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Institute of Political Studies

Department of Political Science

Master's Thesis

2021 **Luca Alexandru**

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The effect of climate change on state security – an analysis of Burkina Faso and Djibouti

Master's thesis

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Study programme: Geopolitics

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Year of the defence: 2021

Declaration

1.I hereby declare that I have compiled this thesis using the listed literature and resources only.

2.I hereby declare that my thesis has not been used to gain any other academic title.

3.I fully agree to my work being used for study and scientific purposes.

In Prague on Luca Alexandru

References

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Length of the thesis: 115,552 characters, including spaces.

Abstract

This thesis examines the extent to which climate change is able to affect the security of states, with Burkina Faso and the Republic of Djibouti chosen as the case studies for this investigation. While the general effects of climate change on security are understood, the academic community appears to disagree on the subject of conflict-generation via climactic pressures. Consequently, the analysis is divided into two sections: The first part utilizes over 2,000 individual events collected by the Armed Conflict and Event Data program and examines the relationship between climate change and their occurrence. This is done firstly through a preliminary keyword analysis, then through a multivariate regression analysis of the relevant climate change factors. The second part takes a pseudo-qualitative approach by merging the Fragile State Index methodology and a weighted systems model in order to calculate values for each relevant state dimension that has been affected, thereby numerically quantifying the effect. The results indicate that currently, weak to moderate negative effects may be observed on the two states, depending on the security dimension examined. The economic and sociodemographic aspects appear to be most susceptible to environmental pressures.

Keywords

Africa, climate change, state security, Djibouti, Burkina Faso, conflict.

Title

The effect of climate change on state security – an analysis of Burkina Faso and Djibouti.

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I am grateful to my parents and brother for their assistance and moral support in what has been a challenging year.

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Contents

Glossary

ACLED	Armed Conflict Location & Event Data Project
BRI	Belt and Road Initiative
FAO	Food and Agriculture Organization
FSI	Fragile States Index
GBD	Global Burden of Disease Collaborative Network
HDI	Human Development Index
IDP	Internally Displaced People
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
PNDES	National Economic and Social Development Plan
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNHCR	United Nations High Commissioner for Refugees
WFP	World Food Programme

1. Introduction

There are numerous narratives around climate change as concerned citizens, experts, organizations, and states may struggle to arrive at a common argument as to what, precisely, the most pressing issue is and what needs to be done to solve it (Fløttum, 2010). This research aims to bridge the gap between concerned actors by examining to what extent the effects of climate change are currently able to significantly influence the security of states, a point of interest which may draw agreement from all the afore-mentioned members. Although similar studies have been made in the past (Nordås & Gleditsch; Papaioannou; Barnett & Adger, Climate change, human security and violent conflict), this one is focused on comparing two similar cases in terms of climate and environment: Burkina Faso and Djibouti.

While the effects of climate change are global in nature, there is little doubt that the distribution of consequences across the world is uneven. The two states were chosen specifically because of their objectively delicate political and climatological environments. Their proximity to the Sahel region leaves them in an unforgiving and arid area where worsening of climate conditions is far more difficult to bear than in temperate climates. Furthermore, there are various state-stability metrics relevant for Burkina Faso and Djibouti that point out how fragile their political and security climate is. The Fragile State Index ranks them as 37th and 47th (Country Dashboard, 2020) most insecure states, respectively, and the Political Stability Index, as evaluated by the Global Economy.

The reason for choosing such fragile states is two-fold: Firstly, an analysis into the most vulnerable states should provide the widest margin of error in interpreting results, as the effects are expected to be greater in magnitude and as such easier to measure. Secondly, if it is found that if, even in such hostile circumstances, climate change represents little threat to a state's security, then this thesis would recommend that policymakers direct their attention and resources towards more immediate concerns.

1.1 Research goals

The aim of this thesis is to investigate the relationship between climate change and the security of two states: Burkina Faso and Djibouti. Both states are known to be either exceptionally water-insecure, as is Djibouti, or heavily reliant on rainfall to sustain its primarily agricultural economy, as in the case of Burkina Faso. Their susceptibility to environmental variability and natural disasters opens up the countries to a number of risks if conditions were to worsen at their current pace, making them attractive case studies for an investigation into state security.

Climate change is oftentimes discussed in media as the key contributor to natural disasters such as droughts, floods, or hurricanes, even if only implied. This thesis acknowledges that the environment of many countries naturally allows for such disasters to occur and aims to focus on the relationship between the "change" in climate change and state security elements, so as not to conflate the two. Additionally, the relationship to conflicts is examined, as the literature review indicates a significant amount of debate surrounds this specific issue.

1.2 Research questions

1. Can we identify a measurable impact on the frequency and scale of physical conflict that can be attributed to climate change?
2. What is the extent to which climate change affects the overall security of the selected countries?

1.3 Structure of the thesis

The thesis is composed of nine chapters, but may broadly be viewed as split into two large sections.The first half, particularly chapters two, four, and five, approach the theoretical background knowledge on state security and climate change as well as offer an overview of those topics within the two case studies analyzed. The methodology is located in chapter three, shortly after the theoretical chapter since it has ties to the security aspects discussed therein. Chapter six concludes the review of all relevant knowledge with a literature review.

The second half refers to chapters seven through nine which contains the analytical portion, where the two case studies are approached firstly in a quantitative manner, through a keyword and a multivariate regression analysis, then qualitatively through the Fragile States Index model. Chapter nine then summarizes the conclusions found.

2. Theoretical background

2.1 State security

The purpose of this subchapter is to provide the necessary theoretical background, as the entire analysis revolves around the interaction of two rather abstract concepts – climate change and state security – each of which spans across multiple disciplines. Failing at defining the bounds of these concepts would lead to a lack of frames of reference from which an analysis may be drawn.

State security, or national security, is a concept that encompasses numerous disciplines, many of which may be considered technical in nature. This has made attempts at arriving at a universal definition difficult, as researchers propose various analyses from the natural and social sciences that prove challenging to compare due to differing methodological approaches and, in some cases, may even be limited by regional perspectives (Bock & Berkowitz, 1966). It is a well-known issue and scholars have made numerous attempts at standardizing the definition, yet these definitions are frequently contextualized to the country in which they were made in an attempt to either draw attention to humanitarian issues and injustices, or to direct the policy of the respective nation down a specific path, which reduces its applicability to other nations and makes reaching a consensus increasingly difficult (Baldwin, 1997).

On the whole, the first point of agreement we can find among scholars is that the duty of national security falls first and foremost on the shoulders of the government. The government then turns to its assortment of policymakers and experts to identify areas that are critical to the survival and well-functioning of the state. This appraisal of threats may be the first point of contention among scholars and interest groups.

Shortly following is the next issue, that of the increased interconnectivity offered by technological developments in recent years. Whereas once a state could delineate its interests clearly by its borders and perhaps surrounding states, the advent of satellites, telecommunication systems, global stock markets and other advancements have greatly expanded the ability of a state to affect and, in turn, become affected by actors far beyond its immediate physical reach (Ronis, 2011). Furthermore, it has also increased the capacity of the state to feel threatened, as can be seen by something as abstract as a change in greenhouse gas concentration to cause island nations to shift national policies (UNDP, 2017).

Lastly, the final issue is a tendency for discourse and research on the topic to include progressively more esoteric elements. The concept of state security took off properly with the

advent of the two World Wars and the popularization of the concept by Edward Mead Earle between 1930s and 1950s, prior to which policymakers and interest groups were primarily drawn to the more traditionally realist elements of military, territorial conquest, or direct economic effects when discussing national security (Fergie, 2019). This development can be represented visually by the results of an n-gram analysis with the keywords "national security" and "national defense" plotted across time over the 20th century.

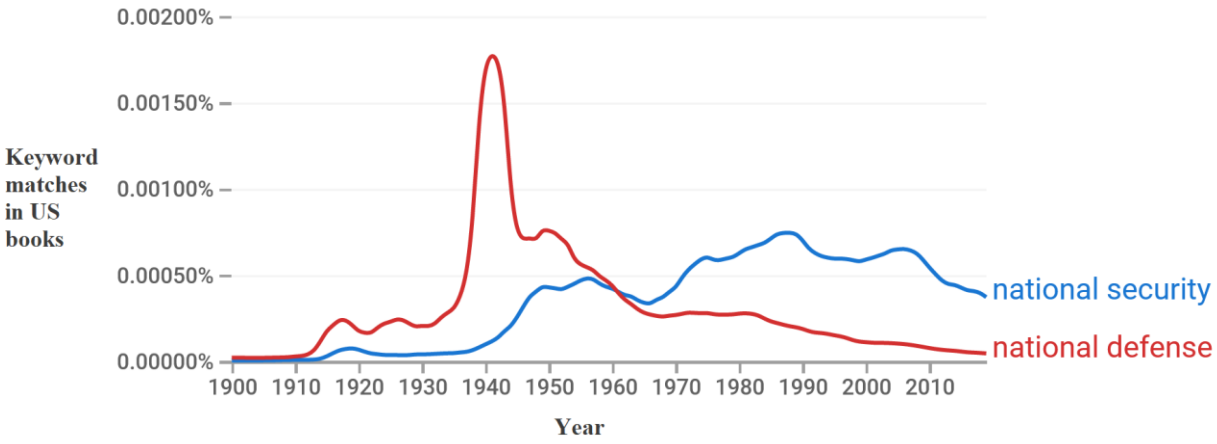


Figure 1. Google Ngram results between 1900-2019 showing change in frequency of appearance of two keywords in US books (Retrieved December 2020)

In this period, the field was very much focused on realist security elements and lacked a certain amount of diversity, of which it has gained a potentially excessive amount in recent years. In the United States for instance, President Trump has allowed national security to encompass such elements as: caravans of refugees crossing from Honduras to Guatemala (Brewer, 2018), foreign automobile imports (Shepardson, 2019), and Chinese ownership of dating apps (O'Donnell, Baker, & Wang, 2019). This behaviour is not limited to the US and may simply be a tool of public political figures to distract the general population, without actually shifting national policy to reflect their spoken words. Even so, it broadens the discussion when one seeks to evaluate what aspects state security is interested in.

In reference to the n-gram analysis, of interest is the downward trend of the phrase "national defense", following the end of World War II and beginning of the Cold War. The assumption is that this has to do with the realization that simply defending against threats merely allows them to build up unopposed until they become too large to ignore. As such, although the data for this visual

is representative of the US only, a similar line of reasoning is likely to have taken hold in the rest of the international community. The counter to this downward trend is an increase in the usage of the phrase “national security”, which has far broader applicability as the security aspect is less reliant on being a domestic or even regional issue. Furthermore, it not only allows for directly offensive initiatives to be sanctioned under the guise of security which may take place a great distance away from the state in question, but also broadens the field of national security so that it encompasses whatever the state desires (Wolfers, 1952; Chacon, 2007). In fact, based on the diverse range of issues mentioned previously by President Trump in the context of national security, it may be argued that any event or action which opposes the interests of the state could be declared as being an issue of national security.

With regards to more academically reputable developments, a similar trend may be noticed, which is discussed in more detail in the literature review. Scholars have increasingly expanded the field of state security from the primarily unidimensional military facet to one that includes economics, food availability, the natural environment, energy, cyber and other types of security (Levy, 1995; Neu & Charles Wolf, 1994; Ronis, 2011; Paleri, 2008). The introduction and exclusion of such fields is a matter of significant academic debate which has been raging for decades but as of yet has not seen a conclusion. If anything, more dimensions are being added, some of which would be quite meaningful to analyze in the context of this thesis’ research area. Choosing to focus on ecological and infrastructure security, while ignoring physical and economic security, would likely yield more salient analyses. However, such cherry-picking for topical relevancy would forego traditionally core components of state security that are of crucial importance to conflict-ridden regions, such as those chosen as case studies for this analysis. Furthermore, these newer proposed dimensions such as human or ecological security are not yet developed enough to offer reliable tools for analyses in relation to climate change at this level.

In the interest of compromise between the past and present, available data, and taking into account the obvious security issues facing the regions in question, this thesis will rely on the Fragile State Index indicators (The Fund For Peace, 2017) as one of the main pillars of analysis. The research performed over the years has identified certain fundamental dimensions that may be considered as the core pillars of the state security field and I believe these are in large part represented by the FSI indicators. It is viewed as a reliable and widely accepted tool for evaluating the stability of states, which contains relevant data pertinent to an analysis of state security. The

indicators are composed of four dimensions, each of which has 3 subcategories, for a total of 12 avenues of analysis. However, given the direction of this analysis, certain subcategories are excluded as they likely have little to no bearing on the relationship between climate change and security[1].

The first FSI indicator is the Cohesion Indicator, which ties in closely to the military and conflict analysis that has been considered core to the field of national security since its conception. Of particular interest here is the Factionalized Elites (C2) indicator, which considers aspects such as ethnic, cultural, or racial societal fragmentation; these have ramifications on state stability in times of persistent resource scarcity (Devlin & S.Hendrix, 2014). The other relevant indicator from this dimension is Group Grievance (C3), which is concerned with any divisions in society, distribution of wealth, and access to resources.

The second indicator examines the economic state of the country in question. It does so by considering three separate aspects. The first being economic Development and Poverty (E1), which is measured both at the level of state and citizen in terms of GDP, productivity, unemployment, and general economic climate. The second refers to Uneven Development (E2), delving into equal opportunities of education, economic prospects, housing, and rights available to citizens, as well as whether there are ghettos and slums, a clear indicator of poor economic development. The third refers to Human Flight and Brain Drain (E3) and measures the extent to which the country's economic and political climate motivates its citizens to relocate elsewhere.

The third pillar of analysis is the Political Indicator, which is represented firstly by State Legitimacy (P1). Here, the relationship between government and citizen is explored. Do citizens have faith in the government and political institutions? Are there mass demonstrations? Insurgencies developing in response to poor governance? There are other aspects such as political opposition and degree of corruption that are also examined but are less relevant to our analysis, yet on the whole it is still a valuable dimension to take into account, particularly because of its measurement of violence against the government. The following indicator is Public Services (P2), which refers to the ability of the state to provide access to basic support and infrastructure for its citizens, such as health, water, telecommunication connectivity, education, and energy. It also measures the extent to which the state and its policing branch can care for and protect its citizens

[1] More information regarding the selection process and on why some are excluded can be found in the methodology section.

from perceived threats, as well as whether this protection is discriminatory based on ethnic, regional, religious, or economic dimensions.

Lastly, the fourth indicator is the Social Indicator, which provides several useful metrics. The first, related to Demographic Pressures (S1), evaluates population growth rate, the exerted pressure of the population upon the state, population access to food and water, and prevalence of diseases and epidemics. Furthermore, it also takes into account environmental developments such as natural disasters and sustainable environmental policies. The second, and also only other indicator of interest, is one regarding Refugees and IDPS (S2) which measures the extent to which the state feels pressured to respond to large population displacements within its territory, whether due to environmental, political, or economic reasons. These displacements put a burden on the state's services and infrastructure and frequently indicates the presence of humanitarian and security issues that the state has failed to address.

2.2 Climate change

Addressing the definitions of climate change is a useful starting point as it will not only make its relationship to state security more clear, but may also lend support to the necessity of action in this field, particularly by states who are at most risk to its effects.

The United Nations Framework Convention on Climate Change (UNFCCC) defined climate change in Article 1 as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (1992). The Intergovernmental Panel on Climate Change (IPCC) offers a slightly different definition: "Climate change refers to a change in the state of the climate that can be identified […] by changes in the mean and/or variability of its properties and that persists for an extended period, typically decades or longer" (Matthews, J.B.R. (ed.), 2018). Of note is the distinction made between causes; whereas the UNFCCC considers human activity to be central to climate change, the IPCC makes no such causational link central to its definition. For the purposes of this thesis, such a link between human activity and climate change is also not the main point of interest.

A more layman's definition is provided by the UC Davis Science & Climate department as: "Climate change refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer" (UC Davis, n.d.).

These changes are widely understood to be severely detrimental on both a macro and micro scale, bringing on a myriad of issues and unforeseen effects far beyond what a slightly higher temperature and variable weather may suggest (Denchak, 2016). There are two sides to this issue that should be addressed: causes and effects. Presuming that causes are identifiable and relevant to our case studies, they are necessary in order to offer any sort of tangible recommendations for remediating them. As for effects, these are required to be established in order to see if links exist to national security. However, given that there are countless specialized researchers, institutions, and international organizations whose sole purpose is to analyze and produce solutions for climate change issues, this master's thesis will instead concentrate its efforts on specifically Burkina Faso and Djibouti in the context of national security, if such a link can be found.

Before presenting each country on its own, the general effects of effects of climate change are listed below; they are already well outlined in great detail in the IPCC Synthesis Report (2014) and countless studies. Among them we can observe:

- An increase in the mean annual temperature of 0.08 ℃ to 0.14 ℃ per decade between 1951 – 2012;
- Acidification of the Earth's oceans caused by CO_2 absorption, measured as a 26% increase.
- Melting of Arctic sea ice and glaciers, along with the thermal expansion of ocean water, led to a 0.19 m rise in global mean sea level from the start of the 20th century until 2010 (Gregory & Kuhlbrodt, 2012).
- Damaging of ecosystems resulting in extermination of lifeforms in climate-sensitive regions (Vergara, 2009).

3. Methodology

3.1 Data set description and terminology

The dataset used for evaluating the climate change – conflict relationship is from the Armed Conflict Location & Event Data Project (Raleigh, Clionadh, Linke, Hegre, & Karlsen, 2010).

The term "conflict event" is borrowed from the ACLED Codebook (ACLED, 2017) with a slight modification. While their official term is simply "event", "conflict" was added in this thesis for clarity as the majority of events were of a conflictual nature, with a few exceptions. The three broad categories listed by ACLED are violent events, demonstrations, and non-violent events – of which there were the fewest[2].

With regard to the regression analysis, the variable "environmental heat and cold exposure (cases)" is taken from the data export tool provided the Global Burden of Disease Collaborative Network (GHDx, 2020). The "cases" refers to the total number of cases in the population, given as the average between high and low estimates. What is meant by "exposure" is unclear. Based on the number of cases relative to the population, it is assumed to mean cases of a medically significant nature such as heatstroke or fainting from heat exposure. Given that cold exposure is not a factor in either of the two cases investigated, it is shortened as "environmental heat exposure (cases)".

A consequence of utilizing the data provided by ACLED means that small-scale conflicts, such as between pastoralists and farmers or other members of rural communities are not listed, which is where we would expect to see the highest response to climate variability and water pressures. While this is a significant drawback into an investigation of conflict-generating causes which limits the utility of the quantitative analysis, the methodology itself should work adequately, with small adjustments, if more granular data is obtained at a later date.

3.2 Counterfactual

The chosen method of assessing the extent to which climate change affects state security is through a form of impact evaluation. Generally, impact evaluation is used to assess the impact a policy or program has on one or more outcomes of interest (Gertler et al., 2011). Instead of assessing the impact of a program, however, I will attempt to assess the impact of climate change

[2] Full definitions may be seen in Appendix 1.

on each country through the FSI methodology, with some modifications and additions. One method of performing impact evaluation is through the use of counterfactuals, which in the case of this thesis is: “What would the FSI state stability index of Burkina Faso, respectively Djibouti, be if climate change had no effect on them?”

The counterfactual may be phrased in this way because the FSI index is evaluated annually and already takes into account the many environmental factors, their interactions, and their change over time. The aim is to identify them, subtract their scoring from the assessment, and compare it to the original final score. The methodology is structured in such a way so as to make the best use of available data to answer this question.

3.3 Methodological limitations

In order to assess the impact climate change has on state security, I have chosen to cradle this thesis’ analytical model in the Fragile State Index’s own methodology, with the final aim of assessing climate change’s effect on each FSI state stability dimension for the two chosen case studies. Given that not every detail of their methodology is outlined, some assumptions and modifications need to be made.

According to FSI’s methodology (The Fund For Peace, 2017), each of the four dimensions of Cohesion, Economy, Politics, and Social is split into three subcategories, each of which is then further divided into three to six topics. The topics themselves have a number of questions associated to them, which are not in any way exhaustive and are meant to be treated as entry points into the analysis. While the questions are more open to interpretation, the topics themselves appear to be central to each indicator’s analysis and as such will be retained without further modifications for this methodology. The primary change that must be made, however, is that the listed topics for each indicator will be treated as if weighted equally in terms of importance on the final scoring, despite little evidence suggesting this is the case.

This adjustment is not insignificant, yet there are ways to mitigate the effect of the changes made. Their methodology makes it clear that aside from this qualitative approach of coaxing the answer out with guided questions, they also rely on interpreting quantitative datasets. Similarly, this thesis will interlace qualitative analysis with a quantitative approach wherever such data is both available and relevant. Furthermore, the final results of the analysis will be represented by a numerical range, instead of one calculated value, which should account for the majority of the

inequal weighting issue at the cost of a less precise final assessment. Lastly, deviations from FSI's line of inquiry will be made if it is found the two countries contain unique characteristics which should, but cannot be, taken into account due to a lack of representative questions from the FSI's methodology to choose from. This will be done either by supplying additional questions under the representative topic within each indicator, or as an addendum to the final score.

Lastly, the methodology will employ the use of a keyword analysis on approximately two thousand descriptions of conflict occurring within the two countries' territories, with the aim of identifying those conflicts that have been motivated by effects commonly attributed to climate change, such as water scarcity, land degradation, or food insecurity. It is expected that the search terms applied may not find all the relevant cases, but the results can be double-checked manually post-search in order to eliminate false positive matches. Furthermore, preliminary analysis of this database indicates that it does not include very low-level, rural conflict between pastoralist communities and farmers, which the literature review suggests is somewhat frequent in the Horn of Africa and similar territories. There is a medium to high likelihood that the descriptions, while short, include enough information to make a keyword analysis viable as a research approach for this thesis.

3.4 Methodology: FSI and keyword analysis

The foundation of this research is reliant on attributing weights to FSI's indicators before conducting the analysis. The units of analysis are *dimensions*: Cohesion, Economic, Politics, Social; *indicators*: C1, C2, … S2, X1; *topics*, which are listed for each indicator; *questions*, which guide the analysis for each respective topic. Certain units of analysis remain unchanged and maintain their current score, if it is expected that they have little or no relation to climate change effects.

To begin with, we continue with the assumption listed in the previous section that the topics within indicators are weighted equally. Consequently, the maximum impact a given topic can have on its parent indicator is given by the formula $\frac{t_i}{n}$,where t_i represents the topic in question and n represents the total number of topics within its parent category. The sum total of the weights of topics within each dimension d is so that they are equal to 1. In the majority of cases, this will mean each topic explains 25% of its indicator's final value since most indicators have four topics.

With the weights for topics established, the next step involves dividing the score of each indicator by the number of topics that were involved in its assessment. This is done for each year that is analyzed, after which the mean for these values is calculated as a robust estimate of the security situation for each country in the determined time period. For Burkina Faso, this period is 2013 to 2019, while for Djibouti it is 2012 to 2018; the difference being necessary due to limitations caused by data availability.

As an example, Burkina Faso is provided a score[3] of 7.2 in the year 2013 for Security Apparatus (C1), within the overarching Cohesion dimension. Given that the indicator C1 has four topics, it means that on average, the topics had a score of 1.8 out of a maximum of 2.5. If it is found that there is a topic which is likely to be affected by climate change, it is re-evaluated and calculated under the presumption that the issues generated by climate change had no impact on the indicator whatsoever, thereby assessing the extent to which that indicator has, or has not, been affected. However, the adjusted value cannot become greater than 2.5 in this example. If climate change is expected to have no impact on the indicator, it is left as is.

This can be done because there are questions within the topics that, based on the literature review and theoretical background research, have a medium to high likelihood of being affected by climate change. By analyzing the climate change variable on the topic and removing its effect, one may see the extent to which the final FSI score is affected. In order to do this, however, the analysis will need to establish the degree to which climate change has the ability to affect each topic. This may be achieved through a combination of qualitative and quantitative observations that will result in the creation of a variable for each topic, on scale of 0% to 100% representing the effect climate change has on the topic in increments of 5%, based on the questions that are listed under each topic and the available literature as supporting evidence. This variable will be assigned twice, first as a lower bound estimate of the minimal effect climate change has on it, then as an upper bound estimate reflecting the maximum effect. The resulting multiplication between itself and the weighting acting as the score for the topic at hand, as shown below:

$$Topic\ score = topic\ weight\ \times effect\ of\ climate\ change\ on\ topic$$

[3] Scores are given as 0 – 10, with smaller values being better than larger ones (FSI-Methodology, 2017).

Table 1. Selected units of analysis and their associated weightings

Dimension	Indicator	Topic	Weight
Cohesion	C3 – Group grievance	Divisions	25%
		Communal violence	25%
Economy	E1 – Economic decline and poverty	Economic conditions	25%
		Economic diversification	25%
Political	P2 – Public services	Health	20%
Social	S1 – Demographic pressures	Population	20%
		Public health	20%
		Food and nutrition	20%
		Environment	20%
		Resources	20%
	S2 – Refugees and IDPs	Refugees	33%
		IDPs	33%

With regard to the quantitative analysis, there are two sources that can be relied on. The first is survey data provided by the World Bank in the form of microdata, which is imported into PSPP and Microsoft Excel then interpreted on a case-by-case basis for each appropriate topic, particularly those that deal with population perception.

The other set of data is provided by the Armed Conflict Location & Event Data Project (ACLED), which allowed for the export of conflicts and conflict-related data within the territories of Burkina Faso and Djibouti for the time period of interest within this analysis. Most importantly, each conflict is given a short description which generally outlines the causes, effects, and notable events that occurred. A keyword analysis is then performed upon each description using terms which indicate environmentally-caused issues. The results are then examined to determine the relationship between climate change effects and conflict frequency or scale in the context of all conflicts that were logged in the database.

Additional smaller data sets, such as from the Global Health Data Exchange or World Bank, are relied on as needed during the analysis.

With regard to formatting, in order to prevent the consistent usage of “low” or “high” in table headers, the columns representing a low estimate or score are written regularly, while the column representing the high value for that variable will be denoted by the prime symbol ′.

Lastly, while each topic is its own unit of analysis and has a separate classification in FSI’s methodology, it was found that many of them present comparable problems for a state and their

interaction with environmental variability are similar enough to merit combining under the same analysis. These are: divisions (C3) and communal violence (C3); economic conditions (E1) and economic diversification (E1); health (P2) and public health (S1); food (S1), environment (S1), and resources (S1); refugees (S2) and IDPs (S2). Despite being merged in the same analysis, they retain their individual weighting and are scored separately in the end.

3.5 Regression analysis

When speaking of climate change's effects on a country the primary concerns relate to the evident temperature increases, weather variability, and amount of precipitation. In terms of this thesis' analysis, the interest lies between the effect of these factors on the scale and frequency of conflict. The other security aspects under the umbrella of FSI indicators may be assessed qualitatively.

Data availability introduces several issues, shared between both regression analyses. The scale of conflict events is not available, meaning an arrest of a political activist is treated as being the same as a formal, organized protest of thousands in the capital. Each is referred to as one event. The time frame for each unit of analysis in the regression is chosen by the most common denominator, which in the case of this data set was the variable "environmental heat and cold exposure (cases)". Since this variable was only available on a yearly basis between 2002 – 2016, events and other variables needed to be computed as a sum, or average, for each of those years. Given that temperature variability is practically non-existent over these time frames, it is excluded from the analysis. The result of this set of compromises, as well as the lack of control variables, makes a qualitative evaluation in conjunction with the regression obligatory, particularly with regard to the other, non-conflict security aspects.

The chosen variables are as follows:

Dependent variable (Y_i):

Conflict events (Y_1).

Independent variables (X_i):

Precipitation, mm per year (X_1).

Environmental heat and cold exposure (cases) (X_2).

Renewable internal fresh water resources per capita (m^3/inhabitant/year) (X_3).

With regard to the third variable X_3, data was only available for four out of fifteen years, as listed below:

Table 2. Availability of data for variable X_3 (World Bank, 2020)

Year	**2002**	*2003-2006*	**2007**	*2008-2011*	**2012**	*2013*	**2014**
Burkina Faso	1017	-	877	-	754	-	711
Djibouti	401.6	-	372.5	-	345.6	-	338.8

Linear interpolation was used to calculate the data for missing years under the assumption that the year-over-year change was linear. The following formula applies:

$$\hat{y}(x) = y + \frac{(y_{i+1} - y_i)(x - x_i)}{(x_{i+1} - x_i)}$$

Where $\hat{y}(x)$ is the estimate for the year in question and y is the amount of renewable fresh water resources per capita for the year x.

4. Burkina Faso overview

4.1 Security aims

Given the various considerations on what constitutes an element of national security, it may be appropriate to evaluate what Burkina Faso itself thinks of its security and how it prioritizes its issues.

Burkina Faso has faced significant security challenges from the terrorism and violent extremism endemic to the region for the last twenty years, which have been tied to the socio-economic and political climate of the country (Ouédraogo, 2018). In terms of physical violence and conflict the most recent factor may be traced to former President Blaise Compaoré's attempt at modifying Article 37 of the Constitution in order to run for a third term of presidency. The response to this by the general population has been characterized by outrage and uprising in 2014, which lasted approximately one year until a new President, Roch Marc Christian Kaboré, was elected democratically. While these developments appear dire and require immediate attention, it is not a drastic change for the country's security climate.

In 2004's Defense Policy, the country highlighted its strategic interests across three ranks: (1) the peripheral interests related to its commitments to the international community's involvement in assisting establishing peace and security in the region; (2) its strategic interests were expressed as a desire to end extremism and terrorism in its regional sphere; (3) its vital interests reiterated a need for sovereignty and the safe, continued existence of its people. (BFA National Defense Policy, 2004). Evidently, the state has struggled against physical violence for a long time, yet at this point none of the expressed interests directly relate to either economic, societal, or environmental aspects. More recent official documents indicate that this is no longer the case and that its ability to perceive threats has increased significantly.

In terms of climate change, the economic damage of floods and droughts and related effects are rather significant. 2009 saw some of the worst flooding the country has ever experienced, culminating in $102 million in damages and another $120 million in reparations, representing a sum total 2.65% of the country's GDP at the time (UNDP, 2017). These disasters, even when addressed, tend to have lingering effects for multiple years and prevent even economic development, adding to the risk that those deprived of basic necessities feel alienated and turn towards violent groups instead of the government for assistance. The Plan National de

Développement Économique et Social[4] (PNDES, 2016) has published a report which identifies climate change as one of the core issues the state's economy faces, primarily due to the structural inadequacies of the agricultural industry which make it particularly susceptible to exogenous shocks. The other assessed risks are: (1) the risk of security degradation; (2) sociopolitical issues; (3) financial risks; (4) the risks associated with the international and regional economic situation. The reason why the state of the environment is critical to Burkina Faso's economy is explained by GDP, as agriculture took up between 28% and 31% of the entire country's GDP in in the 1994 – 2014 period and the worsening climate is expected to impact its core revenue stream.

The Stratégie Nationale de la Sécurité Intérieure[5] represents a massive effort on behalf of government agencies to address security issues at various levels, the highest of which being the international context. At this level, four threats are identified: (1) The international economic and financial situation, where Burkina Faso feels that the gap between wealthy and developing countries is widening and its reliance on the dwindling official development assistance (ODA) hurts its position; (2) proliferation of arms which sometimes find their way to hostile regional actors; (3) the spread of epidemic and endemic diseases; (4) climate change (Academie de Police, 2016). Of the four, we may expect that climate change will aggravate two of its security threats and is even assigned its own class-risk. The wording of the report also suggests that the state considers itself to be a victim, to a certain extent, of the polluting done by the larger and more developed members of the international community, and that there are two primary consequences for its domestic situation. The first is that climate change causes increased resource scarcity and is cause for conflict for many of its rural citizens. The second is the increased risk and magnitude of natural disasters along with disruptions to seasonal rhythms, hindering industries central to its economy and generating demographic pressures. In terms of more domestic concerns, the report points out several issuss: (1) population growth and urbanization; (2) economic dynamics; (3) foreign interference and subversive activities; (4) terrorism; (5) human trafficking and money laundering.

[4] National Plan for Economic and Social Development (2016 – 2020). For reference, the cost of the implementation of this plan was quoted at approximately €23 billion, of which Burkina Faso could finance 63.8%. The 2009 flood amounted to 1.5% of the amount of money the government could allocate for the PNDES initiative in upfront costs for reparations, plus an unknown amount in future damages.

[5] National Strategy for Internal Security.

Lastly, we have the report from the Ministry of Security outlining the details of the Forum National sur la Sécurité[6]. It was unanimously agreed that the first issue that needs addressing is the cross-border crime and conflict, which most assuredly referenced the spill-over effects of the war in Mali. Tejpar and Lins de Albuquerque (2015) mirror this concern in their assessment of armed conflict and transnational crime in Western Africa, highlighting the role of institutionalism and economic relations in limiting these wars. Given that the economy in Burkina Faso is heavily reliant on agriculture, it makes sense that the Forum considered climate change to be the second issue which needs addressing. The other identified security concerns related to demographics and gender inequality; corruption and economic crime; and insecurity linked to new technologies.

As of this moment the most pressing security threats have presented themselves in the form of physical violence and terrorism in the northern regions of Burkina Faso, arising from the conflict between the Malian government and jihadist forces and which has crossed well past Mali's borders (ISSAT, 2020). The country's inability to handle this situation well is likely caused by the poor transition of power between former president Compaoré, who held 10% of the state's military force in the form of a Presidential Guard, and his successor. The Presidential Guard was dissolved and its members either deserted or were arrested, simultaneously hindering the ability of the state to project military force internally and further weaking public trust in security institutions. The consequence of this series of events led to over 765,000 IDPs and refugees, placing a heavy strain on the country's budget (World Bank, 2020) while also providing an effective mechanism for the spread of crime and epidemics.

International organizations have offered their own assessments which echo Burkina Faso's concerns. One country partnership framework in partnership with the UNDP outlined and ranked nine different risk categories, among which the ones with the highest risk rating were macroeconomic, fiduciary, environmental and social, and security (World Bank, 2018). Overall, the environmental concern appears to be a recurring theme for various branches of government when discussing security. While it is considered its own issue, it is closely interlinked with other elements such as demographic concerns, health of the economy, and violent conflict.

[6] National Forum on Security, 24-26 October 2017.

4.2 Climate situation

The climate effects discussed in chapter 2.2 are already troubling, but are cause for twice the concern for underdeveloped, conflict-ridden states that are located in regions susceptible to such changes. Burkina Faso is precisely one such state, being a landlocked state in Western Africa which lies partially along the Sahel in its northern areas. Its environment is characterized by a dry, tropical climate that shifts between a short rainy season between June and September and the significantly longer dry season for the rest of the year (UNDP, n.d.).

The importance of climate cannot be understated for the Burkinabé, as 80% of the them rely on agriculture and livestock (Oxfam, n.d.), yet most of the country relies on rain-fall dependent crop (Lenhardt, Glennie, Intscher, Ali, & Morin, 2014). Accepting the premise that climate change brings about more variable weather along with higher average temperatures, it has the potential to severely affect the life-cycle of crops if the government and agricultural sector is unable to adapt rapidly and effectively enough. Even assuming rainfall averages remain constant, higher average temperatures raise the amount of evapotranspiration[7], drying the soil. This increases the general demand for water which decreases its availability, harming agricultural and animal husbandry activities. Average evapotranspiration amounts to 100 mm per month, spiking between February and March when it can reach up to 200 mm.

One worrying aspect is related to demographics, which directly ties into the state's already-strained agricultural capacity. Burkina Faso, much like most of Africa, experienced continuous development in its annual population growth rate year by year since 1961, climbing from a meagre 1.34% then to 2.84% in 2019 (World Bank, 2020). Lenhardt et al. (2014) argued that this growth is frequently concentrated in the Central Plateau, which is thought of as one of the most environmentally fragile regions in the country. Furthermore, they found that periods of heavy environmental strain are linked to migration from Burkina Faso to neighboring states, due to the country's infrastructure having difficulty in supporting its population during environmentally challenging periods. At times, population in rural villages would decrease by more than 25% since local environmental circumstances were so dire (Reij, Tappan, & Smale, 2010). Some of the climate-related disasters relevant that drive these migration patterns are dust storms, heat waves, droughts, and floods (Climate Risk and Adaptation Profile, 2011).

[7] The sum total of transpiration from vegetation and evaporation of water from the Earth's soil and bodies of water.

Another point of concern is the aftermath of rapid, unrestrained population growth. Population bulges lead to an unfavorable dependency ratio – a ratio which describes the relationship between the portion of population that is too young or too old to work and those engaged in the labour force, with values closer to 0 being favorable as it indicates only a small portion of the population cannot contribute to the nation's productivity. Burkina Faso had a dependency ratio of 94.5 in 2010 (World Bank, 2020), which was 13.3 points higher than the average for all of Africa at the time. It has since fallen to 88.9 in 2019 and is projected to keep falling for the foreseeable future (UN, 2019), however is still considered to be quite high relative to most other states. While a high population growth rate and unfavorable dependency ratio is not an effect of climate change, it is closely interlinked as it places growing pressure on the state to care for a greater number of people on a dwindling supply of resources. Doing so with a large elderly and young population would prove an excessively challenging task that may have to become considered a matter of national security.

Considering its geography, we may view it as being divided into three portions, each with its own characteristics, rainfall averages, and environmental concerns.

The northern region, bordering Mali and Nigeria, is known as the Sahelian zone and sees the lowest amount of precipitation – less than 600 mm/year. It is also a part of the country that has seen a tremendous amount of instability in recent years. Between January 2019 and March 2020, the number of internally displaced people (IDPs) grew from 50,000 to 765,000 (World Bank, 2020), stressing infrastructure, halting education, and generally wreaking havoc on the country's ability to care for its citizens – leading to massive economic, security, and humanitarian issues. The economy is particularly susceptible to such events, as can be seen from past events: while GDP growth in the decade preceding 2013 averaged 6%, it fell to 4% in the following two years, largely due to the Ebola epidemic and political upheaval (IFAD, n.d.). A similar impact on the economy may well be expected if the conflict ravaging the northern region continues at its current pace, as the local climate-related disasters have been linked to epidemics of meningitis and cholera among other risks such as food insecurity and higher levels of poverty (Climate Risk and Adaptation Profile, 2011). Despite these findings, the African Development Bank offers the conflicting and surprisingly less pessimistic forecast of 6 - 6.1% by 2021.

The other two geographically separate regions are the north-sudenian zone which runs through the center of the country across the Mossi Plateau, receiving between 600 and 900 mm of

rainfall per year, and the more humid south-sudenian zone averaging 900 to 1200 mm of rainfall per year (Climate Risk and Adaptation Profile, 2011). These areas see less conflict than the northern region and generally fare better in terms of rainfall, though disasters such as flooding and droughts still remain an issue.

By 2050, the United Nations Climate Change Adaptation program forecasts that temperatures will increase by 1.4 - 1.6 °C and rainfall will decrease by 10%, indicating that the environmental issues experienced today are only going to become more severe and that steps need to be taken to manage the agricultural economy and bushfire disasters. Given that the African Development Bank recommends that the Burkinabé government continue to invest in agricultural reforms and infrastructure for higher returns in order to fund the security issues plaguing the country – with Burkina Faso following through with this suggestion in 2019 (ADBG, 2020) – it falls into question how they will finance military ventures if their land and environment will become unable to support them.

5. Djibouti overview

5.1 Security aims

The Republic of Djibouti is a coastal state with access to the Gulf Sea and Horn of Aden and is one of the smallest countries in the Horn of Africa, bordering the larger, stronger nations of Eritrea to the north, Ethiopia on its western flank, and Somalia along its southern border. Its geostrategically valuable position allows it to host one of the largest ports in Africa, since it is in close proximity to the strait of Bab-el-Mandeb, as well as the presence of military forces from numerous international powers. While acting as a strategic hub and logistics point for stronger international powers goes a long way in stabilizing the region, it has a number of systemic problems stemming from an unfavorable demography, rigid economy which is susceptible to external shocks, and poor environmental conditions. The fragile balance of these elements stands to be uprooted in the coming years due to the heightened interest of international actors in establishing a military and economic presence in Djibouti – such as China with its Belt and Road initiative, regional instability spilling over from neighboring states, or due to its declining environmental security making true its old moniker of "Hell of Africa" (Schraeder, 1993).

The interest of global actors in Djibouti's security is reflected in the attention it receives from academics and international organizations. Its value to interested states is largely reliant on its geostrategic location, with authors even going so far as to claim the state qualifies as an example of an abstract "resource curse" situation, due to the discrepancy between the income its position brings it vis-à-vis its real economic and social development (Brass, 2008; Hawes, 2019). As an overview, there have been a number of organizations which have put forth detailed reports showcasing the country's primary threats: lack of food security (WFP, 2019); environmental issues (UNFCCC, 2015); demographic challenges (UNDP, 2017); economic weaknesses (Kireyev, 2018; World Bank, 2018). While these assessments are valuable, Djibouti's political elite and governmental agencies have themselves spoken up about its security interests, and their own evaluation deserves mention.

In July 2019, President Guelleh has spoken up about a restructuring of priorities and identification of threats. In this address, allusions were made to previous security issues, implying they still exist and are not forgotten. In addition to these, environmental, economic, and cybersecurity threats stemming from new technologies were explicitly added to the list (République de Djibouti, 2019). The country's 2035 Vision report, made prior to the President's

speech, shines a light on what security issues were alluded to in the speech, listing: demographic issues caused by the very high growth rate and influx of population to the city from rural areas; stabilization of the volatile political climate; reduction in economic inequality among its citizens and macroeconomic equilibrium among industries; establishing basic food and water security; resolving socio-demographic issues of education and healthcare which need to be urgently addressed (Republic of Djibouti, 2013).

The regional dynamic also adds a number of uncertainties which Djibouti may be keen to rid itself of. One such risk manifests itself as China's Belt and Road Initiative, which arguably has imperialistic tendencies and coerces states into giving it a foothold in the region in exchange for economic and trading benefits (Thrall, 2015). While the assistance that comes with it is immediately beneficial, it requires it to play a delicate balancing act with those powers who are less enthused by China's encroachment. Given that countries such as the U.S. and Japan seek to counter China's expanding influence in the region (Reuters, 2016; Blanchard & Collins, 2019), it might seem that it is in Djibouti's best economic and safety interests to play both parties against each other; yet this gamble runs the risk of alienating either member. Moreover, while Ethiopia has been a long-standing ally of Djibouti, supplying it with electricity, water and other key resources in exchange for access to its port, Ethiopia's desire to add more ports in order to spread out its risks is a lesson learned from its previously beneficial relationship with Eritrea – who had also granted it access to its own port, up until relations soured and it stopped doing so (Lilley, 2018).

On the one hand, Djibouti can capitalize on this boiling pot of interests. Ethiopia's usage of Djiboutian ports earned Guelleh's government between 1.5 and 2 billion U.S. dollars in 2018 (Ethiopeia Observer), while the leasing of military bases earns it a consistent $120 million per year for multiple years[8], depending on the deal agreed, as well as serving as a threat deterrent for hostile actors (Lilley, 2018). On the other hand, this economic and security reliance on foreign actors means it is externalizing agency, placing the well-being of the state on the whims of actors who have their own interests. This is a choice the state has faced for a number of years at this point and it has consistently chosen one option over the other. Answering the "Why?" to this question should yield insight into the true security interests of the state; an approach based on Hans Morgenthau's

[8] This figure only represents the leasing of military bases to France, U.S., and China.

(1948) views that we should direct our analysis towards the actions and consequences of statesmen, not their words.

The age-old "follow the money" catchphrase is a pithy and appropriate method for tackling this question. Djibouti has pursued this strategy of relying on its geostrategically valuable position to attract foreign powers into its borders and ports ever since President Guellah's ascent to power at the turn of the millennium, who has earned foreign powers' political support as well as their financial backing through trade and the leasing of ports (Igrouane, 2019). In this time, he has doubled the GDP of the country, consolidated his hold over the country, and has allowed his extended family from the sub-clans of Issa and Issaq to establish an oligopoly over various sectors of the economy and government (Crisis24, 2020; World Bank, 2020), all the while providing the country with a very favorable yearly GDP growth rate of 5% – 8% from 2014 to 2020 (World Bank, 2020). Despite the influx of money and economic growth, the country's Human Development Index is one of the lowest in the world at 172nd out of 188 countries, basic and extreme levels of poverty are 41% and 23%, respectively, and unemployment affects 39% of the population (UNDP, 2017). There is also significant political instability as opposition grows and is snuffed overnight repeatedly, signifying a large portion of the population is displeased with the current state of affairs.

At this point we may notice dissonance between the security interests of the state and the security interests of its people. The central government wishes to maintain its hold over its current financial instruments and security guarantors while a large portion of the population is concerned with the more immediate food, financial, and health-related concerns. In essence, the political leadership of Djibouti has started the country down a path from which any hesitation or change in plans aside from moving forward may have significant destabilization effects, akin to riding a bicycle downhill with only front wheel brakes. However, internal pressures from its society may eventually become strong enough to pressure the central government into change. One way this could happen is through intra-African trade with regional partners, as it has been linked to a significant reduction in food import dependency and food security (FAO, 2016) – one of the key security issues it faces. Instead of relying on the same great powers and international organizations, strengthening its relations with its continental neighbors would spread out its risks and decrease its reliance on stronger powers such as the U.S. or China, granting it more bargaining power in the process.

5.2 Climate situation

Djibouti's capital, Djibouti City, faces the Red Sea and the Gulf of Aden to the east and houses 65.5% of the country's 973,560 inhabitants, leaving only 16.5% in the other coastal urban centers and approximately 18% of living in rural areas (Raey, 2010; World Bank, 2020). The distribution of this population may be explained by environmental determinism, as the country has primarily rocky terrain and uninhabitable plateaus, which are interspersed with rocky mountains generated by volcanic activity (UNDP, 2020). There is also very little incentive for its citizens to live in rural areas, as 89% of the country is desert and only 10% is pasture, making agriculture or animal husbandry practically impossible. Mean annual rainfall of 150 mm acts as the final metaphorical nail in the coffin for any nation-wide ambitions of food production (UNDP, 2020).

In terms of climate-caused challenges, droughts are by and large the most devastating due to the already paltry rainfall Djibouti experiences yearly, along with the sparse sources of potable water. One report from 2011 investigating the types of disasters correlated with climate change between 1980 and 2008 in Djibouti examined 24 such disaster events. It found that 33% of the country's population was affected by droughts, with earthquakes, floods, and epidemics each affecting another 21% of the population (WFP, 2019). The 2035 Vision report also mentions that the country cannot yet sustain its current water requirements – estimated at 25 million cubic meters in 2013 – of which it can only supply 14.8. This means an annual deficit of approximately 10 million cubic meters of water annually which may be expected to increase as population levels steadily increase and water sources fail to replenish themselves rapidly enough (Republic of Djibouti, 2013).

While the epidemic issue may be explained by poor sanitation due to water scarcity, nomadic groups or displaced migrants – 100,000 of which came to Djibouti from Ethiopia and surrounding states (OCHA, 2019) – who are forced to relocate due to the climate's variability, it is almost paradoxical that flooding has such a large negative effect on one of the driest nations on Earth. This may be explained by the extremely volatile weather and the complete lack of socioeconomic development to fund the water infrastructure necessary to handle such events; investments for long term prevention of water drainage and soil management are deemed secondary to the myriad of immediate short-term concerns plaguing the country.

Looking at past data, it would seem that the number of people affected by droughts is also increasing. Between 1980 and 1996 approximately 260,000 people were affected, while that

number rose to 580,000 between 1997 and 2008, suggesting the severity of the issue to be more than twice as high (World Bank, 2011). However, after taking into account the average population growth rate between the two periods of 47%, ceteris paribus, the adjusted number of people that would have been affected in the second period would only be 307,400. The new comparison thus suggests the severity of droughts has increased by approximately 18% over a period of 28 years.

Much like in Burkina Faso, such disasters tend to push desperate families to migrate to neighboring states where possible. Due to most of the population being concentrated in Djibouti City, however, the number of IDPs is relatively lower than in Burkina Faso. Unfortunately, the steady demographic shift toward the east coast opens it up to a new issue: sea level rise. While Djibouti has 314 km of coastline, due to the cultural, economic, and demographic concentration in the capital, that is the area that will receive the most focus in this thesis. In 2017 for instance, Djibouti City had a population of 562,000 while each of the other major cities along the coast had under 50,000 inhabitants (CIA, 2020). The coastline ecosystem is the first line of defense against flooding for the city, containing coral reefs, mangroves, and estuaries; each of which have degraded under the effects of anthropogenic activities and climate change. While discussing anthropogenic activity seems counterintuitive when examining the relationship between climate change and state security, the higher temperatures experienced by Djibutians lead to a higher rate of evapotranspiration of the land, which itself forced a portion of the population out of pastures towards the coastline. This results in both a reduction in livestock as well as harming the sustainability of fisheries, indirectly leading to higher food insecurity than merely losing livestock.

Aside from the impact on food security, the rising tide can result in river and groundwater degradation via salinization. One recent study examined the effect of sea level intrusion on the coastal aquifer Tadjourah in Djibouti, which sustains a small town of 21,000 people, and found that the degradation of potable water was both significant and worrying (Razack, Jalludin, & Houmed-Gaba, 2019). Given the consistent exploitation of perennial and underground sources of drinkable water by coastal communities in recent years, it is not considered a course of action that may be sustained indefinitely (Kireyev, 2018). Worth noting is that flooding is a poor system for recharging ground aquifers, as the type of soil present in Djibouti results in most of the water either being lost as run-off or evaporation, with only small amounts recharging groundwater supplies (World Bank, 2011). Lastly,

The increase in severity of these environmental disasters is a result of an increase in mean global temperatures attributed to climate change. While this is well known, what is concerning is the rate of change exhibited in the Horn of Africa compared to the rest of the world. Osima et al. analyzed the climate data of 1971 – 2000 against pre-industrial levels (1861 – 1890) in the region alongside the fifth assessment report from the UNFCCC which projected a 1.5 – 2 °C in terms of mean global temperature increase. The results of the analysis suggest that climate hotspots like the Horn of Africa are expected to experience surface level temperature increases 0.5 – 0.8 °C higher than the 2 °C projection, with the lower end being experienced by coastal regions such as Djibouti and higher end experienced by the more inland regions such as Sudan and Northern Eritrea (2018, p. 8).

With regard to the economic consequences, there are several climate assessment models that rely on mathematical and statistical techniques which have attempted at estimating the costs of adaptation (Kireyev, 2018): the Climate Framework for Uncertainty, Negotiation and Distribution (FUND) estimates 2.7% of Djibouti's GDP per year should be allocated for adaptation by 2025; the Policy Analysis of the Greenhouse Effect (PAGE) projects, with 5 – 95% certainty, that costs would amount to 0.4% - 4% of annual GDP by 2040, but may increase to up to 10% of annual GDP by the end of the 21st century and would be impossible for the economy to sustain; the Regional Integrated Climate-Economy model (RICE) provides recommendations based on three different climate scenarios, each of which are similarly pessimistic and suggests costs may reach 450% of GDP if no adaptation measures are taken (Kireyev, 2018). As of 2015, nearly €100 million were invested into the adaptation measures, which amounts to approximately 12% of the required sum for the 2°C scenario offered by the UNFCCC (Intended Nationally Determined Contribution of the Republic of Djibouti, 2015).

6. Literature review

When speaking of the relationship between climate change and state security, we must first briefly return to the concept of state security. It may include various elements ranging from physical security, to political stability, to food security, and so on; as discussed in the theoretical background chapter. Of these, the academic literature and reports from reputable international organizations appear to be overwhelmingly in favor of drawing a positive correlation between climate change and several of these security elements, with one exception: physical conflict. Consequently, this chapter will briefly summarize the views of the academic community on the first point, which draws the most agreement, after which it will more closely examine both sides of the issue of physical conflict to see where the disagreement lies, as it is one of the more pressing concerns of this thesis.

6.1 General negative effects of climate change on African states

The physical distribution of resources and environmental circumstances are not uniform across the world, or even across the same continent, so it is reasonable to expect that climate change affects states differently based on their own circumstances. Taking this into account, the literature review section focuses primarily on Africa for relevancy, where we notice relationships being made to economic and food security, as well as political stability.

In terms of economic impact, a Working Paper for the IMF by Kahn et al. found that variability in climate leads to uneven macroeconomic effects largely dependent on the country's development and wealth, which determined how well it can adapt in the short-run (2019). In other words, less prosperous states experience a proportionally larger impact on their economy in the short- and medium-run, which is hypothesized to be caused by a combination of factors, among which weak adaptability and poor governance are expected to be the stronger correlative factors (Busby, Smith, & Krishnan, 2014). Furthermore, the study highlights non-linearity between a rise in temperature and effect on the economy, and even finds long-term effects in the form of comparatively weaker economic growth (Busby, Smith, & Krishnan, 2014). An analysis of adaptation costs to climate change by UNEP also suggests that economic consequences will be more severe for African states than in most parts of the world, estimating 1.5% - 3% of GDP/year in terms of costs (UNEP, 2010). Most of these findings, barring the non-linearity relationship, are

supported by other studies such as Jones & Olken (2010), Heal and Park (2016), and Acevedo et al. (2018).

With regard to food security, we may expect repercussions for both human and economic security. The IPCC has outlined both positive and negative effects, depending on the inherent traits of the environment in question, such as latitude, biodiversity, or the state's reliance on agriculture (Field, et al., 2014). Additionally, it is expected with high certainty that major crops' yields in the tropical and temperate regions to decrease in response to temperature exceeding 30 °C, affecting food availability and pricing. For countries such as Burkina Faso this is especially damaging due to the sensitivity of the population to additional economic pressures. Furthermore, premature drying of surface water has been linked to a weaker animal husbandry industry, further limiting food availability and generating pastoralist-farmer tensions in states where such relationships exist (Brown & Crawford, 2008).

The relationship to political stability is significantly more convoluted. One notable article which sparked discussion in this field is "The Coming Anarchy" by Robert Kaplan (1994), who strongly believed politics should be closely interlinked with the public health and general state of the country's environment. He drew attention to the rising population in Africa and the displacement occurring due to environmental degradation, citing Egypt's receding coastline as an example. Shifting our attention south along the Red Sea, we notice Djibouti City with 41% of its population in the Low Elevation Coastal Zone (McGranahan, Balk, & Anderson, 2007) due to rural areas becoming increasingly inhospitable, with flooding exacerbating the spread of malaria with 16,000 cases in 2016 compared to 24 in 2012 (UNDP, 2017). The current understanding is that this health insecurity, economic risk, and forced displacement build off one another in a cascading effect that is likely to cause regional political instability, though there are some concerns regarding the causal mechanism outlying this relationship (Strategic Studies Institute, 2008). One notable hypothesis is attributed to Ted Gurr in the SSI report, who is quoted as suggesting that higher poverty levels generate perceived threats of depravation and injustice which frequently led to civil violence; this is in turn supported by data correlating low HDI correlates with violence in Indonesia (Strategic Studies Institute, 2008). When 65% of Africa's population is entrenched in the agricultural industry (Serdeczny, et al., 2017), external pressures have the potential to significantly upset their economic wellbeing (Ringler, Zhu, Cai, Koo, & Wang, 2010), risking their satisfaction

with the political leadership and drawing Western powers into regional conflicts (Brown & McLeman, 2009).

6.2 No significant correlation, inconclusive, or weak effect of climate change on physical conflict

There have been a number of studies which disagree with the premise of climate changing having a significant, if even measurable effect, on the level of physical conflict in a state or region. One study reviewed 44 publications in prominent political science journals between 2015 and 2017 which studied the effect of climate change on violence – specifically politically-motivated violence against the state – and found that none of the authors could claim that climate change can act as a sufficient cause for conflict (Theisen, 2017). While the study makes no claims regarding violence of individual against individual, such as pastoralist-farmer conflicts in Burkina Faso, it does seem to indicate that climate change has so far shown little to no potential of causing politically destabilizing conflicts. Another of the author's grievances was that the methodologies behind most climate change-security studies are unable to establish sufficiently concrete causal chains between the environmental variability and the conflict in question.

Meierding echoes this criticism, claiming researchers "have failed to uncover consistent linkages between environmental shifts and intrastate contention" (2013). The main issue so far appears to be that there are exogenous factors such as historical context, longstanding racial tensions, or other similar factors which introduce a degree of bias that researchers tend to, knowingly or otherwise, rely on in order to gently support the assertion of conflict being generated by climate change pressures. Some authors, such as Hauge and Ellingsen (1998), were aware of these issues early on and took great care to approach the issue with a sound methodology, controlling for other conflict-generating causes. Their findings suggested that while added climate pressures do increase the risk of conflict, particularly of the low-level kind, it was a significantly weaker predictor for violence than other variables such as degree of economic development or the type of political regime. Raleigh and Urdalb (2007) corroborated these assessments using IPCC climate models applied to past data, using small, geographical units of analysis, and arrived at nearly identical conclusions.

As opposed to methodological critiques and holistic analyses, others have taken a more direct approach with specific case studies that were chosen for the apparently obvious relationship

between environmental change and regional conflict, as Linke et al. did with Kenya (2015) and De Juan with Darfur between 2003 – 2005 (2015). Despite the change in approach, both papers arrived at similar conclusions as their predecessors, finding little relationship between the severity of droughts or general climate variability with the frequency and scale of conflict. Instead, the social context of inter-ethnic community dialogue was found to be sufficient at attenuating environmental pressures, while formal, institutionalized rules – such as governmental ones – had little to no effect on reducing possibility of conflict. Applying rational choice theory from a social and economic context, we should assume that in periods of food, water, or economic scarcity, actors engaging in physical conflict run the risk of burdening themselves with added pressures. Salehyan (2008) builds on this view but points out how the hypothetical of violence may be used at the negotiation table, sometimes even more effectively than violence itself, given that it presents little to no added risk to the instigator.

6.3 Significant correlation between climate change on physical conflict

A comprehensive review of existing literature tying climate change to conflict was performed in the form of a meta-analysis by Burke, Hsiang, and Miguel (2013), where they examined all degrees of conflict, ranging from the interpersonal, to intergroup, to violence causing institutional breakdown and political instability. The analysis resulting from the review of 60 topically relevant papers indicated that a change of one standard deviation in climate change results in a "14% change in risk of intergroup conflict" and a "4% change in interpersonal conflict", which suggests there is a smaller likelihood of low-level conflict as a result of environmental changes compared to larger conflicts such as civil wars. This partially conflicts with the conclusions of multiple previous analyses that highlighted the severity of low-level conflicts, for instance Barnett's general observations on low-level conflicts (2001) or Meierab, Bond, and Bond's review of conflict in the Horn of Africa (2007).

The authors of many of these studies are well aware that the causal mechanisms they posit cannot be precisely outlined. The cause may even be psychological – evidence shows wealthier countries express a higher crime rate in the presence of high temperatures (Akresh, 2016), suggesting there are non-economic factors at play. However, the lack of explicable causality should not detract from the importance of the findings themselves. As discussed in the previous subsection, authors such as Meierding, Hauge and Ellingsen (1998; 2013) have either criticized analyses based

on their methodology or have themselves found that climate change is a weaker predictor for conflict than other causes. While that may be the case for the moment, the "change" in climate change is one that is widely understood to continue on its upwards trend for the next several decades under the best of circumstances (C.B., et al., 2014); what is now a weak predictor for conflict may grow in size in the near future until it cannot be so easily dismissed, by which time it should be hoped that policymakers have sufficient evidence and support from the academic community that they can adapt accordingly.

Other authors mirror Burke, Hsiang, and Miguel's findings. Reuveny found that in times of environmental change, impoverished populations in less developed countries are more likely to migrate to neighboring regions where the grass is greener, which in turn may result in conflict with the existing occupants (2007). Of 36 such cases of migration examined, 15 were in Africa, signifying the region's susceptibility to such environmental effects and the population's reliance on adequate agricultural conditions. Moreover, while it was found that conflict was more likely to occur when there were religious or ethnic differences, interstate conflict probability was significantly lower for this reason. In terms of civil conflict, Papaioannou (2016) was able to draw a curvilinear relationship between rainfall availability and intensity of state-wide conflict in colonial Nigeria, relying on historical data to find additional relevant variables such as food-shortages and prices of crops. In terms of lower-level conflict, annual precipitation is also linked to pastoralist violence due to the pressures of competition and resource scarcity (Meierab, Bond, & Bond, 2007).

A last note of interest is the difference in effect between short-term and long-term precipitation rates on conflict likelihood. While short-term water scarcity is suggested to have a pacifying effect on interstate aggression, long-term scarcity was linked to a higher probability of conflict (Devlin & Hendrix, 2014). Given the variability in weather that climate change is known to bring, it may partially explain why analyses have been somewhat divided so far.

7. Case Study I – Burkina Faso

7.1 Quantitative analysis of climate change – conflict relationship

7.1.1 Keyword analysis

Out of 1867 events, the search parameters mentioned in chapter 4.4 found that 19 were motivated by effects closely related to climate change, representing 1.02% of all conflict events in the period. In terms of fatalities, 19 fatalities out of a total of 2787 represents a 0.682% share.

Table 3. Results of keyword analysis on short description of 1868 conflict events in Burkina Faso between 2013-01-23 and 2019-12-31. Data retrieved from ACLED.

Keyword	**Water**	**Food**	**Pastor**	**Farm**	**Well**
No. matches	9	1	3	5	1
Fatalities	0	0	12	7	0

The results should not be immediately dismissed, as the numbers presented hide the scale of these events. Seven of them were public marches, sit-ins, or organized protests against the government due to disruptions in water availability and empty wells, while the farmer-pastoralist relations were the ones which led to fatalities.

Overall, a brief review of all violent events within the country in recent years, as defined and measured by ACLED, indicates that climate change has a weak effect on generating violent conflict which results in fatalities. The most that can be said is that the pressures which rarely lead desperate individuals towards manslaughter are felt even by those who have not committed such acts, pressuring the government to address them before desperation takes hold of its population. It appears that climate pressure is mounting but as yet remains borderline tolerable in the majority of cases.

The data is useful in that it points towards specific cases of dissatisfaction at the lowest levels of society which has begun to manifest as protests against the government. However, there may well be cases where climate change was a significant factor but was either not captured in the search parameters or was not reflected in the description. The investigation continues through a multivariate regression and a qualitative assessment via the Fragile State Index methodology.

7.1.2 Regression analysis

The three independent variables of precipitation, cases of heat exposure, and per capita renewable water resource are run through a multivariate regression to assess their effect on the dependent variable, conflict events.

It is expected that precipitation has a larger effect than the amount of renewable water resources due to the country's dependence on rainfall for agricultural activities.

Table 4. Multivariate regression variables for Burkina Faso

Precipitation, mm per year	**Environmental heat exposure (cases)**	**Total internal renewable water resources per capita (m3/inhab/year)**	**Conflict events**
676.83	22586.96	1016.83	6
917.89	24254.89	988.88	1
726.99	23406.48	960.93	4
798.03	25109.09	932.97	6
777.88	25960.10	905.02	8
851.87	26838.30	877.07	1
816.56	27744.14	852.52	12
853.53	28684.45	827.97	1
863.95	29667.36	803.42	5
719.11	30669.60	778.87	137
893.16	31696.81	754.32	68
782.75	32763.27	732.56	39
844.58	35114.07	710.79	123
773.74	33893.03	689.44	116
887.73	38013.68	646.32	104

Regression Statistics	
Multiple R	0.867410254
R Square	0.752400549
Adjusted R Square	0.684873425
Standard Error	29.28276657
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	28662.64874	9554.216245	11.14219759	0.001161582
Residual	11	9432.284597	857.4804179		
Total	14	38094.93333			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-554.5763018	600.8732695	-0.922950529	0.375833908	-1877.089451	767.9368476	-1877.089451	767.9368476
X Variable 1	-0.297896892	0.123550528	-2.411134107	0.034545022	-0.569829771	-0.025964013	-0.569829771	-0.025964013
X Variable 2	0.019013486	0.010085712	1.885190322	0.086079092	-0.003185016	0.041211987	-0.003185016	0.041211987
X Variable 3	0.343156398	0.397001289	0.864370993	0.405838831	-0.530637547	1.216950344	-0.530637547	1.216950344

Table 5. Summary output of the regression analysis for Burkina Faso, 2002 – 2016 with ACLED event data.

Effect of dependent variables on number of conflict events.

Interpretation of regression analysis for Burkina Faso

What the summary output shows is that the model can predict with 68.49% certainty the number of conflict events that occur in the following years, in Burkina Faso, to an accuracy of 2*standard error = 58.57 conflict events. The low p-values of less 0.003, respectively 0.086, suggest that that yearly precipitation amount and environmental cases of heat exposure meaningfully contribute to the outcome of the dependent variable. However, given that the predictive margin of 57.94 is higher than the mean of conflict events throughout the period examined (42.07), it is considered to lack practical utility if it remains unmodified. Moreover, a p-value of 0.41 for the third variable falls in line with our initial assumption that it is less impactful than rainfall, possibly due to the minimal effect underwater freshwater resources have on agriculture, relative to rainfall and other water sources.

Future models can be improved by utilizing more data at a monthly or daily level, at which point temperature may be a useful variable as well because short-term temperature variations are more pertinent to this analysis than long term averages. Introducing control variables to limit the effect of confounders, such as political climate, would also yield a more precise model. Most importantly, sorting conflict events by their magnitude should be the first priority, perhaps by assigning weights to conflicts which include multiple members or have fatalities. On a final note, utilizing the number of cases as a variable runs the risk of partially introducing the effect of population growth on the model.

Assuming all conflict events in a given country can be obtained, including small-scale ones such as those in rural communities, one could hypothetically overlay the date these events occur on top of the dates they do not occur, resulting in a dichotomous variable where “1” denotes conflict and “0” denotes no conflict. Dichotomous variables are suitable for logistic regressions and the added data values could have provided significantly more precise models.

7.2 Qualitative analysis of security aspects through FSI methodology

7.2.1 Group grievance (C3)

Divisions and communal violence

The relevance of this topic is attributed to Reuveny's (2007) findings related to conflict resulting from migration, whereby conflict is more likely to appear in the migrant-receiving area either due to ethnic tensions, socio-economic fault lines, general distrust, or competition over scarce resources. With that said, their analysis also discusses how sometimes migration can benefit a state, if it is able to integrate them well into local communities and offer sufficient support.

The situation in Burkina Faso does not appear to be one conducive to migration, nor is it beneficial to the health of the region that is being migrated to. The reason for this is that Burkina Faso, like many other African states, experiences moderate ethnic diversity, with Mossi representing 52% of the population and most other ethnicities estimated at less than 5% each (CIA, 2010). Inter-communal clashes due to ethnicity and religion are frequent, with control over land being one of the most highly coveted rewards (Dafinger, 2013).

Furthermore, the country is not well equipped to govern even stable populations, with the keyword analysis showing how protests and marches occur over water management and poor governance of basic utilities. Adding in migrating populations with few resources into this mix is expected to end poorly.

7.2.2 Economic decline and poverty (E1)

Economic conditions and economic diversification

Akresh (2016) discusses how in Africa, for every one degree Celsius increase in warming, crop yields are reduced by 10% - 30%. Exporting data from the World Bank for the period 2010 – 2016, focusing on the indicator "agriculture, forestry, and fishing, value added (% of GDP)", yields the following values:

Table 6. Values for the indicator *agriculture, forestry, and fishing, value added (% of GDP)* for the period 2010 – 2016 in Burkina Faso (World Development Indicators, 2020)

Indicator	2010	2011	2012	2013	2014	2015	2016	Average
Agriculture, forestry, and fishing, value added (% of GDP)	24.1	23.0	23.8	23.6	23.7	22.6	21.7	23.21

With reference to the theoretical background chapter, we are reminded that the UNFCCC considers climate change to have anthropogenic causes and is widely accepted to have begun with the industrial revolution, which is when temperatures began to increase above the norm.

Exporting data from World Bank database, monthly average temperatures can be compared between the periods 1901 – 1907 and 2010 – 2016 in Burkina Faso[9]. The first period had an average temperature of 27.9268 °C, while the more recent was 28.9189 °C, representing a 0.992 °C increase which is rounded as 1 °C for this analysis.

Assuming average annual temperature would not have naturally risen by 1 °C due to climate change and accepting Akresh's observation regarding the relationship between temperature and effect on agricultural yield, it may be estimated that Burkina Faso's value added as a percentage of GDP for the agriculture, forestry, and fishing indicator would have been between 25.53% and 30.17% over the period examined[10]. This is considered to be both a significant increase compared to the 23.31% of GDP for 2010 – 2016, as well as being a large portion of the country's total economic output, indicating very weak economic diversification that is susceptible to a worsening of environmental conditions.

7.2.3 Public services (P2)

Health (P2) and public health (S1)

The Burkina Faso Climate Change Adaptation Plan (UNFCCC, 2015), under the health sector, outlines five individual steps of adapting to climate change. The necessity of adaptation is primarily due to three reasons: the increased number of affected individuals by environmental

[9] Although later than the industrial revolution, these are the some of the earliest reliable values that can be found. Similarly, 2016 is the most recent year for which temperature data was obtained.
[10] This range may be slightly inflated since it also includes fishing, which Akresh makes no mention of.

extremes (as seen from the regression analysis data), the increased prevalence of malaria, meningitis, and similar diseases in high temperatures (Feldscher, 2018), and the effect on the food production sector which lowers the average nutritional availability of citizens, as discussed previously. Adding water scarcity to this mix creates sanitary issues which further exacerbates the issue.

Refugees and IDPs are connected to this topic in that they strain the country's health sector and water services, but their relationship to this topic is discussed in more detail in their respective subchapter.

7.2.4 Demographic pressures (S1)

Population

It is no revolutionary observation that a steadily increasing population places additional strain on a country with dwindling food, water, and economic resources. Despite population growth rates decreasing slightly from 3% in 2012 to 2.8% in 2019 (World Bank, 2020), due to the compounding effects of growth the 2019 census of 20,321,378 may be expected to nearly double in 25 years at current rates. This is considered to be unsustainable due to existing environmental pressures, as well as due to poverty levels being largely unchanged despite an annual growth rate of approximately 2% (Grimm, Wetta, & Nikiema, 2014). This is one of the key questions that is asked under this topic within the FSI methodology.

The silver lining being that, as discussed in chapter four, the country's dependency ratio is expected to keep decreasing in the following decennia (World Population Prospects 2019). However, it is a small benefit as resource availability likely cares less about the ratio of productive to unproductive citizens than it does about factors such as area of arable land and adequate rainfall volume, since all citizens need to eat regardless of status. With that said, a more productive society may be able to increase the agricultural output of the country, barring any limitations imposed by environmental changes.

Food, environment, and resources

Population growth rate has risen faster than developments in the agricultural sector (Grimm, Wetta, & Nikiema, 2014), leading to higher food insecurity. This relationship is partially verified by tracking the change in the World Bank indicator "prevalence of moderate or severe food

insecurity in the population (%)", which between 2015 and 2018 has increased year by year from 42.4% to 47.7%. A longer period of analysis was not available, yet the trend appears to be a worrying one, particularly due to the severity of the indicator in the first place. If significant developments in the agriculture sector are not implemented to match population growth rate and demand, the systemic pressures may be expected to worsen significantly.

The country is also susceptible to natural disasters such as droughts and flooding that periodically challenge its ability to adequately provide food for its population. However, the extent to which climate change exacerbates these naturally-occurring issues is difficult to assess, particularly due to their highly variable occurrence, which makes evaluating the magnitude of its effect on food security problematic. Lenhardt et al. (2014) observed that a great deal of the country's development occurred in the Central Plateau, towards which citizens from rural areas migrated to. Unfortunately, this region is considered environmentally fragile, in part due to its proximity to the northern semi-arid steppe in the Sahelian zone. The government has enacted a number of policies, most recently the National Economic and Social Development Plan (PNDES, 2016), in an attempt to prevent further damage to its environment and economy, but it still places 141 out of 162 countries in terms of achieving its aims for the 2030 Sustainable Development goals (UNEP, 2020).

With regard to resources, the most pressing issues pertain to adequate potable water availability and resource competition. Currently, it is estimated that groundwater in the northern regions recharges at a rate of 5 mm/year, while the more humid southern areas at a rate between 50mm/year and 250 mm/year (UPGro, 2020). Additionally, the majority of communities are thought to experience a high degree of food and water stress, with the WFP noticing a 66% rice in food insecurity compared to the previous year (WFP Central Sahel Situation Report, 2020).

7.2.5 Refugees and IDPs (S1)

Refugees and IDPs

Some of the questions under this topic within FSI's methodology cover the likelihood of refugees arriving from neighboring countries, Burkina Faso's ability to take them in and care for them, and its ability to do so in a secure environment. With regard to the first, the most recent review of the causes generating migration indicates that the situation is primarily generated by physical conflict between armed forces, with one in twenty Burkinabe being internally displaced

and tens of thousands more refugees entering from Mali and Niger (Baloch, 2020). While refugees and asylum seekers are technically granted the same rights in terms of quality of health care as regular citizens, practically, de facto discrimination occurs due to resource constraints, availability, and bureaucratic inefficiencies (UNHCR, 2005). With access to poor health care, a mobile population is more likely to develop and transmit infectious diseases.

Moreover, the rate of groundwater recharge suggests that the northern population will migrate south in the form of IDPs or towards neighboring countries as migrants in the near future, as water availability dwindles and climate variability weakens crop production, worsening the food security issue. With that said, the causes generating refugees and IDPs appear to be significantly more impacted by physical conflict between armed forces, with climate change so far having a weak to moderate impact on this aspect over a much longer time frame.

7.2.6 Quantifying the analysis

Translating the entirety of this analysis into numerical form with the modified Likert-scale, as described in the methodology, the range of values of the final score may be computed. The results are shown below:

Table 7. Weights, relationship to climate change, and computed final scores for topics

Topic	Internal weighting	CC relationship	CC relationship′	Final score	Final score′
Divisions	25%	10%	20%	0.03	0.05
Communal violence	25%	5%	10%	0.01	0.03
Economic conditions	25%	25%	30%	0.06	0.08
Economic diversification	25%	25%	30%	0.06	0.08
Health	20%	20%	30%	0.04	0.06
Population	20%	25%	30%	0.05	0.06
Public health	20%	10%	20%	0.02	0.04
Food and nutrition	20%	20%	25%	0.04	0.05
Environment	20%	30%	40%	0.06	0.08
Resources	20%	20%	30%	0.04	0.06
Refugees	33%	15%	20%	0.05	0.07
IDPs	33%	25%	30%	0.08	0.10
Economic intervention	25%	10%	20%	0.03	0.05

Aggregating the results and sorting them into their respective indicators yields the following table:

Table 8. Scores for indicators

Indicator	2013-2019 average FSI score	Low bound effect estimate	High bound effect estimate	Adjusted FSI score	Adjusted FSI score′
C3 – Group grievance	4.70	0.04	0.08	4.66	4.63
E1 - Economic decline and poverty	6.93	0.13	0.15	6.81	6.78
P2 - Public services	8.64	0.04	0.06	8.60	8.58
S1 - Demographic pressures	9.07	0.21	0.29	8.86	8.78
S2 - Refugees and IDPs	6.83	0.13	0.17	6.70	6.66

Finally, the values obtained can now be used to calculate the score used by FSI to order international actors by their fragility, which is calculated by summing all indicator scores for each year and averaging their values for the period 2013 – 2019.

While the original average score for this period for Burkina Faso was 88.01, our analysis concludes that had climate change not been a factor, its score would instead have been between 87.27 on the high end and 87.47 on the low end, with smaller values signifying an improvement. This may be estimated as climate changing having an effect of 0.62% to 0.84% on its FSI score[11].

[11] The range itself is meant to represent the error margin, but it may well be that the estimates could differ significantly from this analysis with the introduction of other aspects some might consider relevant to state security, such as foreign intervention.

8. Case Study II – Djibouti

8.1 Quantitative analysis of climate change – conflict relationship

8.1.1 Keyword analysis

As in the first case, the same search parameters are applied on the database from the ACLED for the period 2013-01-17 to 2019-12-20 in Djibouti. A total of 73 conflict events are recorded, which are marked as violence against civilians (26), protests (15), battles (12), strategic developments[12] (12), riots (7), and explosions/remote violence (1). Of these 73 events, one is matched by the search parameters selected but is excluded subsequently as a false-positive match.

Upon closer inspection, the majority of conflicts are either politically motivated or as a result of poor economic and employment conditions, resulting in protests for better work opportunities and livelihood standards. Yet from the descriptions attached it may be surmised that none are indicative of direct effects of climate change.

In terms of indirect effects, however, we know that some of the effects of climate change are stronger and more frequent weather variability, which includes natural disasters. These may be thought to impact the average standard of living of citizens, which in turn manifests as dissatisfaction towards the government. Additionally, worsening of environmental conditions makes food imports mandatory for the state, increasing its reliance on outside actors and preventing a degree of independence.

The causal relationship as yet appears to be too weak or convoluted to draw any meaningful conclusion.

[12] Such as arrests, release of political opposition or prisoners of war, and in one case a failed military coup from 2014.

8.1.2 Regression analysis

As in the first case, the same variables are introduced into a multivariate regression to assess their effect on producing conflict events.

While for Burkina Faso, precipitation was expected to have a significant effect on conflict events relative to the other variables, the same is not expected in Djibouti. Precipitation amounts represent an extremely small portion of water sources, so deviations are not expected to be large enough to matter in the grand scheme of things. On the other hand, this places more value on underground fresh water resources such as aquifers; as they are drained the government may enact harsher policies on water restrictions that may threaten the wellbeing and comfort of its citizens, increasing dissatisfaction and fueling dissent.

Table 9. Multivariate regression variables for Djibouti

Year	Precipitation, mm per year	Environmental heat and cold exposure (cases)	Total internal renewable water resources per capita (m3/inhab/year)	Conflict events
2002	15.95	1871.88	401.60	1
2003	18.74	1875.20	395.78	1
2004	21.37	2422.18	389.96	2
2005	17.34	2360.42	384.14	2
2006	25.72	2367.44	378.32	3
2007	17.87	2359.39	372.50	2
2008	16.75	2379.32	367.12	2
2009	16.42	2403.52	361.74	6
2010	23.11	2392.52	356.36	10
2011	21.44	2408.03	350.98	6
2012	19.46	2407.87	345.60	2
2013	31.74	2400.05	349.00	10
2014	26.21	2404.96	338.80	23
2015	15.44	2396.58	328.60	9
2016	23.99	2391.97	318.40	5

Regression Statistics	
Multiple R	0.664351732
R Square	0.441363223
Adjusted R Square	0.289007739
Standard Error	4.873103891
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	206.3814432	68.79381439	2.896930323	0.083142342
Residual	11	261.2185568	23.74714153		
Total	14	467.6			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	42.75598147	41.40188583	1.032706134	0.323912755	-48.36895483	133.8809178	-48.36895483	133.8809178
X Variable 1	0.455922427	0.29896894	1.524982589	0.155486018	-0.202103772	1.113948627	-0.202103772	1.113948627
X Variable 2	-0.002105554	0.009148683	-0.230148357	0.822200471	-0.02224167	0.018030561	-0.02224167	0.018030561
X Variable 3	-0.115100834	0.068089787	-1.690427287	0.119051291	-0.264965445	0.034763777	-0.264965445	0.034763777

Table 10. Summary output of the regression analysis for Djibouti, 2002 – 2016 with ACLED event data.

Effect of dependent variables on number of conflict events.

Interpretation of regression analysis for Djibouti

The adjusted R^2 of 0.289 indicates that the three chosen independent variables can explain 28.9% of the variation in the dependent variable, to an accuracy of 2*standard error = 9.74 conflict events. Given that the average of all conflict events for this period is 5.6, the standard deviation of the sample is 5.78, and the R^2 is relatively low, this is considered a poor fit and insufficiently accurate. The significance F value of 0.083 may be interpreted as there being an 8.3% chance the model is unreliable.

With regard to the p-values of the independent variables, the high p-value of 0.82 suggests that the number of cases of environmental heat exposure likely had no effect on generating conflict events. This is consistent with the keyword analysis which indicated the majority of such events were politically or economically motivated. The p-values of variables X_1 and X_3 of 0.155, respectively 0.119, are slightly higher than what would customarily be accepted as rejecting evidence of a relationship with the dependent variable. However, they are low enough to indicate some compatibility with the data, and the usage of linear interpolation and averages over entire year-long periods introduces noise into the dataset, so hard conclusions should be omitted.

What can be said is that the regression analysis and the data utilized suggests that there is a somewhat reasonable possibility that precipitation and underground freshwater resources can have a small effect on producing conflict events, but it appears that there are other factors that are more significant which are not revealed in the model.

8.2 Qualitative analysis of security aspects through FSI methodology

8.2.1 Group grievance (C3)

Divisions and communal violence

One meta-analysis reviewing 43 publications that examined the climate change – violence relationship theorized that the main mechanism through which this occurs is through worsening of livelihood conditions, with other factors such as increased migration, changes in pastoral movement routes, and elite exploitation being other proposed factors (Baalen & Mobjörk, 2018). Of note is that this assessment was solely made for several countries in east Africa, with Djibouti and its neighbors being included. With regard to communal violence and division, the worsening of livelihood conditions due to water pressures and soil degradation may be expected to create conflict in rural areas, which represent approximately 18% of the country's population as discussed in chapter five. Given that 215,000 migrants from Ethiopia passed into Djibouti in 2019, it is the rural population which first suffers as its wells and food sources are ransacked (IOM, 2019). Since migration routes span across the north through Balho and Dorra, in the center through Galafi and Yoboki, and in the south through Dikhil and Holl-Holl, no region is left as a safe haven for pastoralists and farmers[13]. If food and water scarcity was not such a significant issue, these populations should have less incentives for desperate actions or joining of violent non-state actors. While some of this is conjecture, it is based on an assessment of factors affecting the region and supporting literature, as precise values are difficult to obtain firsthand.

8.2.2 Economic decline and poverty (E1)

Economic conditions and economic diversification

Akresh's observations on the relationship between temperature increases and crop production are not nearly as applicable to Djibouti as they are to Burkina Faso (Akresh, 2016). Djibouti's natural environment is already inhospitable to many crops, and animal husbandry is difficult due to undernourished soil and poor pasture conditions. It's reliance on the general environment for economic development is much weaker.

With that said, Djibouti has experienced a mass exodus from rural areas to Djibouti city. This may be attributed to rural citizens desiring higher standards of living as well as the

[13] Refer to Annex 2 for more details.

environment turning from challenging to inhospitable from the frequent droughts (BTI, 2020). The latter is one which can lead to the capital struggling financially, as it struggles to develop at the same pace as people are coming in, with poverty levels so severe households have to spend 77% of their income on food (WFP, 2019).

Additionally, worsening of environmental conditions means country-wide food production worsens even beyond its naturally dismal state, forcing Djibouti in the position of relying almost exclusively on importing food – a financially unfavorable affair.

Lastly, in terms of economic diversification Djibouti has almost the entirety of its economic activity derived from coastal regions, mainly from the services industry (BTI, 2020). These regions are the most susceptible to flash floods caused by cyclones in the Indian Ocean, which are expected to worsen as a consequence of climate change (McGrath, 2020). The proximity of the country's economic centers to the coast leaves them exceedingly vulnerable to the physical effects of flooding. As discussed in chapter five, approximately 33% of the country is affected by droughts and 21% by flooding, leaving Djibouti in a position where it must spend an estimated 2.7% of its GDP by 2025 on adaptation measures. Although less of its GDP is derived from agricultural activities, like Burkina Faso, its economy is not immune to the worsening of climate conditions.

On a positive note, the economy is somewhat stable, largely due to foreign investment (BTI, 2020). This helps mitigate some of the climate issues it faces, but its reliance on maintaining good economic relations with foreign powers is a potential weakness, particularly since it is under pressured to pay off loans to China (BTI, 2020). If it can do so without the selling of core state infrastructure and assets related to its ports, it stands a chance at weathering the current climate effects on its economy.

8.2.3 Public services (P2)

Health (P2) and public health (S1)

A summary of Djibouti's health situation is rather grim: As of 2011, the country had two available physicians for every 10,000 individuals; one health care facility for every 20,000 individuals; 5.4% of the nation's GDP directed towards health expenditures (WHO, 2013). Additionally, the poverty rate of 72% (WFP, 2019) makes it difficult for a large portion of its population to afford meaningful healthcare when needed, as well as creating systemic healthcare issues such as nutritional deficiencies due to food scarcity.

While many of these issues appear to be endemic and related to governance and funding issues, such as the Ministry of Health having little to say in overall policy formulation or healthcare infrastructure being below par, climate-related pressures introduce water scarcity which threatens sanitation practices, making illnesses more prevalent. Taking into account the natural environment of Djibouti and the relatively small effects of climate change so far, it is assumed the effect on illness transmission is at least weak (McMichael, Campbell-Lendrum, Corvalán, & Ebi, 2003), while the effect on sanitary practices is moderate due to the more noticeable evapotranspiration of the land. These effects are compounded by the slums of Djibouti where population density is high and sanitary conditions low.

8.2.4 Demographic pressures (S1)

Population

With reference to chapter five, we are reminded that Djibouti's population is heavily concentrated in the capital, which struggles to fit in the influx of citizens from rural regions. Its population growth rate has slowed to below sustainable levels, but its infrastructure cannot support the bulging communities in its capital. In 2018, the World Bank counted 13 slums that host more than a third of its population (World Bank, 2018). These are the key concerns of FSI's methodology on this aspect and in both cases, Djibouti appears to fair quite poorly. While on their own they are not directly linked to climate change, they occurred in part because of it. Moreover, now that they have happened, they have their own effects on the economy, individual satisfaction, and health. This appears to be a key trend with climate change, where its effects cascade like dominoes across multiple interlinked dimensions.

The extent to which climate change drove rural citizens towards the capital is difficult to assess, since it is also affected by their desire to relocate towards a more prosperous environment, among other possible confounders. One report examining the relationship of climate change and migration in the Horn of Africa and Yemen (Research and Evidence Facility, 2017) found that migrants often complained of the high living costs in Djibouti City, suggesting that moving from rural areas to the capital is not always an easy choice to make when they sought to improve their economic situation. However, desertification of land and harsh and poor security were significant drivers, suggesting climate change has at least a moderate impact on migration. This position is sometimes contested, as another report form the Mixed Migration Center found that climate

change is a “negligible mobility driver” (Centre, 2020). Instead, it is seen as a threat amplifier on existing security risks. The sum of the information available on Djibouti offers conflicting reports, yet climate change appears to have at least a weak effect on migration pressures. Adding in water and food scarcity elements, the effect becomes significantly stronger.

Food, environment, and resources

As discussed in four, Djibouti’s environment is one poorly suited to agriculture due to near non-existent precipitation and poor soil conditions. As a result, the country is unable to self-sustain its food requirements domestically and is reliant on importing most of its food, being capable of only growing small amounts of fruits and vegetables (CIA Factbook: Djibouti, 2020).

The importance of this issue is rooted in the concept of autarky and numerous examples across the globe of nations taking purposeful steps in establishing as high a degree of food security as possible: (1) self-sufficiency of agricultural output in China is promoted through nation-wide policies even at the level of provinces; (2) South Korea argues that agriculture should be a special case in WTO negotiations; (3) countries often discuss food security in the context of non-trade benefits of agriculture (Sumner, 2000). One 2019 brief assessed that approximately 90% of food needs to be imported (WFP, 2019) and it is well established that the nation suffers heavily because of it, with an estimated 280,000 Djibutians – 29% of the population – projected to have suffered the effects of moderate to severe levels of food insecurity between 2018 and 2020 (ACAPS, 2020). Global fluctuations in food prices further the food security challenge, as poverty levels are extremely high and the destitute spend as much as 77% of their household budget on obtaining food (WFP, 2019).

8.2.5 Refugees and IDPs (S1)

Refugees and IDPs

With regard to the ability of climate change to generate refugees and IDPs, the most concerning causes are natural disasters and physical violence in neighboring countries. Additionally, migrants from neighboring states use Djibouti either as a final destination or as a transit state toward countries in the Arabian Peninsula (ReliefWeb, 2019). As of October 2019, approximately 500 migrants passed through every day, and a combined total of 130,000 migrants and refugees set up camp in villages throughout the country. The Djibutian Prime Minister has also

commented on the subject, stating that the country's ability to help is limited, likely implicitly referring to the logistical and economic challenges (ReliefWeb, 2019).

With the scale of the issue quantified, the next step involves assessing the extent to which climate change can generate IDPs and migrants. This is discussed under the topic of Population, with background knowledge from chapter five.

8.2.6 Quantifying the analysis

As in the first case, final values are computed based on all the evidence that can be provided:

Table 11. Weights, relationship to climate change, and computed final scores for topics

Topic	Internal weighting	CC relationship	CC relationship′	Final score	Final score′
Divisions	25%	5%	10%	0.01	0.03
Communal violence	25%	5%	10%	0.01	0.03
Economic conditions	25%	10%	15%	0.03	0.04
Economic diversification	25%	0%	0%	0.00	0.00
Health	20%	20%	25%	0.04	0.05
Population	20%	20%	25%	0.04	0.05
Public health	20%	20%	25%	0.04	0.05
Food and nutrition	20%	20%	25%	0.04	0.05
Environment	20%	30%	35%	0.06	0.07
Resources	20%	15%	30%	0.03	0.06
Refugees	33.33%	15%	20%	0.05	0.07
IDPs	33.33%	30%	40%	0.10	0.13
Economic intervention	25%	5%	10%	0.01	0.03

Aggregating the data into each indicator and calculating the adjusted range for FSI scores yields the following table:

Table 12. Scores for indicators

Indicator	2013-2019 average FSI score	Low bound effect estimate	High bound effect estimate	Adjusted FSI score	Adjusted FSI score′
C3 – Group grievance	4.70	0.03	0.05	4.68	4.65
E1 - Economic decline and poverty	6.93	0.03	0.04	6.91	6.89
P2 - Public services	8.64	0.04	0.05	8.60	8.59
S1 - Demographic pressures	9.07	0.21	0.28	8.86	8.79
S2 - Refugees and IDPs	6.83	0.15	0.20	6.68	6.63

Thus, it can be summarized that while Djibouti had an average FSI score of 87.37 between 2013 and 2019, had its climate not changed its score would have been between 86.31 on the low end and 86.14 on the high end, representing an approximate 1.01% to 1.2% effect of climate change on its average FSI score for the period 2012 to 2018.

9. Conclusion

The complexity of climate change means that the analysis performed in this thesis likely only scratches the tip of the melting iceberg. While the measurable aspects are identified, the cascading effects on the unmeasurable are simultaneously within the scope yet outside the potential of this thesis.

One of the pitfalls of trying to model these effects is that they constrain the researcher to the limits imposed by the model itself, through necessity. With regressions, one is limited to the variables chosen. With more flexible, qualitative models – such as the one used in this work in conjunction with FSI's methodology – one is able to gather more nuance and compare states among themselves, which in itself can be very useful. However, the ones with the most vested interest in reliable analyses are the states themselves, and their security interests have a difficult time being quantified and introduced into such models. Nevertheless, some conclusions may be drawn.

The results of this thesis' analysis indicate that when it comes to Burkina Faso, climate change so far has a fairly small effect on its security, decreasing its FSI score by approximately 0.71% and having a weak ability to fuel conflict events[14]. As discussed in chapter 4.1, it has three primary security aims, two of which relate to ending extremism and violence in the region and the third which aims at maintaining sovereignty and the wellbeing of its population. Of these three, we may infer that the effects of climate change as analyzed in the thesis are moderately related to the health and wellbeing of its people, and only tangentially related to the first two; the food and economic insecurity between communities has the potential to generate conflict, but the academic community remains somewhat divided on the relationship and causal mechanisms.

With regard to Djibouti, the effect is slightly more impactful at approximately 1.1%. Unlike Burkina Faso, however, it was found that the relationship to conflict events was much weaker, with other unknown variables having a much stronger effect than water scarcity, which was itself was only a weak predictor for conflict. With regard to the five long term objectives outlined in Djibouti Vision 2035, water and food scarcity are directly related to climate change effects, and two other objectives related to socioeconomic and demographic challenges may be moderately related as

[14] A reminder that as discussed in the methodology, the ACLED event data does not include low level individual cases of conflicts between individuals. Because of this, I am hesitant to draw conclusions on this aspect with too much certainty.

well (Republic of Djibouti, 2013). Consequently, it would seem as if the country's own perspective would rank its decrease in security at more than what was estimated via the FSI approach.

The small estimates resulting from the qualitative assessment should not be immediately discounted either, as they still represent a loss of security that occurred entirely passively, akin to bleeding from a small open wound. This is a situation that is strongly expected to deteriorate and we have seen examples throughout this investigation of states adopting both domestic measures and collaborating with international institutions to turn the tide[15], yet it seems like adaptation measures are lagging behind the inherent environmental changes. What could be the cause for this?

One answer could simply be triage, an ordering of priorities given the constraints every state operates under. I believe that Maslow's hierarchy of needs applies to states in a similar way that it does to people, whereby more pressing concerns such as the economic wellbeing of citizens, territorial disputes, or security dilemmas need to be addressed before more lofty goals may be considered (Maslow, 1943). This could explain why the trends such as environmental activism or progressive rights for all groups of people seem to come primarily from more developed countries, not those in the Sahel. There are, of course, other relevant factors at play such as the obvious structural pressures of industries maintaining status quos and environmental effects coming from beyond a state's borders, limiting what it can do domestically to defend itself. Overall, however, the trend appears to be that climate change has begun to slightly affect the security of two already vulnerable states. It remains to be seen whether other less fragile members of the international community will follow suit.

[15] Such as the National Adaptation Plan in collaboration with the UNDP, which both countries participate in.

10.List of Appendices

Appendix 1:

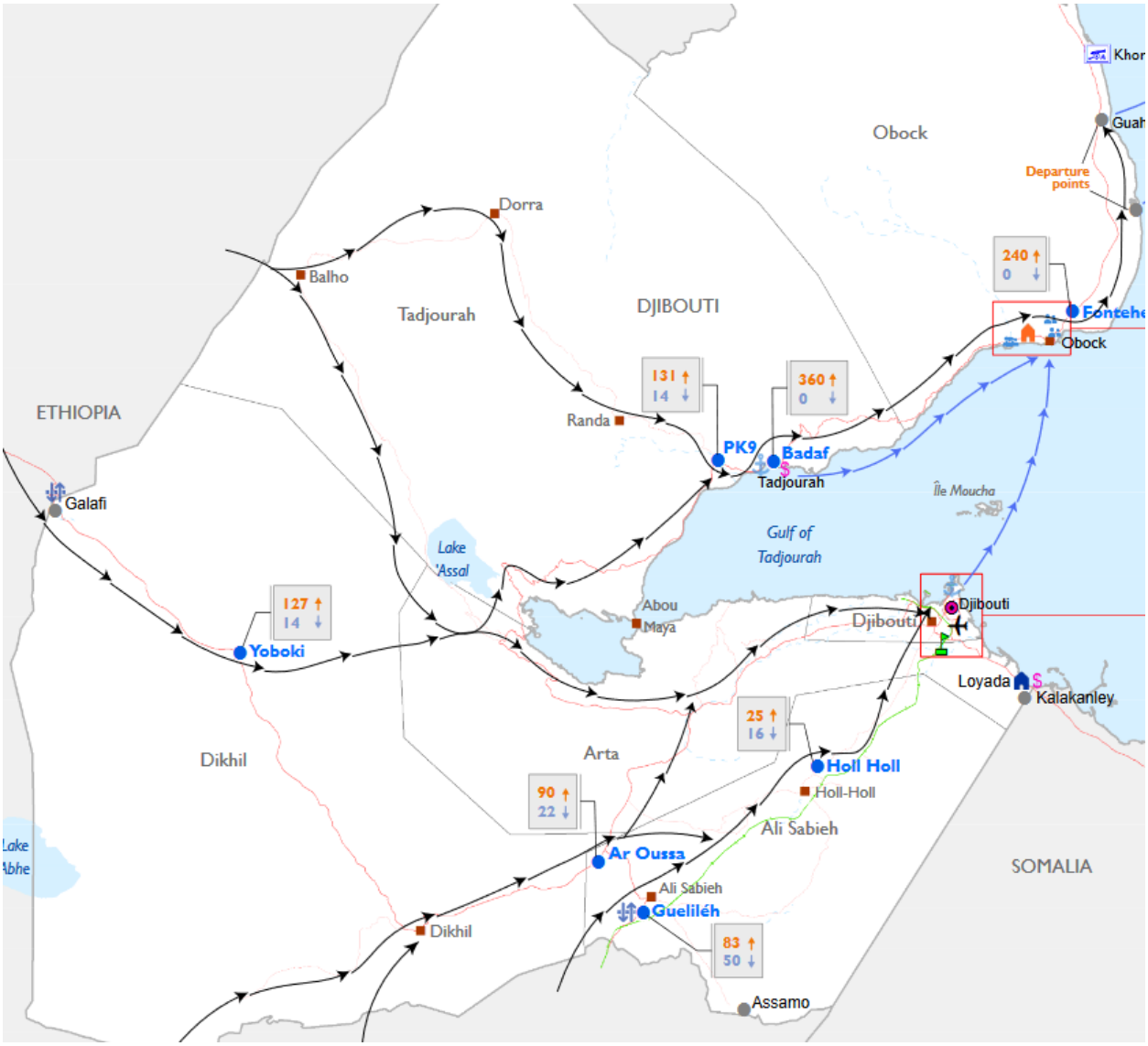
Table 1. ACLED event types (ACLED, 2017)

General	Event Type Code	Event Description
Violent	Battles-No change of territory	A battle between two violent armed groups where control of the contested location does not change. This is the correct event type if the government controls an area, fights with rebels and wins; if rebels control a location and maintain control after fighting with government forces; or if two militia groups are fighting. Battles take place between a range of actors.
	Battle-Non-state actor overtakes territory	A battle between two violent armed groups where non-state actors win control of a location. If, after fighting with another force, a non-state group acquires control, or if two non-state groups fight and the group that did not begin with control acquires it, this is the correct event. There are few cases where opposition groups other than rebels acquire territory.
	Battle-Government regains territory	A battle between two violent armed groups where the government (or its affiliates) regains control of a location. This event type is used solely for government re-acquisition of control. A small number of events of this type include militias operating on behalf of the government to regain territory outside of areas of a government's direct control (for example, proxy militias in Somalia which hold territory independently but are allied with the Federal Government).
	Violence against civilians	Violence against civilians is a violent act upon civilians by an armed, organized, and violent group.3By definition, civilians are unarmed and not engaged in political violence. Rebels, governments, militias, external forces, and rioters can all commit violence against civilians. Protesters are also civilians, and significant violence against protesters falls under this category.
	Remote violence	Events where engaging in conflict did not require the physical presence of the perpetrator. The main characteristic of this event is when a group determines the time, place, and victims of the attack, but is not directly present. These include bombings, IED attacks, mortar and missile attacks, etc. Remote violence can be waged on both armed agents (e.g., an active rebel group;

		a military garrison) and civilians (e.g., a roadside bombing).
Demonstrations	Protests and Riots	A protest is a public demonstration in which the participants do not engage in violence, though violence may be used against them. Often –though not always – protests are against a government institution. Rioting is a violent form of demonstration where the participants engage in violent acts, including but not limited to rock throwing, property destruction, etc. Both of these can be coded as one-sided events. All rioters and protesters are noted by generic terms (e.g., "Rioters (Country)" or "Protesters (Country)"); if representing a group, the name of that group is recorded in the respective "associated actor" column.
Non-violent actions	Non-violent transfer of territory	Situations in which rebels, governments, or affiliates of both acquire control of a location without engaging in a violent act.
	Headquarters or base established	A violent group establishes a permanent or semi-permanent base or headquarters. This event is not violent. There are few, if any, cases where opposition groups other than rebels establish a headquarters or base (e.g., AMISOM forces establish bases in Somalia). These events are coded as one-sided events without a second actor involved.
	Strategic development	Contextually important information regarding the activities of violent groups that is not itself political violence. For example: recruitment drives, looting, incursions, and rallies qualify for inclusion. It also records the location and date of peace talks and both arrests of high-ranking officials as well as mass arrests. The inclusion of such events is limited, as its purpose is to capture pivotal events within campaigns of political violence.

Appendix 2:

Figure 1. Migration routes through Djibouti (IOM, 2019)



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