household structure, household labor supply, fertility, savings, borrowings, investments, and consumption. In developing countries, coping strategies are likely to be of particular importance, as other safety nets are dearly lacking (Skoufias 2003).

Previous studies on Chad have found that these coping strategies include pastoralists in Kanem employing seasonal migration, diversification of economic activities, and feeding crop residues to livestock to cope with drought impacts (Abraham, Mohamed-Brahmi, and Ngoundo 2019); farmers relying on conservation management of soil, water, and fertilizer (Sanoussi et al. 2015); or households substituting herds of grazer animals, such as cattle and camels, with herds of browser animals, such as sheep and goats (Hutchinson et al. 1992). As much of this literature finds that a large percentage of their study group uses a great variety of coping strategies, one would expect that drought pushes households to implement virtually every coping strategy available to them, and to a large extend.

4.3 Data and methods

The primary data source used in this analysis is the 2016-2020 National Food Security Survey (the Enquête nationale sur la Sécurité alimentaire des ménages ruraux, ENSA)[11], which provides household-level information on ten livelihood-based coping strategies and self-assessed drought exposure, as well as data on the exposure to other shocks, on economic activities, assets, and sociodemographic factors. Basing its sampling frame on the 2009 national census, the sample, which is collected through a two-stage cluster approach, is representative for rural areas on the national and first administrative level (23 regions). Data collection takes place every year between October and December, capturing thus the post-harvest situation.

[11] The ENSA data is co-owned by the Système d'Information sur la Sécurité Alimentaire et d'Alerte Précoce du Tchad (SISAAP) and the United Nations World Food Programme (WFP).

Unfortunately, this study cannot use the 2018 ENSA wave, as the shocks module was not collected.

Complementing the primary data source, I use the Armed Conflict Location and Event Data (ACLED) for Africa[12], filtered for Chad and the timeframe 2015-2020 to include conflict data in the twelve months prior to the ENSA data collection. As ACLED data relies on reports that are publicly available (Raleigh et al. 2010), measurement errors are possible, as low-level community conflict in Chad's sparsely populated regions remain underreported, while media attention is focused on the Lac region, where Boko Haram operates. These sets are merged through georeferential information. Because the ENSA set includes georeferential data only for its 2020 wave, I match admin level 3 (village), admin level 2 (sous-prefeture) and admin level 1 (region) names across waves, allowing to assign longitude and latitude to 95 percent of the households from the original sample (see Appendix 1). To capture the effects of drought as a covariate shock affecting entire communities, I aggregate the household dataset on the admin 2-level by calculating the weighted average for each wave-sous-prefeture group (255 sous-prefetures across 5 waves, though data was not collected for all sous-prefetures in all waves); as the dataset does not provide weights for the 2019 wave, I weight those observations with 1. The resulting dataset contains 1,096 observations with 238 missing values for the drought variable and an average of 43.9 households per sous-prefeture.

4.3.1 Dependent variables

The outcome variables for this study are the five livelihood coping strategies in the total sample, which were used most within the last 30 days before data collection: the percentage of households selling non-productive assets/goods, purchasing food/non-food on credit, spending savings, selling more animals (non-productive) than usual, and taking at least one of child out of school, all due to lack of food. While the ENSA assesses these coping strategies on the household level, other studies on coping strategies point out that households are embedded in their wider community socio-economic systems, potentially mitigating the impacts of covariate shocks on their constituents, though these systems might also become ineffective (Skoufias

[12] ACLED data is publicly available through https://www.acleddata.com/.

2003) and thus I consider the sous-prefeture aggregates of the all variables more appropriate for this analysis.

4.3.2 Independent variable

As part of a set of seven covariate shocks reported in the ENSA, drought affecting households in the 6 months prior to the data collection is my main variable of interest. On the sous-prefeture level, this is the headcount ratio of drought-affected households measured on a scale from 0 to 1. The self-reported data permits granularity down to the household level, which other precipitation data would not permit. This method thereby provides a safeguard against disqualifying households as being affected by drought and it allows to exploit the quasi-randomness of water availability, not only precipitation, on a microlevel of 255 sous-prefetures. I consider the granularity an important added value of this paper, while recognizing that satellite precipitation data would be more objective.

4.3.3 Other relevant variables

To mitigate omitted variable bias, all regressions of this analysis control for unit (sous-prefeture) and time (wave) fixed effects capturing unobserved regional- and time-invariant factors. I further control for characteristics of the head of household in terms of average age, alphabetization prevalence (scaled 0 to 1 in a continuous variable) and prevalence of female heads of households (scaled 0 to 1 in a continuous variable). I also control for socio-economic factors by including the percentages of households practicing pastoralism and agriculture, and their average size and wealth measured through an index aggregating household assets (see Appendix 2). Other covariate shocks potentially being transmission channels between drought and coping strategies are accounted for by including the percentage of households having reported exposure to these shocks in the 30 days prior to being interviewed. These shocks are domesticated animals devastating crops, as drought drives them to search for food by breaking into enclosed and cultivated land; wildfires, which thrive in drought conditions; domesticated animals being affected by disease, as lack of fodder weakens their immune

system; and silting, as wind can swap dry ground easier onto arable land. Finally, I control for the average number of fatalities of armed conflict within a 20 km radius of each household using the ACLED data.

4.3.4 Identification strategy

This analysis aims to quantify the causal relationship between seasonal drought exposure and households' engagement in coping strategies. Following the literature on unreliable rainfall and water availability patterns, as well as related studies on climate impacts (Oskorouchi and Sousa-Poza 2021; Dinkelman 2015; Kumar, Molitor, and Vollmer 2016), I assume that the yearly drought events in Chad are quasi-random, and that the set-up provides for a natural experiment. Assessing whether the employed two-way fixed-effects approach supports a causal interpretation of its results, I test for bias due to negative weights of observations (Imai and Kim 2021) by estimating measures of the robustness to heterogeneous treatment effects of the two-way fixed-effects regressions following the methodology proposed by de Chaisemartin and d'Haultfœuille (2020). Further robustness checks are conducted by adding an alternative explanatory variable, by excluding Chad's water-rich regions in the southern and Lac regions, and by regressing the variables of interest on a placebo outcome.

Controlling for potential confounders of the relation between drought and coping strategies, I estimate the following equation:

$$CS_{ijt} = \alpha + \beta_1 drought_{ijt} + \beta_2 I_{ijt} + \beta_3 H_{ijt} + \beta_4 S_{it} + \beta_5 W_{ij} + \varepsilon_{ijt} \quad (1)$$

Where for each household i in sous-prefeture j during wave t, CS are the coping strategies used by households in the 30 days before being interviewed, $drought$ denotes drought exposure, I is a vector of individual characteristics of the head of household, H is a vector of broader household characteristics, and S is a vector of sous-prefecture-level controls, notably covariate shocks. Wave dummies are denoted by W with 2016 as the reference, ε captures the error term, and β_1 shows the estimated impact of drought exposure on the prevalence of coping strategies. Standard errors are clustered at the sous-prefeture level.

While ε in Equation 1 captures unobserved variables both on the household and the sous-prefeture level, the covariate shock $drought$ is more likely to be correlated with the ones on the latter level, which I account for by employing a model with fixed effects on precisely this level, thus eliminating its unobserved time-invariant variables. This could lead to endogeneity if $drought$ were also to be correlated with unobserved time-variant variables, which is a distinct possibility due to the self-reported nature of the variable. However, similar studies consider this only a minor problem (Nguyen et al. 2020; Arouri, Nguyen, and Youssef 2015), while others point out the consistency and correlation of self-reported drought with meteorological data (Hunter, Gray, and Edwards 2013). In this particular case, any such correlation should be minimized by the other control variables, by the contextual framework that there occurred no large-scale drought in Chad in the study period beyond the annually recurrent lean season, and the fact that $drought$, as it is a natural shock, can be assumed to be an exogenous variable. For the purpose of this analysis, I view the added granularity of household-specific indicator as an acceptable trade-off to what I consider a low risk of such endogeneity.

Furthermore, I argue that the quasi-experimental set up, due to randomness of rainfall and water availability patterns on the sous-prefeture level, enables the fixed-effects estimations to provide for a generalized difference-in-difference (DID) approach (Duflo, Glennerster, and Kremer 2007). This approach rest on the assumption that heterogenous treatment effects are small, i.e., when different groups (j, t) are exposed to an increase in $drought$, their individually estimated β_1 should all increase, an argument that is further developed and tested in Part 4.4.2. In Part 4.4.3 I also test the impact of restricting j to those regions of Chad most affected by the lean season on the estimates of Equation 1, and of adding the lead of the treatment variable, $f.drought$, to the equation to verify if households might employ coping strategies ex-ante the shock. In the same section I also report the estimates of regressing the model on $premature$, that is the percentage of households that harvested premature crops, to test whether the model picks up any significant correlation between $drought$ and this counterintuitive coping strategy.

4.4 Results

Table 4.1, Column 1, shows the overall summary statistics of the ENSA dataset. Columns 2 and 3 show the same statistics for those households not affected and affected by drought, respectively, and Column 4 reports estimates of the difference between those two groups, i.e., the first difference. Because of missing values, the sample sizes of Columns 2 and 3 do not necessarily add up to the sample sizes reported in Column 1. As this table shows, 10 percent of households in the total sample used selling non-productive assets as a coping strategy; however, the prevalence among the drought-affected is 3.5 percentage points higher than the prevalence among those not affected. Displaying a similar tendency, 30 percent of the total sample, as well as 37 percent of the sample not affected by drought, purchased food/non-food on credit in the 30 days before the data collection, yet among the drought-affected it was 38 percent, a difference of 15.3 percentage points. Twenty percent of the households in the total sample spent savings as a coping strategy, compared to 23 percent in the unaffected group and 26 percent in the affected group. Selling more animals (non-productive) than usual was used by 21 percent, 26 percent, and 28 percent of households, respectively. The coping strategy of taking children out of school shows a difference of 2.4 percentage points, having been used by 5 percent of drought-affected households compared to 2 percent among the non-affected and the total sample, each. Almost one out of three households declared having been affected by drought in the six months prior to being interviewed.

Forty-three percent of heads of households can read and write, with 3.2 percentage points less among the affected compared to the unaffected. Women make up 17 percent of heads of households, contributing 3.4 more percentage points among drought affected households, than unaffected ones. The average head of household is 42 years old, with similar average ages among all samples, and the same is true for the average household size, which is around 8 members. As expected in a rural survey, more than one in ten households practice agriculture across all samples. As indicated by a difference of -0.5 percentage points, drought-affected households are marginally poorer than their unaffected counterparts and as the overall sample. There is a considerable overlap between households affected by drought and those affected by conflict, as on average more than twice as many fatalities were registered in a 20km radius around a drought-affected household, than around an unaffected household.

Table 4.1: Descriptive statistics

	1 Total sample		2 Unaffected		3 Affected		4 Difference
	N	mean	N	mean	N	mean	
Sold non-productive assets	29867	0,10	10142	0,12	2378	0,16	0.0352***
Purchased food/non-food on credit	38378	0,30	13058	0,37	3379	0,38	0.0145
Spent savings	29995	0,20	9589	0,23	2372	0,26	0.0295***
Sold more animals (non-productive) than usual	31206	0,21	10542	0,26	2690	0,28	0.0224**
Took children out of school	27258	0,02	9983	0,02	2141	0,05	0.0235***
Affected by drought[a]	20132	0,29	16005	0,00	4127	1,00	1
Literate head of household	48150	0,43	16005	0,43	4127	0,40	-0.0322***
Age of head of household	48150	41,69	16005	42,31	4127	42,58	0.272
Female head of household	48150	0,17	16005	0,18	4127	0,21	0.0336***
Household size	48150	7,87	16005	8,04	4127	8,32	0.275***
Practices agriculture	48150	0,91	16005	0,93	4127	0,92	-0.00642
Wealth index[b]	48150	0,19	16005	0,18	4127	0,17	-0.00496***

CONT. NEXT PAGE

Shock: conflict	48150	2,15	16005	1,52	4127	3,71	2.189***
Shock: domesticated animals devastating crops[a]	20132	0,14	16005	0,20	4127	0,00	NA
Shock: wildfires[a]	20132	0,01	16005	0,01	4127	0,00	NA
Shock: domesticated animals being affected by disease[a]	20132	0,04	16005	0,06	4127	0,00	NA
Shock: silting[a]	20132	0,02	16005	0,02	4127	0,00	NA

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020). Due to missing values, sample sizes do not add up to the total across all lines.

[a] The ENSA questionnaire gives households only the ability to declare having been affected by one shock, thus 0 values for the group of the drought-affected.

[b] Due to the scarcity of households with any monetary income in the sample, economic differences between households are captured in a wealth index, calculated by the author (see Appendix B).

*** p<0.01, ** p<0.05, * p<0.1.

4.4.1 Effects of droughts on the use of coping strategies

In this section, I report the estimated effects of drought exposure during the 6 months before data collection on the sous-prefeture-level prevalence of households implementing coping strategies in the 30 days prior to the interview. Tables 4.2, 4.3 and 4.4 show the results of the two-way fixed-effects model, those of the model excluding the fixed effects but including all other controls, and of estimations without any control variables, respectively. Standard errors are clustered on the sous-prefeture level in all cases. An increase of one percentage point of drought exposure results in an increase of 7.1 percentage points of households selling non-productive assets, taking the estimates of the fixed-effects model. When excluding fixed effects, results indicate that drought exposure is associated with a 10 percentage points increase, while estimations without any controls yield an associated 16.5 percentage point increase (column 1 of Tables 4.2, 4.3, and 4.4). The effect of drought exposure on households spending their saving is estimated to result in a 7.6 percentage point increase and, when excluding the fixed effects, drought exposure is associated with a 14.4 percentage points increase. Exclusively regressing the drought variable on this outcome results in an estimated increase of 20 percentage points (column 3 of Tables 4.2, 4.3, and 4.4).

While these results confirm expectations on drought exposure affecting the prevalence of coping strategies used by households, I find no statistically significant effect of drought exposure on the prevalence of households purchasing food/non-food on credit, when estimating the fixed-effects model. However, drought exposure is associated with an increase of the prevalence of this coping strategy by 11.1 percentage points when excluding the fixed effects, and by 18.2 percentage points when excluding all control variables (column 2 of Tables 4.2, 4.3, and 4.4). Displaying a similar dynamic, the fixed-effects estimations do not find a statistically significant treatment effect on the treatment group (TOT) of drought on selling more animals (non-productive) than usual. However, when excluding the fixed effects, drought exposure is associated with a 10.9 percentage point increase of this coping strategy, and when no controls are included, this rises to 17.7 percentage points (column 4 of Tables 4.2, 4.3, and 4.4). Finally, drought exposure cannot be associated with households taking children out of school, neither under the fixed-effects model, nor when excluding the fixed effects, and achieves only some level of statistical significance when

not including any controls, being associated with a 6.6 percentage point increase (column 5 of Tables 4.2, 4.3, and 4.4).

Across all estimations, the more parsimonious OLS models, with and without controls, yield estimated effects much larger than the two-way fixed effects model. Likely, these results are the product of omitted variable bias; households might have a large variety of reasons to engage in coping strategies which are only captured in the fixed effects. Employing the lens of the two-way fixed effects model providing for a generalized DID, its estimates report the TOT, while the OLS models' estimates capture the average number of households engaging in coping strategies of both the treatment and the control group.

Table 4.2: Two-way fixed effects estimates

	1 Sold non-productive assets	2 Purchased food/non-food on credit	3 Spent savings	4 Sold more animals (non-productive) than usual	5 Took children out of school
Affected by drought	0.0706*	0.0126	0.0758*	0.0280	0.0361
	(2.35)	(0.36)	(2.19)	(0.85)	(1.53)
Constant	-0.136	0.870***	0.395*	0.146	-0.254*
	(-1.00)	(5.09)	(2.13)	(0.78)	(-2.37)
N	846	850	839	845	832

Notes:
Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
For readability, control variables are omitted from tables in-text and reported in Appendix C.
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.3: OLS estimates with controls

	1 sold non-productive assets	2 purchased food/non-food on credit	3 spent savings	4 sold more animals (non-productive) than usual	5 took children out of school
Affected by drought	0.104***	0.111**	0.144***	0.109***	0.0174
	(3.63)	(3.31)	(4.30)	(3.75)	(0.86)
Constant	0.0881	0.745***	0.302*	0.186	-0.0201
	(0.97)	(7.07)	(2.36)	(1.54)	(-0.32)
N	846	850	839	845	832

Notes:
Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
For readability, control variables are omitted from tables in-text and reported in Appendix C.
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.4: OLS estimates sans controls

	1 Sold non-productive assets	2 Purchased food/non-food on credit	3 Spent savings	4 Sold more animals (non-productive) than usual	5 Took children out of school
Affected by drought	0.165***	0.182***	0.200***	0.177***	0.0657**
	(5.55)	(5.22)	(5.95)	(5.93)	(2.83)
Constant	0.0715***	0.233***	0.136***	0.162***	0.0515***
	(10.63)	(22.17)	(16.10)	(20.13)	(9.94)
N	846	850	839	845	832

Notes:
Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
For readability, control variables are omitted from tables in-text and reported in Appendix C.
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

4.4.2 Robustness to heterogeneous treatment effects

As Imai and Kim (2021) point out, two-way fixed-effects estimations with multiple groups and periods differ from DIDs in their estimations being sums of average treatment effects (ATT) per time and unit grouping, and these sums being weighted. In turn, weights might be negative, leading to biased estimates where a fixed-effects estimate $\tilde{\beta}$ might have a different sign than its corresponding treatment effect $\tilde{\Delta}$ for any given time and unit grouping (j, t). Following the argument of Oliu-Barton et al. (2022), I first estimate the regressions outlined in Equation 1 without the wave dummies. Without wave effects capturing nation-wide trends, I assume that the model is underspecified, and that estimates obtained this way will be larger and with wider confidence intervals than those of Equation 1, meaning that the inclusion of wave fixed effects, if anything, leads to underestimating the drought effects on coping strategies. The results reported in Table 4.5 are consistent with these expectations, also yielding estimates larger than what I consider realistic drought effects, based on the differences of descriptive statistics reported in Table 1 and on approaches of other authors using two-way fixed-effects to estimate drought impacts (Akampumuza and Matsuda 2017).

Going beyond the above-cited argument, I regress the treatment variable on the wave dummies. If the direction of a specific wave effect would diverge from the others to a statistically significant extend, bias could arise from it. For example, if there were an overall positive trend of the wave effects because of them picking up the worsening effects of climate change, then it would assume no issue of treatment effect heterogeneity; if, however, one specific wave effect would diverge from this trend to a statistically significant extend, I would assume an issue of treatment effect heterogeneity. The estimates reported in Table 4.6 demonstrate that all but one wave effect have negative directions and are statistically significant, with the one having a positive direction not achieving such significance.

Furthermore, following de Chaisemartin and d'Haultfœuille (2020), I estimate the percentage of negative weights and the ratio of the fixed effects' drought coefficient of each coping strategy divided by the weights' standard deviation (Equation 2).

$$\underline{\sigma}_k = \hat{\beta}_1 / \sigma_k(P) \quad (2)$$

Where $\underline{\sigma}$ is the ratio of the k^{th} coping strategy, $\hat{\beta}_1$ is the drought coefficient estimated in Equation 1 and σ is the standard deviation of a vector of weights PW. If $\underline{\sigma}$ is large, then treatment effect heterogeneity would need to be large as well to permit any flip in sign between $\tilde{\beta}$ and $\tilde{\Delta}$. What is considered large for $\underline{\sigma}$ depends on whether the treatment effects of all time and unit groupings fall under a uniform or under a normal distribution and what can be considered an unrealistically large $\tilde{\beta}$. A priori, I consider that any $\tilde{\beta}$ larger than ten percent would be unrealistic, based on the descriptive statistics. As I do not know a priori under which distribution $\tilde{\beta}$ falls, I calculate both: For uniform distribution, I calculate whether $\tilde{\beta}$ falls in the 95 percent interval of $\underline{\sigma}$ (Equation 3) and for normal distribution, whether $\tilde{\beta}$ falls in the range of the 3rd root of $\underline{\sigma}$ (Equation 4).

$$\tilde{\beta}_k \geq 1.96\underline{\sigma_k} \qquad (3)$$

$$\tilde{\beta}_k \geq \sqrt{3}\,\underline{\sigma_k} \qquad (4)$$

While 21.4 percent of weights are negative, the measures calculated in Equations 3 and 4 above are larger than any expected treatment effect for all coping strategies at 22.4 percentage points, 12.3 percentage points, 23.5 percentage points, 11.9 percentage points, and 12.9 percentage points under the assumption of uniform distribution (25.4 percentage points, 13.9 percentage points, 26.6 percentage points, 13.5 percentage points, and 14.6 percentage points under the assumption of normal distribution), as reported in Table 4.7. Treatment effect heterogeneity is a minor issue when estimating drought impact on households taking children out of school, for buying food/non-food on credit, and for selling more animals (non-productive) than usual. It is of almost no concern for selling non-productive assets/goods and spending savings, considering that the cut-off points estimated are almost twice as large as the largest realistic $\tilde{\beta}$ that I assumed a priori. The fixed effects estimate for each $\hat{\beta}_1$ are reasonably close to treatment effects $\tilde{\Delta}$ that a DID methodology with staggered treatment would have yielded.

Table 4.5: Estimates excluding wave effects

	1 Sold non-productive assets	2 Purchased food/non-food on credit	3 Spent savings	4 Sold more animals (non-productive) than usual	5 Took children out of school
Affected by drought	0.101**	0.0733*	0.123**	0.0821*	0.0102
	(3.19)	(1.98)	(3.23)	(2.27)	(0.44)
Constant	-0.100	0.913***	0.461*	0.230	-0.239*
	(-0.73)	(5.43)	(2.48)	(1.20)	(-2.18)
N	846	850	839	845	832

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
For readability, control variables are omitted from tables in-text and reported in Appendix C.
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.6: Wave-effects and treatment variable

	1 Affected by drought
Wave = 2017 (ref. 2016)	0.00358 (0.13)
Wave = 2019 (ref. 2016)	-0.0816** (-2.91)
Wave 2020 (ref. 2016)	-0.142*** (-5.20)
Constant	0.257*** (12.98)
N	858

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.7: Measures of treatment heterogeneity

Uniform Measurements		Normal Measurements	
Negative LATES:	21%	Negative LATES:	21%
Sold non-productive assets	.2243731259855261	Sold non-productive assets	.2539020939858562
Purchased food/non-food on credit	.1230770185104471	Purchased food/non-food on credit	.1392747575454039
Spent savings	.2352487599914281	Spent savings	.2662090324188504
Sold more animals (non-productive) than usual	.1191879255406809	Sold more animals (non-productive) than usual	.1348738345543278
Took children out of school	.1290880768051009	Took children out of school	.1460769103494884

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).

4.4.3 Robustness to alternative samples, treatments, and outcomes

To test whether other shocks than drought could be the cause behind households using these coping strategies, I employ a three-pronged approach following Eggers, Tuñón, and Dafoe (2021) to provide for placebos. First, I assume that the effects might not actually have stemmed from the yearly lean season, but from shocks to Chad's relatively water-rich and agriculturally productive south and Lake Chad hinterland. If this were true, the estimated effect sizes should decrease when excluding these regions from the sample. To test this assumption, I re-run Equation 1, without Chad's southern and Lac regions. The effects estimated by this method, as reported in Table 4.8, are generally larger than estimates of Equation 1, supporting that it is in fact the lean season that is driving the original estimates, though these results should not be taken at face value due to the decreased sample size.

Secondly, I add the lead of drought to Equation 1 to provide for a placebo treatment, that is the treatment variable of the year after to the outcome is measured, $drought_{ijt+1}$. If this lead were to pick up any significant relation with any of the coping strategies, the expectation of households to be affected by drought during the next lean season would impact estimations. As Table 4.9 shows, the estimated effect of this lead on households selling more animals (non-productive) than usual increases in size and gains statistical significance, compared to the treatment effect estimated in Table 4.2. For all other coping strategies, the lead effect sizes are small and do not achieve statistical significance. I consider it unlikely that households acting in anticipation of drought would implement one and only one coping strategy. Instead, I assume that the estimates for the lead of selling more animals are picking up a false-positive which would disappear with more complete data. In total, I take the estimates reported in Table 4.8 as evidence that expectations do not play a role in households engaging in coping strategies.

Lastly, I exploit that the ENSA data contains one coping strategy that cannot be affected by drought, namely harvest of immature crops. If this coping strategy were to register any statistically significant relationship with drought, the model would pick it up because of uncontrolled cofounders. Estimating Equation 1 with this coping strategy as an outcome variable, Table 4.10 shows that there is no meaningful relation between harvest of immature crops and drought, unless one stops including all control variables.

Table 4.8: Robustness to changed sample

	1 Sold non-productive assets	2 Purchased food/non-food on credit	3 Spent savings	4 Sold more animals (non-productive) than usual	5 Took children out of school
Affected by drought	0.180**	0.159**	0.265***	0.0370	0.0518
	(3.23)	(2.75)	(4.31)	(0.67)	(1.03)
Constant	-0.403	1.089***	-0.0766	0.0617	-0.206
	(-1.67)	(4.05)	(-0.23)	(0.24)	(-0.98)
N	308	308	306	307	299

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020), excluding all sous-prefetures in the regions of Lac, Hadjer-Lamis, Chari-Baguirmi, Mayo-Kebbi Est, Mayo-Kebbi Ouest, Logone Oriental, Logone Occidental, Tandjile, Mandoul, Moyen-Chari, Salamat, and Sila.
Standard errors are clustered at the sous-prefeture level.
For readability, control variables are omitted from tables in-text and reported in Appendix C.
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.9: Robustness to alternative treatment

	1 Sold non-productive assets	2 Purchased food/non-food on credit	3 Spent savings	4 Sold more animals (non-productive) than usual	5 Took children out of school
Treatment lead	0.0177	0.0577	-0.0399	0.102*	0.0324
	(0.43)	(1.28)	(-0.93)	(2.53)	(1.04)
Affected by drought	0.0538	-0.00305	0.0710	-0.0207	0.0161
	(1.19)	(-0.07)	(1.40)	(-0.41)	(0.43)
Constant	-0.0446	0.889***	0.390	0.145	-0.177
	(-0.28)	(4.75)	(1.90)	(0.70)	(-1.35)
N	690	693	683	689	679

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
For readability, control variables are omitted from tables in-text and reported in Appendix C.
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4.10: Robustness to alternative outcome

	1 Harvested prematurely
Affected by drought	0.0149
	(0.75)
Constant	0.0717
	(0.64)
N	784

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
For readability, control variables are omitted from tables in-text and reported in Appendix C.
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

4.5 Discussion

While this analysis of ENSA 2016-2020 data demonstrates that drought exposure affects the prevalence of households enacting some coping strategies, it contradicts some of the expectations based on extant literature and descriptive statistics from previous works on Chad. On the one hand, this literature shows how prevalent many coping strategies are among affected populations, including strategies related to households' economic activities, and to their financial and human capital. On the other hand, the present analysis takes a comparative look at affected versus non-affected populations. It concludes that drought has an effect on the enaction of only very specific coping strategies, namely, households selling non-productive assets and smoothing food consumption by spending part of their savings. As both coping strategies relate to the finances of a household – non-productive asset often serve as easy-to-liquidize savings (Banerjee and Duflo 2012) – I take this as a very specific approach that Chadian households developed in their very specific context to mitigate the negative impacts of the yearly lean season on their lives and livelihoods. This context-specificity is in line with the finding of Akampumuza and Matsuda (2017) which contrasts their urban-specific sample with the rural one from Hoddinot (2006). In the case of Chad, this specific context is the yearly recurrent lean season, especially in the Sahelian region, as supported by the robustness checks. However, this argument does not imply that larger-scale droughts are harmless for the Chadian population.

Considering that many coping strategies can have negative long-term consequences (Skoufias 2003), the findings that seasonal drought does not lead households to implement longer-term detrimental coping strategies suggests that the decision of households is based on simultaneously smoothing food consumption and avoiding poverty traps. Households seem to act on their preferences, weighting trade-offs of short-term versus long-term impacts of the use each coping strategy, the potential of maximizing gains from coping strategies in local markets, and the acceptability or lack thereof within the local cultural and social context. Thus, further research and the modeling of a preference function of households' considerations related to their choice of coping strategies could inform humanitarian and development interventions to skew these preferences towards less-harmful coping strategies. In any case, the findings presented here support that household drought resilience can be strengthened by providing the households with efficient saving schemes, including investment in non-

productive assets. Additionally, the particular wording of the questions concerning coping strategies emanating from the ENSA (i.e., if the interviewee implemented the coping strategy *to buy food)*, also suggests that supply-side interventions to stabilize prices and to ensure food availability would reduce the prevalence of these coping strategies. Because the robustness checks suggest that households implement coping strategies ex-post a shock, the timeliness of interventions can also be tailored to the drought period.

Nevertheless, the threats to a causal interpretation of the results need to be acknowledged. Risks of measurement errors are inherent due to the self-reported nature of the shock variable, though I consider this risk to be negligible and worth the trade-off for increased granularity. Survivor bias could arise from households migrating to urban areas due to drought, thus being affected by drought but not appearing in the sample. In a similar vein, households need certain capacities to implement coping strategies, like owning assets to be able to sell them. Recurrent shocks, such as seasonal droughts, might affect capacities to even implement the most basic coping strategies. Lastly, treatment effect heterogeneity remains a concern, though I argue that this concern is a minor one as shown in section 4.4.2.

4.6 Conclusion

Seasonal drought has a major impact on Chadian livelihoods, with one-third of the sampled households being affected at least once between 2016 and 2020 by this event. While affected households engage in a wide range of coping strategies, this analysis shows that unaffected households do the same and that causal links can only be established between drought and households selling non-productive assets, and/or households using their savings. Practitioners should not be misled by descriptive statistics showing that most of the affected households use many coping strategies. Instead, project design should consider whether the control group is employing these coping strategies as well.

For Chad specifically, these findings suggest that selling assets and using savings are important tools for households to mitigate the impacts of drought. Accordingly, policies and programs designed to increase the capabilities of households to mitigate the impacts of drought should consider linkages to strengthening asset markets and saving schemes, thereby

enabling households to engage in these specific coping strategies more effectively. Alternatively, public agricultural insurance schemes and social protection approaches could alleviate the pressure on households to enact coping strategies in their level. Lastly, the study shows that strategies related to economic activities and human capital are not specifically linked to drought. More research is needed to identify which other idiosyncratic and covariate shocks drive the enaction of most of these strategies.

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Appendix A: Matching procedure

Only the 2020 wave of the ENSA dataset includes georeferential information, meaning that 49,712 observations across the other waves lacked any such information. To retroactively identify this information for entries in the previous waves, I cleaned all village name strings from special characters (French, ASCII, and capital letters) and then matched the villages with this information with those villages without this information but with the same name and in the same department across different waves, using the *R* command *left_join*. This reduced the number of observations without georeferential information to 32,919. Using shapefiles on administrative boundaries[13], also containing village names and georeferential information, I used the same procedure to match village names and reduce the number of observations without georeferential information to 29,084. Using the alternative villages names provided in the same way, I reduced this number to 28,861.

As a manual look at the data revealed, many village names in Chad are not standardized, thus I used the *R* command *agrep* to obtain approximate matches of village names, reviewing them manually and repeating this step three times and thereby reducing the number of observations without georeferential information to 26,195, 25,228, and 24,842 through each consecutive step. The same manual look also revealed that some villages with the same name were not matched because the data collectors had added additional qualifiers or because *agrep* could not recognize certain patterns of words being spelled differently, such as:

Silent “h” and silent vowels because of indigenous village names being frenchified;
village names with double consonants = village names with single consonants;
g = r, corresponding to the Arabic letter غ
j = dj = ch = dch = tch, etc.;
prefixes “D”, “Do”, “Du”, “Doku”, “Dugu”, etc., being a prefix for settlements in local languages;
prefixes “Am”, “Um”, “M”, “Ma”, etc., the Arabic word for “mother”, being a prefix for settlements;

[13] OCHA. Humanitarian Data –Chad - Subnational Administrative Boundaries. https://data.humdata.org/dataset/cod-ab-tcd. 18.06.2022.

prefixes “Ben”, “Bin”, “B”, etc., the Arabic word for “son(s) of”, being a prefix for settlements;
prefixes “Bit”, “Bet”, “Beit”, etc., the Arabic word for “room” or “house”, being a prefix for settlements;
prefixes “Kam”, “Kom”, etc., being a prefix for settlements in local languages;
prefixes “Ferrick”, being a prefix for settlements in local languages;
prefixes “Ouadi”, “Ouaddi”, etc., being a geographical depression where water accumulates;
prefixes “Baba”, “Bibi”, etc., the word for “father”, being a prefix for settlements;
part of word “hadj” in combination with name, denominating that the village was named after someone who had undertaken the hadj;
part of word “leo”, “leon”, “lio”, etc., being a prefix for settlements in local languages;
suffixes “rom”, “erom”, “isserom”, being a suffix for settlements in local languages;
suffixes “mate”, “mante”, etc., being a suffix for settlements in local languages;
suffixes “baye”, “maye”, “aye”, etc., being a suffix for settlements in local languages;
suffixes “ya”, “ye”, etc.;
suffixes “LL”, “II”, etc., being Latin numerals;
suffixes “yerom”, “kerom”, etc., being a suffix for settlements in local languages;
suffixes “madji”, “nadji”, “naji”, etc., being a suffix for settlements in local languages.
plural form “at”, “et”, etc. to “a”, “e”, etc.;
“Quartier ...”, “Bloc ...”, etc. are assumed to be parts of the department capital.

Deleting these qualifiers, as well as their misspelled versions, from the village name strings and repeating the three steps above, I reduced the number of observations without georeferential information to 13,239. Another manual review of the data revealed patterns pertaining to the names of ethnicities or outdated administrative boundaries added to village name strings, such as Foulbe, Zaghaoua or Baguirmi. Deleting them allowed to reduce the number of observations without georeferential information to 9,723, again through three iterative steps.

As administrative boundaries changed over time and data collectors might not have been aware in which department they were, I repeated the above steps matching village names with the same region, i.e. one administrative level larger than the department, reducing the number of observations without georeferential information to 3,456. Lastly, I reviewed the list manually and matched village names as well as adding georeferential information from google maps if no other dataset included it. After all these steps, 2,567 observations information remained without georeferential, which I dropped from the dataset used in the analysis. In total, I was able to identify georeferential information for 95 percent of all observation across all waves.

Appendix B: Wealth index

Following WFP procedure[14], I used household asset data to estimate a wealth index. Having recoded household amenities, such as the quality of household water sources, to being binary, I listed the prevalence of all asset variables in the dataset. Appendix Table B1 displays the French variable names and English translations.

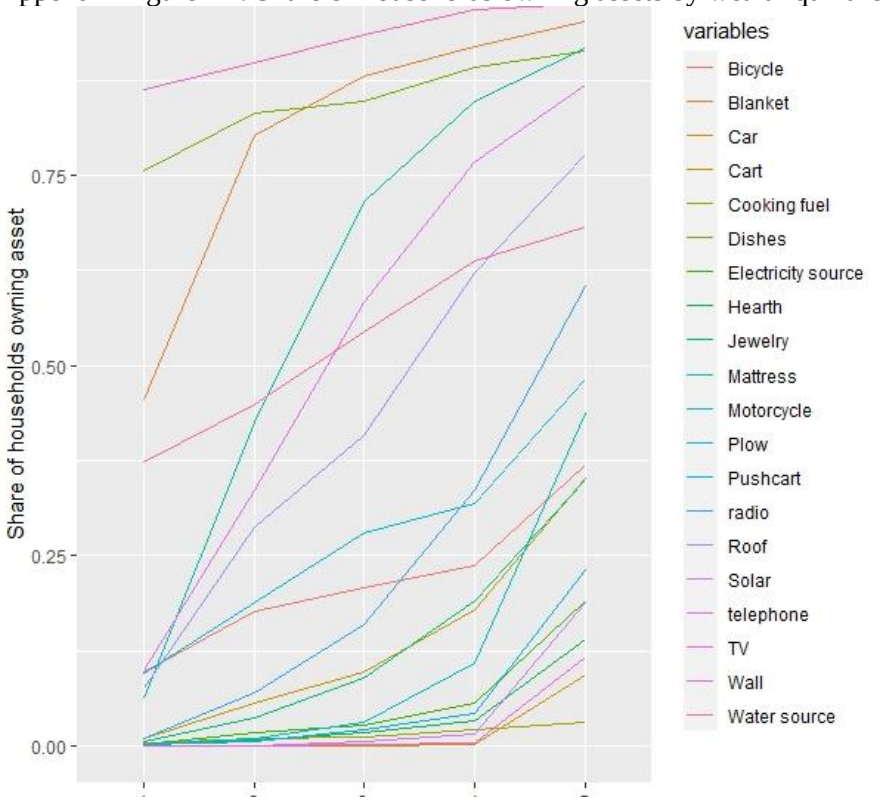
Appendix Table B1: Wealth Index variables

French variable names	**English translation**
"matelas"	Mattress
"couverture"	Blanket
"radio"	radio
"telephone"	Telephone
"foyer_ameliore"	Improved hearth
"charrette"	Cart
"charrue"	Plow
"bicyclette"	Bicycle
"motocyclette"	Motorcycle
"voiture"	Car
"porte_tout"	Pushcart
"bijoux"	Jewelry
"recipients"	Dishes
"televiseur"	TV
"groupe_electrogene_panneau"	Solar panels
"toit_logement_bin"	Improved roof
"mur_logement_bin"	Improved wall
"source_eclairage_bin"	Improved electricity source
"energie_cuisson_aliment_bin"	Improved cooking fuel
"source_eau_boisson_bin"	Improved water source

From this list, I excluded all variables with a prevalence lower than 5 percent and higher than 95 percent, ran the *R* command *prcomp* through various iterations and then graphed the result is Appendix Figure B1.

[14] WFP. Wealth Index. https://docs.wfp.org/api/documents/WFP-0000107668/download/. 19.06.2022.

Appendix Figure B1: Share of households owning assets by wealth quintile



Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).

Appendix C: Full regression tables

Appendix Table C2: Two-way fixed effects estimates

	(1) Sold non-productive assets	(2) Purchased food/non-food on credit	(3) Spent savings	(4) Sold more animals (non-productive) than usual	(5) Took children out of school
Affected by drought	0.0706*	0.0126	0.0758*	0.0280	0.0361
	(2.35)	(0.36)	(2.19)	(0.85)	(1.53)
Literate head of household	-0.0281	0.0412	-0.0538	0.00524	0.184***
	(-0.46)	(0.57)	(-0.83)	(0.07)	(3.53)
Age of head of household	-0.00156	-0.00532	-0.00377	0.00145	0.00247
	(-0.72)	(-1.92)	(-1.26)	(0.48)	(1.55)

Female head of household	0.270**	0.0632	0.0859	0.0230	0.239***
	(3.17)	(0.70)	(0.89)	(0.26)	(3.69)
Household size	0.0267***	0.0167	0.0228**	0.0247*	0.0136
	(3.51)	(1.77)	(2.64)	(2.36)	(1.94)
Practices pastoralism	-0.0539	-0.224***	-0.184**	-0.0222	-0.0845
	(-1.05)	(-3.60)	(-3.24)	(-0.34)	(-1.96)
Practices agriculture	0.100	-0.226	-0.0480	-0.0654	0.0793
	(1.45)	(-1.94)	(-0.52)	(-0.54)	(1.39)
Wealth index[a]	0.0348	-0.855**	-0.367	-0.816**	-0.353
	(0.16)	(-2.83)	(-1.23)	(-2.75)	(-1.95)
Shock: conflict	0.000537	-0.000682	0.0000405	-0.000925	0.00109
	(0.58)	(-0.68)	(0.04)	(-0.75)	(1.18)

Shock: domesticated animals devastating crops	-0.0184	-0.0347	-0.0616	-0.0251	0.0370
	(-0.50)	(-0.73)	(-1.29)	(-0.56)	(1.36)
Shock: wildfires	-0.171	-0.140	-0.200	-0.148	-0.101
	(-1.38)	(-0.83)	(-1.36)	(-0.89)	(-1.39)
Shock: domesticated animals being affected by disease	-0.0891	-0.0698	0.0701	0.0570	-0.0335
Shock: silting	(-1.09)	(-0.84)	(0.72)	(0.75)	(-0.58)
Shock: silting	-0.275	0.0734	-0.310*	0.0324	-0.111
	(-1.90)	(0.56)	(-2.43)	(0.21)	(-1.25)
Wave = 2017 (ref. 2016)	0.0899***	0.115***	0.133***	0.146***	0.0236
	(3.51)	(4.15)	(4.80)	(5.20)	(1.37)

Wave = 2019 (ref. 2016)	-0.0307	-0.0656**	-0.0335	-0.00508	0.0710***
	(-1.49)	(-2.87)	(-1.39)	(-0.21)	(3.95)
Wave = 2020 (ref. 2016)	-0.0190	-0.0762***	-0.0372	-0.0632**	0.0657***
	(-1.02)	(-3.68)	(-1.66)	(-3.04)	(3.85)
Constant	-0.136	0.870***	0.395*	0.146	-0.254*
	(-1.00)	(5.09)	(2.13)	(0.78)	(-2.37)
N	846	850	839	845	832

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
[a] Due to the scarcity of households with any monetary income in the sample, economic differences between households are captured in a wealth index, calculated by the author (see Appendix B).
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table C3: OLS estimates with controls

	(1) Sold non-productive assets	(2) Purchased food/non-food on credit	(3) Spent savings	(4) Sold more animals (non-productive) than usual	(5) Took children out of school
Affected by drought	0.104***	0.111**	0.144***	0.109***	0.0174
	(3.63)	(3.31)	(4.30)	(3.75)	(0.86)
Literate head of household	0.0171	0.0237	0.0706	0.0502	0.0958***
	(0.48)	(0.48)	(1.72)	(1.05)	(3.33)
Age of head of household	-0.00330*	-0.00296	-0.00245	-0.00103	0.00302*
	(-2.07)	(-1.45)	(-1.09)	(-0.45)	(2.47)
Female head of household	0.274***	0.138*	0.179**	0.0935	0.214***
	(4.45)	(2.13)	(2.68)	(1.56)	(4.29)
Household size	0.0294***	0.0151*	0.0196**	0.0283***	0.00755

	(4.67)	(2.01)	(2.78)	(3.85)	(1.46)
Practices pastoralism	-0.0462	-0.162***	-0.0835*	0.0370	-0.0286
	(-1.25)	(-3.44)	(-2.10)	(0.82)	(-1.19)
Practices agriculture	-0.0621	-0.215***	-0.110**	-0.144***	-0.112***
	(-1.89)	(-6.03)	(-3.01)	(-3.70)	(-3.94)
Wealth index[a]	-0.260*	-1.091***	-0.513***	-0.599***	-0.328***
	(-2.39)	(-8.57)	(-3.85)	(-4.26)	(-3.58)
Shock: conflict	0.0000549	-0.00223**	-0.000695	-0.000949	0.000894
	(0.06)	(-3.06)	(-1.12)	(-1.17)	(0.86)
Shock: domesticated animals devastating crops	-0.0386	-0.101**	-0.0686*	-0.106***	-0.00617
	(-1.64)	(-2.83)	(-2.22)	(-3.55)	(-0.37)
Shock: wildfires	0.0104	0.0811	-0.0259	-0.0151	-0.0897

	(0.13)	(0.69)	(-0.18)	(-0.12)	(-1.86)
Shock: domesticated animals being affected by disease	-0.137	-0.0798	-0.00851	0.0441	-0.0626
	(-1.89)	(-1.00)	(-0.09)	(0.58)	(-1.28)
Shock: silting	-0.0929	0.0620	-0.175**	-0.0239	-0.0490
	(-1.32)	(0.60)	(-2.87)	(-0.28)	(-0.86)
Constant	0.0881	0.745***	0.302*	0.186	-0.0201
	(0.97)	(7.07)	(2.36)	(1.54)	(-0.32)
N	846	850	839	845	832

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
[a] Due to the scarcity of households with any monetary income in the sample, economic differences between households are captured in a wealth index, calculated by the author (see Appendix B).
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table C4: OLS estimates

	(1)	(2)	(3)	(4)	(5)
	Sold non-productive assets	Purchased food/non-food on credit	Spent savings	Sold more animals (non-productive) than usual	Took children out of school
Affected by drought	0.165***	0.182***	0.200***	0.177***	0.0657**
	(5.55)	(5.22)	(5.95)	(5.93)	(2.83)
Constant	0.0715***	0.233***	0.136***	0.162***	0.0515***
	(10.63)	(22.17)	(16.10)	(20.13)	(9.94)
N	846	850	839	845	832

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table C5: Estimates excluding wave effects

	(1) Sold non-productive assets	(2) Purchased food/non-food on credit	(3) Spent savings	(4) Sold more animals (non-productive) than usual	(5) Took children out of school
Affected by drought	0.101**	0.0733*	0.123**	0.0821*	0.0102
	(3.19)	(1.98)	(3.23)	(2.27)	(0.44)
Literate head of household	-0.0149	0.0879	-0.0173	0.0724	0.186***
	(-0.23)	(1.09)	(-0.25)	(0.90)	(3.63)
Age of head of household	-0.00414	-0.0105***	-0.00794*	-0.00406	0.00428*
	(-1.89)	(-3.67)	(-2.57)	(-1.28)	(2.59)
Female head of household	0.270**	0.0581	0.0855	0.0397	0.267***
	(3.12)	(0.62)	(0.89)	(0.44)	(4.23)
Household size	0.0357***	0.0334***	0.0371***	0.0441***	0.00796
	(4.34)	(3.46)	(3.96)	(4.07)	(1.15)

Practices pastoralism	-0.0718	-0.252***	-0.217***	-0.0672	-0.0946*
	(-1.31)	(-3.79)	(-3.54)	(-0.98)	(-2.23)
Practices agriculture	0.112	-0.200	-0.0368	-0.0762	0.0709
	(1.85)	(-1.85)	(-0.43)	(-0.67)	(1.25)
Wealth index[a]	0.0840	-0.793**	-0.294	-0.661*	-0.284
	(0.37)	(-2.60)	(-0.99)	(-2.16)	(-1.48)
Shock: conflict	0.000963	-0.000244	0.000622	-0.000406	0.00124
	(1.10)	(-0.25)	(0.63)	(-0.35)	(1.22)
Shock: domesticated animals devastating crops	-0.0646*	-0.0866	-0.137**	-0.126**	-0.0217
	(-2.07)	(-1.90)	(-3.03)	(-3.03)	(-1.14)
Shock: wildfires	-0.101	-0.0208	-0.0871	0.0186	-0.120
	(-0.67)	(-0.10)	(-0.58)	(0.09)	(-1.45)
Shock: domesticated animals being affected by disease	-0.106	-0.0921	0.0543	0.0607	-0.0127
	(-1.30)	(-1.04)	(0.56)	(0.73)	(-0.21)

Shock: silting	-0.254	0.0972	-0.291**	0.0131	-0.136
	(-1.93)	(0.97)	(-2.69)	(0.11)	(-1.50)
Constant	-0.100	0.913***	0.461*	0.230	-0.239*
	(-0.73)	(5.43)	(2.48)	(1.20)	(-2.18)
N	846	850	839	845	832

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
[a] Due to the scarcity of households with any monetary income in the sample, economic differences between households are captured in a wealth index, calculated by the author (see Appendix B).
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table C8: Robustness to changed sample

	(1) Sold non-productive assets	(2) Purchased food/non-food on credit	(3) Spent savings	(4) Sold more animals (non-productive) than usual	(5) Took children out of school
Affected by drought	0.180**	0.159**	0.265***	0.0370	0.0518
	(3.23)	(2.75)	(4.31)	(0.67)	(1.03)
Literate head of household	-0.193	-0.118	-0.107	0.127	0.151
	(-1.47)	(-0.86)	(-0.79)	(1.06)	(1.90)
Age of head of household	-0.00409	-0.00653	-0.00341	0.00349	-0.000257
	(-0.94)	(-1.41)	(-0.62)	(0.75)	(-0.07)
Female head of household	0.257	-0.133	0.0753	0.0645	0.287**
	(1.81)	(-1.08)	(0.45)	(0.51)	(2.64)
Household size	0.0767***	0.0402*	0.0797***	0.0830***	0.0345
	(4.54)	(2.14)	(4.39)	(5.11)	(1.90)

Practices pastoralism	-0.220*	-0.568***	-0.259*	-0.237*	-0.200*
	(-2.23)	(-5.06)	(-2.26)	(-2.50)	(-2.07)
Practices agriculture	0.388*	0.0424	0.101	-0.0389	0.166
	(2.34)	(0.19)	(0.64)	(-0.20)	(1.30)
Wealth index[a]	-0.0675	-1.615**	-0.829	-2.449***	-0.286
	(-0.15)	(-3.29)	(-1.40)	(-5.55)	(-0.77)
Shock: conflict	-0.00966	-0.0103	-0.00210	-0.00422	-0.00828
	(-1.60)	(-0.86)	(-0.17)	(-0.56)	(-1.46)
Shock: domesticated animals devastating crops	-0.137	0.127	0.121	-0.176	-0.0912
	(-1.11)	(0.97)	(0.84)	(-1.20)	(-0.91)
Shock: wildfires	-0.165	-0.154	-0.313*	-0.412***	-0.218
	(-1.80)	(-1.02)	(-2.28)	(-4.57)	(-1.75)
Shock: domesticated animals being affected by disease	-0.0288	-0.139	0.108	-0.00109	-0.0475
	(-0.23)	(-1.04)	(0.78)	(-0.01)	(-0.57)

Shock: silting	-0.455**	-0.0955	-0.410**	-0.174	-0.221
	(-2.72)	(-0.71)	(-2.77)	(-1.37)	(-1.88)
Wave = 2017 (ref. 2016)	0.0970*	0.0799	0.144**	0.130*	-0.00732
	(2.00)	(1.41)	(2.70)	(2.56)	(-0.16)
Wave = 2019 (ref. 2016)	-0.0334	-0.0526	0.0851	0.0585	0.0731
	(-0.73)	(-1.07)	(1.63)	(1.39)	(1.69)
Wave = 2020 (ref. 2016)	0.0471	-0.0331	0.0972	-0.0443	0.0192
	(0.94)	(-0.69)	(1.66)	(-1.06)	(0.49)
Constant	-0.403	1.089***	-0.0766	0.0617	-0.206
	(-1.67)	(4.05)	(-0.23)	(0.24)	(-0.98)
N	308	308	306	307	299

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020), excluding all sous-prefetures in the regions of Lac, Hadjer-Lamis, Chari-Baguirmi, Mayo-Kebbi Est, Mapo-Kebbi Ouest, Logone Oriental, Logone Occidental, Tandjile, Mandoul, Moyen-Chari, Salamat, and Sila.
Standard errors are clustered at the sous-prefeture level.
[a] Due to the scarcity of households with any monetary income in the sample, economic differences between households are captured in a wealth index, calculated by the author (see Appendix B).
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table C9: Robustness to alternative treatment

	(1) Sold non-productive assets	(2) Purchased food/non-food on credit	(3) Spent savings	(4) Sold more animals (non-productive) than usual	(5) Took children out of school
Treatment lead	0.0177	0.0577	-0.0399	0.102*	0.0324
	(0.43)	(1.28)	(-0.93)	(2.53)	(1.04)
Affected by drought	0.0538	-0.00305	0.0710	-0.0207	0.0161
	(1.19)	(-0.07)	(1.40)	(-0.41)	(0.43)
Literate head of household	-0.0578	0.0229	-0.0734	-0.00417	0.185**
	(-0.93)	(0.29)	(-0.92)	(-0.05)	(2.90)
Age of head of household	-0.00295	-0.00545	-0.00265	0.000555	0.00168
	(-1.10)	(-1.67)	(-0.73)	(0.15)	(0.95)
Female head of household	0.282**	0.0210	0.0425	-0.0102	0.229**
	(2.76)	(0.21)	(0.36)	(-0.10)	(3.12)

Household size	0.0270**	0.0125	0.0145	0.0236	0.0119
	(3.10)	(1.22)	(1.49)	(1.96)	(1.57)
Practices pastoralism	-0.0233	-0.132*	-0.129*	0.0176	-0.0327
	(-0.41)	(-2.07)	(-2.17)	(0.25)	(-0.76)
Practices agriculture	0.0423	-0.282*	-0.0261	-0.0392	-0.00220
	(0.55)	(-2.30)	(-0.32)	(-0.34)	(-0.03)
Wealth index[a]	0.0310	-0.764*	-0.375	-0.764*	-0.383
	(0.14)	(-2.27)	(-1.07)	(-2.28)	(-1.82)
Shock: conflict	0.00574***	0.00491*	0.00464	0.00584*	0.00404*
	(3.53)	(2.02)	(1.71)	(2.55)	(2.16)
Shock: domesticated animals devastating crops	-0.00327	-0.0391	-0.0485	-0.0310	0.0453
	(-0.08)	(-0.74)	(-0.93)	(-0.62)	(1.61)
Shock: wildfires	-0.185	-0.240	-0.232	-0.153	-0.120
	(-1.55)	(-1.55)	(-1.50)	(-0.90)	(-1.73)

Shock: domesticated animals being affected by disease	-0.0812 (-0.84)	-0.0988 (-1.00)	0.0578 (0.46)	0.0425 (0.46)	-0.0105 (-0.17)
Shock: silting	-0.343* (-2.16)	-0.106 (-0.80)	-0.468*** (-3.78)	-0.0621 (-0.38)	-0.202 (-1.88)
Wave = 2017 (ref. 2016)	0.0883** (3.11)	0.109*** (3.50)	0.133*** (4.31)	0.125*** (4.09)	0.0430* (2.53)
Wave = 2019 (ref. 2016)	-0.0332 (-1.32)	-0.0820** (-3.04)	-0.0597* (-2.05)	-0.0378 (-1.27)	0.0623** (3.26)
Wave = 2020 (ref. 2016)	-0.0187 (-0.87)	-0.0886*** (-3.65)	-0.0504* (-1.98)	-0.0766** (-2.99)	0.0730*** (3.68)
Constant	-0.0446 (-0.28)	0.889*** (4.75)	0.390 (1.90)	0.145 (0.70)	-0.177 (-1.35)
N	690	693	683	689	679

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).

Standard errors are clustered at the sous-prefeture level.

[a] Due to the scarcity of households with any monetary income in the sample, economic differences between households are captured in a wealth index, calculated by the author (see Appendix B).

T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table C10: Robustness to alternative outcome

	(1) Harvested prematurely
Affected by drought	0.0149 (0.75)
Literate head of household	-0.00798 (-0.14)
Age of head of household	0.000154 (0.07)
Female head of household	0.109 (1.58)
Household size	0.00323 (0.44)
Practices pastoralism	-0.111* (-2.06)

Practices agriculture	0.132 (1.90)
Wealth index[a]	-0.382 (-1.64)
Shock: conflict	-0.000189 (-0.37)
Shock: domesticated animals devastating crops	-0.0737 (-1.97)
Shock: wildfires	-0.131 (-0.72)
Shock: domesticated animals being affected by disease	-0.191** (-2.90)
Shock: silting	0.378** (2.78)
Wave = 2017(ref. 2016)	0.136***

	(5.98)
Wave = 2019 (ref. 2016)	-0.0169
	(-0.97)
Wave = 2020 (ref. 2016)	0.0168
	(1.09)
Constant	0.0717
	(0.64)
N	784

Notes: Estimates obtained using pooled cross-sectional waves of ENSA (2016, 2017, 2019, and 2020).
Standard errors are clustered at the sous-prefeture level.
[a] Due to the scarcity of households with any monetary income in the sample, economic differences between households are captured in a wealth index, calculated by the author (see Appendix B).
T statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5 General Discussion

This chapter is aimed at discussing the findings of this thesis, both to provide the final, full picture of conflict and climate impacts on food security in Chad, and to detail the findings of each specific chapter. It summarizes thereby the key findings of each chapter and puts them in the broader context of the thesis. Additionally, each section aims to outline the limits of these findings.

5.1 Overall findings

The previous chapters have shown that Chad struggles with conflict and climate impacts on food security, exemplified by the Boko Haram insurgency and by recurrent droughts leading to the annual lean season. That is not to say that these are the only factors driving food insecurity. Since its independence until today, Chad has been haunted by a plethora of other conflicts, too (BBC 2011). It has also been subject to climate impacts, beyond the annual droughts (Eckstein et al. 2019). Thus, this thesis does not pretend to provide a full and complete model of the interactions of these factors; as each armed uprising, insurgency, and war goes its unique way, and as each drought, flood, and sandstorm has its unique effects, the added value of such a general model can be doubted anyway. Instead, it aims to provide a brought overview of the topic in Chapter 2 with two specific case studies that inform the reader on the contrast between a high-impact, one-off and very localized conflict event in Chapter 3 with a much lower-impact, recurrent, and wide-spread climatic event in Chapter 4.

By taking a close look at this contrast, we can see that the two events had markedly different impacts: The TOT of the Boko Haram insurgency in Lac on underweight is estimated at -0.085 point of the z-score and on wasting at -0.305 points. Considering that average z-scores for both indicators were already lower in Lac than in the rest of Chad, and that the average for all of Chad already lies at -1.343 and -0.673 points respectively, the insurgency has undoubtedly pushed thousands of children into malnutrition. However, the containment of the insurgency in Lac also meant that the same negative

effects cannot be observed for the rest of Chad. In this control group, the average z-score indicating wasting is improving during the treatment period and, maybe more importantly, the same is true for the rate of participation in agricultural activities and household dietary diversity.

Regarding seasonal drought, however, the geographical scope of Chadian sous-prefetures affected by drought is widespread. Some are more affected across all years than others and for many, drought exposure is waxing and waning; there are few which are completely unexposed over the entire study period. The estimated effect of this exposure is, however, much more limited. It has a statistically significant treatment effect only on two out of five coping strategies on which the effect was tested: a 7.1 percentage point increase in the prevalence of households selling non-productive assets and a 7.6 percentage point increase in the prevalence of them using their savings to buy food. Notably, the use of many coping strategies is more prevalent among the drought-affected than among those who are not affected. However, the difference is in the range of 1.5 to 3.5 percentage points. Once one estimates the full fixed-effects model, the statistical significance of this difference vanishes, except for the two effects mentioned.

5.2 Specific findings from Chapter 2: The Effects of the Boko Haram Insurgency on Food Security in the Lake Chad Basin

In Chapter 2, a literature review provided the background to the research question by outlining the general food security and nutrition situation in Chad and the adjacent countries affected by Boko Haram, and then systematically searching for and classifying literature available on the insurgency's impacts and food security and nutrition. Here, 29 sources in English and French on the impacts of Boko Haram on food security and nutrition in the research area were reviewed, allowing to categorize their findings by food availability, access, utilization, and stability. Thereby, this chapter outlined transmission channels between the political violence perpetrated by the insurgency and food security and nutrition indicators, while also providing the larger context of food systems in Chad and relevant surrounding areas.

The chapter revealed that there are two broad families of literature on the topic, one treating displaced populations, the other the general

population. These two families look markedly different, with the former one dominated by interviews, focus group discussions and some descriptive statistics, while the latter is dominated by mean-based analysis. Behind this finding is likely that displaced populations are concentrated in camps and are thus much more accessible for researchers to conduct their own survey, compared to the general population. Indeed, among this family of studies, 87.5 percent of studies are based on data collected by the authors themselves, compared to 25 percent of studies being based on such primary data in the family of studies treating the general population. Physical access to the subjects of a study seems to drive the research method. Likely linked to access as well, albite access regulated by language, is the finding that extant literature is almost exclusively focused on Nigeria: Only 1 article treated the insurgency's impact on food security in Niger, and one covered the entire study area of Cameroon, Chad, Niger, and Nigeria; all other 27 articles exclusively treated Nigeria. As the Boko Haram insurgency originated in Nigeria and this country is the most affected, there is a certain rational behind this distribution. However, one must note that among the four countries, Nigeria is the only English-speaking one, providing data and literature in the language that most researchers are comfortable with. Taking the extant literature on Boko Haram and food security in the study area at face value, one might gain the erroneous impression that the insurgency is linked to hunger and malnutrition in Nigeria, but barely anywhere else.

5.3 Specific findings from Chapter 3: Boko Haram's Banditry and Child Health in Chad

Chapter 3 took a deep dive into the effects of the Boko Haram insurgency on human development, measured through anthropometrics. It used a DID methodology to establish cause-effect relationships, supported by analysis of potential transmission channels. In this methodology, all households living within the province of Lac, which is the area of operations of Boko Haram in Chad, were assigned to the treatment group and all households outside Lac to the control group. The period before 2010, which is the time before insurgents became active in the Lake Chad area, was used as the pre-treatment period and the period after it as the treatment period. However, the period from 2015 onwards, when Boko Haram started perpetrating political violence in Chad, is excluded from this analysis, allowing to isolate the

effects of criminal violence. Consequently, two binary variables were constructed, treated/not treated and treatment period/not treatment period. This enabled this chapter to employ the traditional set up of a two-by-two DID, where the estimates represent the effects of the treatment on the treated, the TOT, and enables a causal interpretation of these effects. This interpretation is supported by parallel-trends and placebo tests.

Together with these tests, this chapter showed how Boko Haram's criminal, but not political violence, prevented affected populations to pursue agricultural activities and lowered the participation rate in the agricultural sector by 31.7 percentage points. It also harmed dietary diversity, with the dietary diversity score decreasing by 53.7 points. While these are unlikely to be the only transmission channels through which the insurgency caused childhood malnutrition, they give an important insight on how households in the Lac region reacted to the criminal acts of Boko Haram in their area. Having found that these acts caused significant declines in short-term measures of childhood nutrition, it contributes to the literature on terrorist organizations perpetrating both political and criminal violence by isolating the criminal aspect and quantifying its impacts. Political violence, such as large-scale attacks, bombings of public targets, or kidnappings connected with political demands often receive most of the attention of security forces, the media, and the international community. However, the sheer scale of human suffering, which Boko Haram's crimes caused, underlines that criminal violence by terrorist organizations needs upmost attention. Furthermore, this chapter excluded seasonal drought as an alternative explanation for the decline in nutrition indicators in Lac, compared to other regions. That is not to say that the lean season is not affecting Lac or that it does not lead to food insecurity, too; as a matter of fact, drought prevalence in Lac was larger than in the control group, comprising the rest of Chad. It merely means that the tendencies of drought exposure of Lac and of the control group ran in parallel to each other. Thus, if increasing drought exposure would have caused the decline of nutrition indicators, we should have seen this decline in the control group as well.

5.4 Specific findings from Chapter 4: The Effects of Seasonal Drought on the Use of Coping Strategies

Like the previous chapter, Chapter 4 also used the setup of a natural experiment, namely, it exploited quasi-random rainfall and water availability patterns on the sous-prefeture level. It relied on two-way fixed-effects estimations, which it treated as equivalent to a generalized DID approach for causal interpretation. Unlike the regressions calculated in the previous chapter, however, there is no clear cut-off period when seasonal droughts started to occur. While causal interpretations of two-way fixed-effects estimations should always be taken with a grain of salt due to heterogeneous treatment effects, this chapter outlined various robustness tests to such heterogeneity and their results. Based on them, it concluded that treatment effect heterogeneity is a minor issue and that a causal interpretation of the results is possible. Meanwhile, robustness tests to alternative samples, treatments, and outcomes confirm that seasonal droughts are indeed the culprits behind the effects found in this chapter.

Of note for this chapter is comparing the estimations of the first difference, that is between the treatment and control group, with the full two-way fixed effects estimations, i.e. the full DID. While the former shows large and statistically significant differences for all five coping strategies assessed, the latter shows large and statistically significant differences only for two out of the five coping strategies. Thus, while the population affected by seasonal drought uses more coping strategies and those coping strategies more often, seasonal drought exposure on the sous-prefeture level is the definitive cause for this higher level of use only for two of these coping strategies. These coping strategies are households selling non-productive assets and households using their savings, with seasonal drought causing the use of the former to increase by 7.1. percentage points and of the latter to increase by 7.6 percentage points. The coefficients measuring seasonal drought impact on the three other coping strategies, purchasing food/non-food items on credit, selling more (non-productive) animals than usual, and taking at least one of child out of school, were small and statistically insignificant. It thus seems that Chadian households developed very specific preferences for which coping strategies to employ to mitigate the impacts of seasonal drought on their food security. As these coping strategies relate to capital, in the form of savings or assets, the next chapter will speculate in its recommendations how increasing this capital can shore up food security.

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6 Concluding Remarks

This chapter outlines the contributions of this thesis to extant research and formulates recommendations based on the previously discussed findings. Thereby wrapping up this study, these recommendations pertain to specific topics of this thesis as well as the overall thesis. In many ways, following the thesis' title, *the impacts of conflict and climate change on food security and nutrition in Chad* can be summarized in three sentences: Seasonal climate shocks provide a fragile environment for food security. Households have adapted to this environment through very specific coping strategies. Catastrophe is imminent, once armed conflict hits this environment, causing suffering and affecting long-term human development.

6.1 Contributions to extant research

As shown in Chapter 2, the impacts of the insurgency have been felt through a variety of transmission channels: The disruption of food production, imports, and market functionality, as well as limits to access to markets and infrastructure, and health and education services. Thereby, this chapter contributes to the larger literature on the environments, driven by climate and other shocks, within which terrorism thrives (Nel and Righarts 2008; Nett and Rüttinger 2016), as well as the consequences of armed conflict for food security (Brinkman and Hendrix 2011; Brück, d'Errico, and Pietrelli 2019). These impacts, however, have varied between displaced and general populations, and within these groups across countries and camps of displaced. Extant literature focuses on the insurgency's impacts on access to services, and consequent interaction with gender and protection, when treating displaced populations; however, when treating the general population, literature focuses on the insurgency's impacts on food production and markets. Especially regarding Chad, extant literature is scarce, as the availability of such literature is largely governed by barriers due to physical access and language, which seem especially high for Chad.

Contrasting this lack of availability of literature, Boko Haram was successful in leveraging the difficult-to-access geography of the Lake Chad

area and its multilingual social structure to create save havens to retreat from Nigeria into Chad and resupply through extortion and pillaging, as shown in Chapter 3. For years it flew largely under the radar in Chad's Lac region, where Boko Haram's criminal violence was difficult to distinguish from habitual cross-border and inter-community violence. Likely, Boko Haram's own expertise in using new media for coordination and propaganda (Musa 2012) facilitated veiling the extend of its presence in Lac. Yet, it had a definitive treatment effect on malnutrition levels nevertheless, lending credit to Awosusi's argument that Boko Haram is "a neglected global health threat" (2017). Supporting analyses showed: Dietary diversity and the share of households participating in agricultural activity dropped in parallel to deteriorating nutrition levels, reinforcing that the insurgency held affected populations back from pursuing their livelihoods and food habits. As a corollary of Chapter 3's findings, one can only speculate how many resources Boko Haram was able to pillage and extort from the inhabitants in Lac, and how these were supplying the political violence of the groups across the border in Nigeria. Many authors have touched upon how heavy-handed military approaches have not curbed Boko Haram political violence (Aghedo and Osumah 2014; Awortu 2015; Macpherson et al. 2020; Onapajo and Ozden 2020; Falode 2016), and this thesis adds to this extant its findings regarding criminal violence.

Chapter 4 found that seasonal droughts, while far more widely spread than the insurgency, had only limited effects on the behavior of affected populations. Households engaged in a wide variety of coping strategies to mitigate the impacts of the lean season, but they did so for other shocks as well, including armed conflict and idiosyncratic ones. The chapter found a statistically significant effect of drought prevalence on only two out of five coping strategies, a 7.1 percentage point increase of households selling non-productive assets and a 7.6 percentage point increase of using their savings. No significant increase, compared to the control group, was found for the prevalence of households purchasing food/non-food items on credit, selling more non-productive animals than usual, or taking children out of school. Overall, the chapter painted a picture of a population with behaviors easily affected by shocks in general, but not particularly more by climate than by any other type of shock. Interestingly, to mitigate the impacts of seasonal drought, households tended towards using coping strategies specifically linked to their financial resources, suggesting that their resilience to climate impacts could be shored up with by enabling savings and financial safety nets. These findings add to extant literature on climate impacts across

the Sahel (van der Geest and Dietz 2004; Liu 2004; Sissoko et al. 2011), but also to literature on resilience and coping strategies (Gautier, Denis, and Locatelli 2016; Vivekananda et al. 2019) in the region.

Comparing these findings across chapters, it becomes apparent how localized but also how deep the effects of the Boko Haram insurgency are, compared to the effects of seasonal drought. Chapter 2 shows how most transmission channels are relevant exclusively to populations residing within, or fleeing from, areas where Boko Haram perpetrates violence, with the sole exceptions of border closures affecting traders and population movements affecting host communities. However, Chapter 3 shows the insurgency's significant effects on nutrition and thereby on human development in these areas. Chapter 4 provides a comparison of these effects to the impacts of seasonal drought. While the latter are far more widely spread than those of the insurgency, they are comparatively small, to the extend where many are not statistically significant.

6.2 Recommendations

Meanwhile, research gaps remain on the topic of the impacts of conflict and climate shocks on food security and nutrition in Chad. Beyond the Boko Haram insurgency, a plethora of other armed conflicts are haunting the country, while climate change will likely contribute to extremer lean seasons, as well as extreme weather events around the year. Additionally, while this thesis has shown that these covariate shocks are impacting food security and nutrition, idiosyncratic ones are confounding such impacts. On the methodological side, this thesis has shown the potential and limits of DID methodologies using observational data: potentials in applying a two-by-two DID to analyze the impacts of a very specific and geographically confined conflict shock; limits in searching for a cause effect relationship in the context of a wide-spread and seasonal climate shocks. Nevertheless, extensive testing post-estimation enabled the latter approach to establish a causal interpretation of the estimates.

Thereby, this thesis contributes to the knowledge on the nexus of shocks and food security and nutrition in Chad. The attentive reader might come away from this reading with specific policy recommendations. One should be wary of extant literature on the Boko Haram insurgency as it is skewed towards easily accessible populations. The deterioration of nutrition

indicators in fragile settings can be an indicator for a brewing storm, as such indicators showed in the case of Boko Haram insurgents becoming active in Chad before perpetrating political violence there. Recurrent covariate shocks, specifically the lean season, have a much more limited impact than their geographic scope might suggest, causing the use of very specific coping strategies only. At the same time, this thesis has provided two examples on how DIDs and two-way fixed effects estimations can be used to test causal relationships. Especially for the latter, researchers might come away with clear steps to test models for the causal interpretability, including regarding heterogeneity and various placebo tests. In conjuncture, these findings paint a picture, where both researchers and policy makers have plenty of opportunities to plug gaps in research and responses to shocks to food security and nutrition.

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