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Understanding the Connections: An Analysis of Climate Change and Human Security

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UNDERSTANDING THE CONNECTIONS: AN ANALYSIS OF CLIMATE CHANGE AND HUMAN SECURITY

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DEDICATION

To Sophie, the light of my life.

UNDERSTANDING THE CONNECTIONS: AN ANALYSIS OF CLIMATE CHANGE AND HUMAN SECURITY

by

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THESIS

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ABSTRACT

Increasing evidence shows that the impacts of anthropogenic climate change have magnified and will have dramatic implications for both the natural and social systems (Adger et al., 2014). While research on the security implications of climate change has been found to have a major bearing on policy making, experts have not reached a consensus about how climate change and human security are related, leaving the climate-security nexus and corresponding policies underdeveloped.

The purpose of this study is to delineate and scrutinize the relationship between climate change and human security so that a more comprehensive understanding of the phenomenon is achieved. Employing a mixed methods approach, I examine how climate change variables interact with other economic, social, and political factors that are commonly related to insecurity. I first conduct a qualitative analysis that uses process tracing to track the causal processes that exist between climate change impacts on human security outcomes in Bangladesh and the Sudanese province of Darfur. I use the findings of these investigations to inform a quantitative study that examines the connections statistically. The empirical results show that climate change has both direct and indirect effects on various dimensions of human security. Specifically, I find that increased temperatures decrease livelihood, increase migration, and indirectly contribute to the increase of civil conflict in developing states.

Keywords: *climate change, climate-security, human security, livelihood, migration, conflict, mixed methods, process tracing, environmental security, climate security nexus*

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CHAPTER ONE: INTRODUCTION

Throughout human history, societies have always been threatened by changes in the environment. Food shortages, threats to biodiversity, droughts and floods, are problems that not only confront us today but have plagued humanity for thousands of years (Redman, 1999). However, as we wrap up the first quarter of the 21st century, these threats have magnified, and robust evidence shows that the impacts of climate change will have dramatic implications for both natural and social systems (Adger et al., 2014). These climate impacts can be *acute* in nature, coming on suddenly, as when a tropical storm of unprecedented force destroys and displaces entire communities; or they can be *chronic,* unfolding over time—such as a 10-year drought that depletes crops and leaves individuals to deal with issues of food and income security.

In addition to the adverse environmental conditions that arise from climate variability, such as desertification, water scarcity, drought, and extreme temperatures; climate change is considered a "problem multiplier" that aggravates threats to human security. For example, a climate event resulting in loss of livelihood, is made far worse against a backdrop of poverty, resource decline, displacement, and reduced state capacity. The interactions between climate change outcomes and antagonistic social conditions can trigger despair anywhere in the world but are significantly worse in regions that are considered "climate hotspots"[1] and or developing states, which have limited resilience to absorb the stresses imposed upon by extreme

[1] These are places where the impacts of climate change are both pronounced and well documented (Union of Concerned Scientists, 2020).

temperatures, potentially fueling competition and inflaming social tensions that could lead to violent conditions.

One such example was illustrated in the case of Syria, where limited water resources aggravated other economic and social pressures, creating a perfect storm that undermined the country's stability (Gleick, 2014). According to U.N. officials, the drought in this region created extreme economic and social problems that were beyond what the state could handle (Gleick, 2014). It was projected that between 2006 and 2009, Syria experienced severe agricultural failures that impacted 1.3 million inhabitants (Gleick, 2014). According to Solh, 800,000 people lost their livelihood, and the chaos resulted in mass migration patterns that extended from Syria's rural lands to the country's major cities (Gleick, 2014). The displacement of these large populations had devastating impacts on the country, which was already politically unstable (Gleick, 2014). These escalating pressures combined with Syria's complicated religious and sociopolitical issues, ultimately contributed to Syria's deadly civil war, which recently entered its tenth year, and has claimed the life of over 400,000 people (Gleick, 2014; Kraus, 2015).

While many consider climate change an esoteric and abstract concept that poses a threat in a far and distant future, catastrophic events confirm that climate-related security threats are no longer looming, but instead materializing rather rapidly. These events, such as rising sea levels, destructive wildfires, and natural disasters, are expected to worsen in the coming decades as carbon emissions and temperatures continue to rise (Paton Walsh, 2019).

According to recent reports, carbon dioxide (CO_2) emissions are set to soar to levels higher than during the Paleocene-Eocene era, which occurred 56 million years ago (Gingerich, 2019). During this global greenhouse warming event, the earth experienced the largest deep sea mass extinction and saw an accelerated evolution in continents (Gingerich, 2019). Researchers

have found that present-day carbon releases are now emitting nine to ten times faster than during Paleo-Eocene thermal maximum (PETM), and warn that if these trends continue, a second PETM scale event is on the horizon (Gingerich, 2019). University of Michigan paleoclimate researcher, Philip Gingerich argues that this event is only about four generations away. If he is correct, the warming could cause a major extinction of organisms and possibly make parts of the earth uninhabitable (Wallace-Wells, 2019).

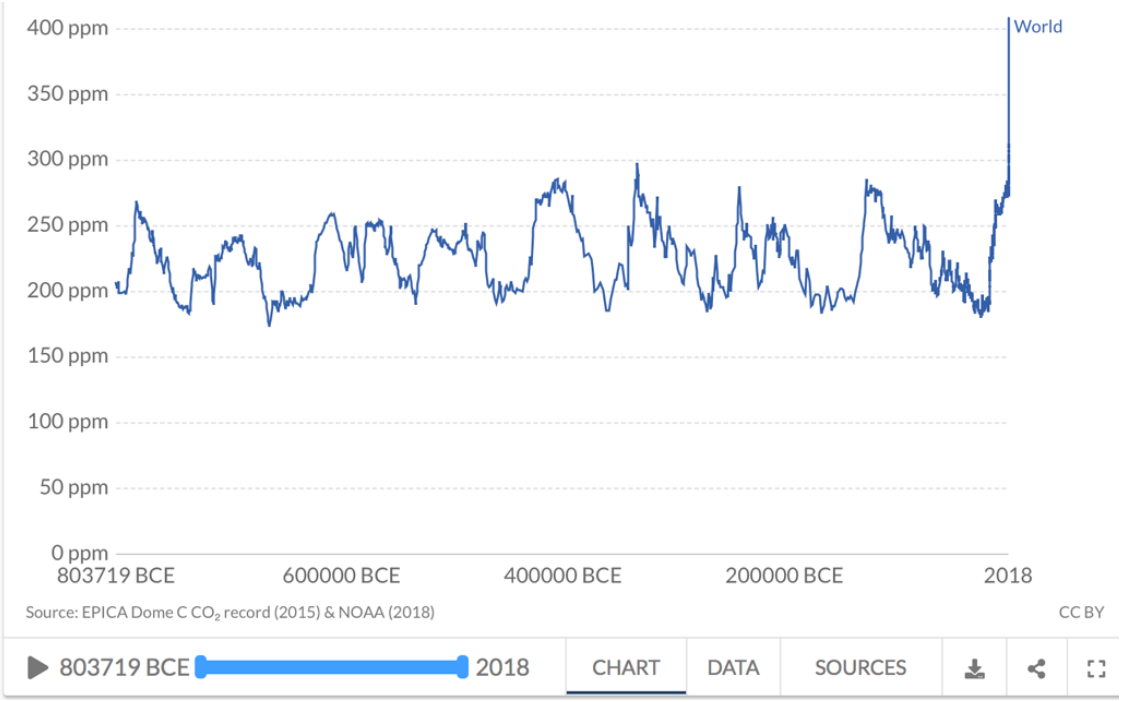

Figure 1. Global Average Long-Term Atmospheric Concentration of Carbon Dioxide Source: Our World in Data

This is just one of many warnings that have called for urgent political action and have stressed the need for a strong global environmental security paradigm. In 2018, the Intergovernmental Panel on Climate Change (IPCC), one of the main authoritative figures in the study of climate-security and a main agenda setter for the climate-adaptation debate, emphasized the need to reduce carbon dioxide emissions by 45% by 2030 to avoid global temperatures from reaching 1.5 degrees Celsius; a threshold that would maintain relatively stable climate conditions

that are adaptable for humans and other species (IPCC, 2018). However, current climate models suggest that we that we are on our way to not only meet this target but exceed it by up to four degrees of warming (Vince, 2019). According to some, this scale of heat could result in catastrophic and irreversible damage to the planet (Wallace-Wells, 2019). Alarmists have gone as far as warning that climate change poses an existential risk that could bring an end to civilization if global leaders do not take a more aggressive approach to address the problem (Dunlop and Spratt, 2017).

For over a decade, world leaders such as UN Secretary-General Ban Ki Moon and The National Aeronautics and Space Administration (NASA) Director James Hansen, have acknowledged the severity of climate change—declaring the situation an "emergency" that required stringent action (Lagorio, 2007; Kenrick, 2008). Still, collective action on climate change has not been achieved and instead we see a "tragedy of the commons" scenario, where "a shared resource tends to be rapidly depleted because no single actor – whether a country or a person–considers how their actions affect other users" (Sekeris, 2015: para 2). Despite years of intelligence reporting on climate security risks, several political figures continue to cast doubt around climate science and have made it increasingly difficult to effectively address climate threats (Nuccitelli, 2019). Among these political actors is U.K. Prime Minister Boris Johnson, who voted against carbon capture and storage technology, instead opting to vote in favor of hefty taxation on renewable energy (Gronewold, 2019). These actions were echoed by United States (U.S.) President Donald Trump who continuously promises to withdraw the U.S. from the Paris Agreement[2] and refers to climate change as a "hoax" while rolling back key climate regulations (Denchak, 2019).

[2] On December 2015, world leaders reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement builds upon

Political resistance to strategies that combat climate change poses a serious obstacle for environmental security, as it hinders the development of adaptation approaches, as well as inhibits the progress of sustainable and renewable energy efforts. Moreover, when the preponderant powers of the world such as the United States (responsible for the largest cumulative CO_2 emissions since 1750), fails to be accountable to this global problem, it sets the stage for other countries to do the same; in turn diminishing the urgency to respond to climate-security threats.

While research on the security implications of climate change has been found to have a major bearing on policy making, experts have failed to reach a consensus about how climate change and human security are related, leaving the climate-security nexus and corresponding policies underdeveloped. Although some scholars argue that there is strong causal evidence that links climate to insecurity—claiming that climate change may increase violent conflict at a global level (Hsiang et al., 2013); others are more careful to draw these conclusions, arguing that "researchers have failed to uncover consistent linkages between environmental shifts and inter/ra state contention" (Meierding, 2013:185; Buhaug et al., 2014). Thus, the environmental security debate consists of different approaches that are largely at odds with one another (Floyd, 2008). Although it is true that the case of Syria may offer insights to the causal association that exists between climate and violent conflict; other states, such as Jordan and Lebanon, facing similar drought conditions have not experienced large-scale violence and have managed to continue a condition of peace under changing climactic conditions (Adams et al., 2018). Why is this so?

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the Convention and – for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so (UN, 2020).

I argue that further research is necessary to understand the linkage that exists between climate change and human security. Furthermore, in this work, I stress that the environmental-conflict thesis, which directly links climate change to militarized conflict or makes them exclusive to one another is *not* the defining component of the climate-security paradigm. In other words, a lack of violent conflict as a result of climate change does not mean *insecurity* does not exist. Gleick (1998) agrees that "while climate change may not directly increase wars around the world, the inequities that brew as a result of climate change will lead to increased poverty, shortened lives, and misery" (113). An IPCC publication explains that while there are many phenomena that influence human security, the impacts of climate change will gradually disrupt various conditions necessary for security, such as: culture and identity, poverty, mobility, adaptation, etc. (Adger et al., 2014). The scope of this thesis focuses solely on dimensions concerning undermined livelihoods, increased internal migration, and increased risk of civil conflict that threaten human security. The purpose of this study is to delineate and scrutinize the relationship between climate change and human security so that a more comprehensive understanding of the phenomenon is achieved. To do this, I aim to answer the following research questions:

1. What are the major causal chains between climate change and human security, and what is the empirical basis for these linkages?
2. What is the likelihood that climate change will decrease livelihoods, increase migration, and increase violent conflict?
3. How do environmental variables interact or affect other economic, social, political variables that are commonly related to insecurity?(livelihood, migration, violent conflict)

A general agreement within the climate-security discourse highlights the need for theories and data that demonstrate a deep understanding of causality, as the risks that climate change poses to human security result from multiple and interacting processes (Homer-Dixon, 2009; Adger et al., 2014). Accordingly, in order to successfully assess whether a positive correlation between climate change and human security exists, a holistic research approach must be taken, where quantitative analyses are conducted only after careful analysis of causal mechanisms are considered (Homer-Dixon, 1999; Stalley, 2003; Seter, 2016).

Although there is no standardized approach to examining the relationship between climate change and security, the majority of existing studies are either qualitative or quantitative and fail to blend the expertise of social scientists with the expertise of climate scientists. This thesis aims to address this research gap by employing a mixed-methods approach to examine the problem. More specifically, I focus on the relationship that exists between *chronic* climate change impacts and their relationship to three dimensions of human security: *livelihood security, internal migration, and civil conflict*; which have been deemed some of the principle threats to human security by the IPCC (Adger et al., 2014).

This thesis begins to unfold with a discussion on each of these human security threats in Chapter Two. Chapter Three explains the advantages of using qualitative research methods to study the connections between climate change and human security and discusses the case selection process of this project. I then examine how climate change affects and interacts with economic, social, and political factors commonly related to insecurity in Bangladesh and Sudan. These case studies are featured in Chapters Four and Five, respectively. The results of these investigations are then used to inform the causal theory and the design of the quantitative study in Chapter Six, that examines the connections statistically. The results of both the qualitative and

quantitative study are then cross-evaluated, and a discussion of the causal systems is provided in Chapter Seven. Finally, I discuss potential global political actions that can aid in mitigating and preventing these threats from reaching their pinnacle.

CHAPTER TWO: LITERATURE REVIEW

2.1 Anthropogenic Climate Change

Since the mid-20th century, human influence has been identified as the dominant cause of warming global temperatures (IPCC, 2018). As a principal agent of change on the planet, humans have accelerated shifts that have taken us out of a moderately stable Holocene period into a new geological era known as the Anthropocene (IPCC, 2018). Today, we live in a world that has warmed 1.0-1.2 degrees Celsius since preindustrial times (NASA, 2020)—an increase that scientists largely attribute to a rise in greenhouse gasses (carbon dioxide, nitrous oxide, methane and others) produced by intense agricultural activities, urbanization, growth-based economies, etc. (IPCC, 2018).

Increased proportions of these gases in the Earth's atmosphere have caused high amounts of the sun's energy to be trapped in the Earth's land, seas, and atmosphere, ultimately resulting in a disturbance in the earth's climactic system, causing temperatures to rise and weather to change (Mann et al., 2018). Figure 2 below illustrates how the Earth has warmed over time and uses global average temperatures between 1850 and 2018 to show trends through time. We can see that the last few decades have seen a sharp increase, going from a median 0.29℃ in 2000 to 0.80℃ in 2018 (Our World in Data, 2020). This rise in warming, which some estimate to be about 1˚C of temperature rise has vast implications for communities, economies, and ecosystems (World Resources Institute, 2018).

In 2015, over 195 states drafted an agreement within the U.N. Framework Convention on Climate Change, that highlighted the need to limit warming increases to 1.5˚C of temperature rise (UN, 2020). The Paris Agreement recognizes the many adverse impacts of climate change

on human security and highlights the specific needs and concerns of developing countries (U.N., 2015).

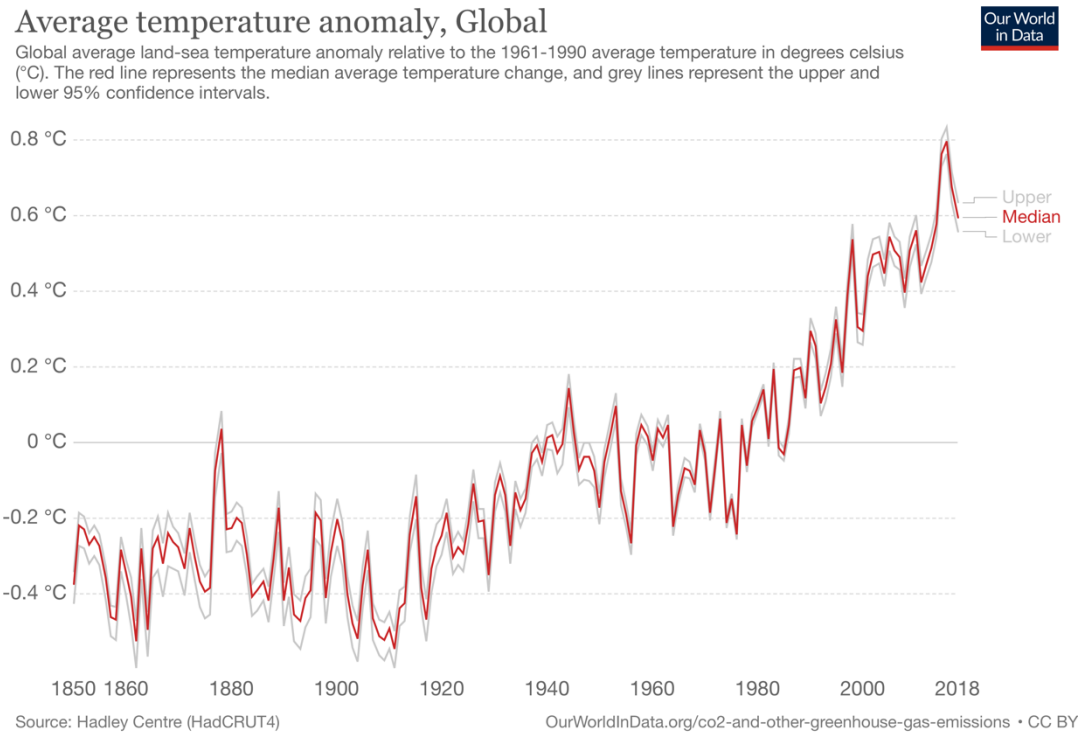

Figure 2. Average Global Land-Sea Temperature in Degrees Celsius
Source: Our World in Data

The impacts of climate change are volatile, wide-ranging, and are typically categorized as sudden-onset impacts or slow-onset events. The acute or sudden-onset impacts are immediate meteorological hazards such as hurricanes, typhoons, coastal floods, mudflows, blizzards, etc. (Human Rights Council, 2015). Chronic or slow-onset events occur gradually over time and include sea level rise, increased temperatures, ocean acidification, glacial retreat, salinization, land and forest degradation, loss of biodiversity, and desertification (Human Rights Council, 2015). Both acute and chronic impacts are equally threatening to human security and are expected to increase in frequency and intensity in the coming years.

According to researchers, even the best case scenario dealing with climate change requires action, and "even if it is possible to implement stringent climate policies that would limit the end of century global warming to 1.5°C, some effects of climate change, such as sea-level rise, may be irreversible and the burden of these impacts may be highly unequal" (Gilmore, 2018: 313). Numerous IPCC reports suggest that meeting the 1.5°C target would require "rapid, far-reaching, and unprecedented changes in all aspects of society" (BBC, 2020: 7); changes that are simply not happening because of growth economies, political disagreement, and a lack of collective action on the issue.

In the past year, however, the world has witnessed a global attitudinal shift sparked by environmental activist Greta Thunberg, the Swedish teen, who led millions worldwide in the largest climate-demonstration in history (Woodward, 2020). Thunberg, who was named Time's Person of the Year and was a Nobel Peace Prize Nominee in 2019, bravely confronted world leaders at the U.N. Climate action summit, condemning them for their lack of action in addressing the climate crisis (Woodward, 2020). "The world is waking up and change is coming whether you like it or not", Thunberg warned, as she demanded urgent action (Woodward, 2020). Adding to Thunberg's efforts, was the increased attention climate change received from broadcast news, with coverage increasing 68 percent in 2019 (Woodward, 2020). The rise in exposure is likely a result of increased environmental disasters such as the fires in the Amazon, California, and Australia; as well as political efforts like the Green New Deal led by U.S Representative Alexandra Ocasio-Cortez. The Green New Deal calls for decisive action against climate change and takes accountability for the U.S.'s role in contributing to the climate crisis, "because the United States has historically been responsible for a disproportionate amount of greenhouse gas emissions, having emitted 20 percent of global greenhouse gas emissions

through 2014, and has a high technological capacity, the United States must take a leading role in reducing emissions through economic transformation" (H. Res. 109, 2019).

Among the many resolutions proposed by the piece of legislation are the goals to achieve a net-zero emission percentage by 2050, create high-paying job opportunities, reduce air pollution, ensure the access to clean water, healthy food, and end all forms of oppression (H. Res. 109, 2020). While the initiative seems like a basic first step in the right direction, many U.S. politicians dismissed it as being too radical, ultimately defeating it in a 57-0 Senate vote (Grandoni and Sonmez, 2019). This example illustrates how politicians remain resistant to decisive and comprehensive policies that will address climate change. In the U.S., Republicans and Democrats are deeply divided on whether climate change should be considered a salient issue of conversation. Given the severity of the climate crisis and the potential for increased human security risks, however, it is necessary to clarify the complexities that exist between climate change and human security outcomes so that an effective climate-security paradigm emerges, and adequate policies are achieved.

2.2 The Past and Present of the Climate-Security Paradigm

It is well established that the Cold War was the major impetus for security studies (Sirin, 2011; Stripple, 2002), as it expanded the debate from a traditional military focused approach to a widening debate on expanding the security agenda to include a range of issues (Buzan, 1997). In addition to these two schools, a third school, Critical Security Studies arose. This school questions the framework and the conceptualization of security as a whole. As the Cold War came to an end, the importance of military security became questionable and other issues such as the international economy and the environment became a growing concern (Buzan, 1997).

Environmental security could be traced back to 1960 when books such as Rachel Carson's *Silent Spring* shed light on how humans were negatively changing the natural environment (Buzan, 1997). By 1980, global environmental problems such as ozone depletion emerged (Trombetta, 2008), and in 1987 the World Commission on Environment and Development published *Our Common Future* and officially introduced environmental concerns to the formal political sphere. In the publication, the term "environmental security" was presented to the global debate and was meant to alarm traditional security analysts, as well as to underscore the relevance of environmental problems in order to get them on political agendas (Trombetta, 2008).

From the beginning, environmental security was a concept that was highly contentious, with some political actors agreeing that the problem required international solidarity and governance, and was an important element in preparing for the future; while others argued that integrating the environment into the security debate would create a zero-sum rationality[3] that would undermine cooperation (Trombetta, 2008). In 1994, however, the United Nations Development Programme (UNDP) prominently featured human security on their annual report and stressed that the concept of security consisted of much more than "maintaining the political control of elites within states or the related matter of preparing for wars with other states" (Redclift and Grasso, 2013: 34). Taking on a more constructivist[4] perspective that is imperative to human security, the UNDP highlighted six essential characteristics that threatened the security

[3] Zero Sum Rationality: A situation in game theory in which one person's gain is equivalent of another person's loss, so that net change in wealth or benefit is zero.

[4] The constructivist perspective of securitization offers insight into a number of additional dimensions of security such as culture, human consciousness, national identity, etc. (Tsai, 2009). It consists of a broader definition of what constitutes 'security', and for whom. Constructivist theorists argue that various aspects of security socially constructed, rather than inevitable consequences of human nature or other essential characteristics of world politics.

of people everywhere: 1) unchecked population growth, 2) disparities in economic opportunities, 3) excessive international migration, 4) environmental degradation, 5) drug production and trafficking, and 6) international terrorism (Redclift and Grasso: 2013: 27). While climate change was not of particular concern at the time, the addition of environmental degradation as a threat to human security was a notable first step in the securitization of the environment (Redclift and Grasso, 2013).

Over the last couple of decades, human security as it relates to climate change, has gained traction and has become an important source of discussion in international politics, academic analysis, as well as policy prescription. While directly linking climate change to human security has been difficult due to the many uncertainties that come with explaining precisely how climate change manifests itself in any particular place, as well as the puzzle that exists in the complexity of achieving human security as a universal norm; invoking the securitization of the environment to the global political debate has been realized due to the rise in climate emergency situations that have been rendered upon some of the world's most vulnerable populations (Redclift and Grasso, 2013). Today, climate change has been deemed "one of the most pressing issues of our time" by various international actors, as it threatens the lives of billions of people (U.N., 2020). Thus, understanding how the consequences of climate change affect and interact with the various dimensions of human security is an important stage in identifying entry points for mitigating security threats on people and communities all over the world (U.N., 2020).

2.3 The Human Security Framework

The human security paradigm is an emerging model that is a people-centered approach to understanding security concerns that pose a threat to the global rather than national population. The Commission on Human Security defines it as:

> "the vital core of all human lives in ways that enhance human freedoms and human fulfillment. Human security means protecting fundamental freedoms—freedoms that are the essence of life. It means protecting people from critical (severe) and pervasive (widespread) threats and situations. It means creating political, social, environmental, economic, military, and cultural systems that together give people the building blocks of survival, livelihood, and dignity" (Commission on Human Security, 2003: 4).

I use this definition for the purposes of this work and echo Secretary General Kofi Annan's 2000 suggestion that "human security in its broadest sense embraces far more than the absence of violent conflict" (Redclift and Grasso, 2013: 29). Human security is instead comprised of building blocks that include but are not limited to good governance, human rights, reduced poverty, resilience, as well as a healthy natural environment (Redclift and Grasso, 2013). Gasper (2020) argues that to present climate change as an issue of human security means to analyze the impacts and implications in the lives of ordinary people, not only in the agenda of armies, states, or national economies. This means looking at how climate change will impact patterns of nutrition, life expectancy, migration, etc.—and not only at the onset of armed conflict, as traditional state-centered security analyses have done (Gasper, 2013). Taking on a humanist perspective, this thesis utilizes the human security framework and looks not only at aggregates of variables, but at the complex interactions of climactic events and the adverse effects they have on the lives of people: such as what happens when climate change outcomes impact some of the basic requirements for human survival.

2.4 Livelihood and Climate Change

At the center of the human security nexus are the concepts of livelihood and economic incentive, as they tend to influence behavioral changes in people that can lead to migration

and/or violent conflict (Werz and Conley, 2012). According to a publication produced by the International Institute for Sustainable Development (IISD), livelihoods are constructed and sustained by how resources are utilized to earn an income to meet basic needs (IISD, 2003). Critical to the security of humans, a stable livelihood gives the individual the ability to generate sufficient resources to reduce poverty as well and build *resilience*[5] through material assets (IISD, 2003). When stable, these conditions should contribute to natural capital, human capital, social-political capital, as well as financial capital (IISD, 2003). Taken together, this report argues that these components largely determine how individuals adapt to the impacts of climate change.

It is well documented that climate change poses a significant threat to livelihood security (Adger et al., 2014), as evidence shows that climate impacts affect access to clean water, food, housing, as well as employment—resulting in a deprivation of basic needs necessary for human life. Some illustrative examples of observed impacts on livelihoods due to aggravated climate stresses are showcased in Carter et al.'s (2007) study that documents how the drought of 1999 in Ethiopia depleted household assets such as livestock leading to extreme and long-term poverty. Though Carter et al. directly link poverty traps to drought and other environmental shocks such as natural disasters, we know that climate change will result in these events occurring at higher volumes and more frequent rates. Thus, while droughts, storms, floods, etc. are part of normal fluctuations of climate—global warming is intensifying occurrence, and there is scientific consensus that climate change will impact the future trajectory of weather extremes (IPCC, 2012a). For example, a model projection shows that a hot day that at one time occurred once

[5] The term resilience, as used in this thesis, is the ability to absorb stresses and maintain function in the face of external stresses imposed upon it climate change and the ability to adapt, reorganize, and evolve into more desirable configurations that improve the sustainability of the system, leaving it better prepared for future climate change impacts.

every 20 years is now likely to occur once every other year by the end of the 21st century (IPCC, 2012a). Such effects will be particularly harmful to people that are dependent on climate sensitive forms of capital.

Gentle and Mareseni (2012) argue that the effects of climate change tend to be more severe on populations that rely on rain-fed agriculture to secure their livelihoods. Their study, which focuses on communities in rural Nepal, shows that climate change was a significant factor that reduced livelihood for an agrarian community who was simultaneously experiencing resource scarcity, lack of basic services, as well as social inequalities. For communities already living in poverty, climate change simply adds burdens, and often contributes to the tipping points of vulnerability (Gentle and Mareseni, 2012). According to IPCC reports, poverty and marginalization make it challenging for individuals to create a buffer to face even modest climate threats. It is these populations that suffer most from successive events; they are the first to "experience asset erosion, poverty traps, and barriers that limit adaptation" (Adger et al., 2014: 802). It is important to note that climate impacts transcend socio-economic status and can affect even the lives of the wealthy; as illustrated by the deadly wildfires that raged through California in 2019. With the most affluent neighborhoods of Napa Valley left destroyed and tens of thousands of its residents left displaced; climate change related threats proved that they do not discriminate in spreading chaos—though the magnitude of this chaos is felt unevenly depending on the vulnerability of a population. Although the total costs of these climate related impacts in California are expected to be astronomical, it is the resilience and adaptation capabilities of these communities that distinguish them from those in developing countries. Eventually the communities in California fully intend to rebuild, as confirmed by an administrator of the Federal Emergency Management Agency (FEMA), "The quicker we remove the debris, the

faster reconstruction can start" (Siegler, 2019: 12). The cost of debris removal alone is projected to cost more than $1.7 billion dollars (Siegler, 2019). In places like Afghanistan, Chad, India, or Kenya, rebuilding is not an easy option due to poverty that is entrenched in the foundation of the countries.

Populations in developing countries seldom have the privilege to recover or appropriately adapt to the stresses of climate change. Instead, the world's most vulnerable communities are left to overcome the ways in which a warming world multiplies poverty, exacerbates inequalities, and triggers new problems like migration (Adger et al., 2014). As I suggest in this thesis, climate change outcomes interact with non-climatic stressors like entrenched structural inequalities and worsen vulnerabilities to vastly reduced livelihoods (Adger et al., 2014); sparking a domino effect that leads to other security threats like forced migration and, in worse case scenarios, violent conflict.

2.5 Human Mobility, Migration, and Climate Change

For nearly 30 years, assessment reports by the IPCC have warned that perhaps the greatest single impact of climate change could be on human migration (International Organization for Migration (IOM), 2008). However, though scientific evidence for climate change has increased in confidence over the years, the impact of climate change on the migratory movement of people remains unclear and challenging to predict. Human migration is defined as the movement of people from one geographic place to another as they seek temporary or permanent settlement (U.N., 2020). Though individuals might choose to migrate for a wide array of reasons such as: search of economic opportunity, to escape persecution or conflict, to join family, or to flee the adverse effects of climate change; human migration levels are on the rise (U.N., 2020).

In this work I focus on a specific type of migration known as internal displacement. Internal displacement is the migration of people within one geopolitical entity, whose general trend of movement is from rural to urban areas, a process known as urbanization (World Migration Report, 2020). In 2018 alone, an estimated 28 million people were displaced from their homes (IDMC, 2019), with 10.8 million leaving their territory to escape conflict and the remaining 17.2 seeking to flee natural disaster (IDMC, 2019). Human migration patterns show that while migration can occur over long distances, internal migration is the dominant form of human mobility at the global level (UN, 2020).

The Internal Displacement Monitoring Center (IDMC) identifies chronic poverty, political instability, and climate-related threats as the main drivers for migration (IDMC, 2020). The IDMC also indicates that ninety-five percent of this global urban growth will take place in developing states, creating a fragile setting that further aggravates inequalities and instabilities (IDMC, 2020). It has been found that changes in the rural economy impacted by climate shocks tend to erode livelihoods and drive displacement toward cities in many countries (IDMC, 2020). "Disasters, conflict, a lack of livelihoods, land grabs, the eviction of indigenous and poor communities, and loss of land, productivity and opportunity in rural areas all push people toward cities" (IDMC, 2020: 79).

	Country	Total number of IDPs (Conflict and violence) (as of 31 December 2018)	New displacements (Conflict and violence) (1 January - 31 December 2018) ▼	New displacements (Disasters) (1 January - 31 December 2018)
1	Ethiopia	2,137,000	2,895,000	296,000
2	Congo, Dem. Rep.	3,081,000	1,840,000	81,000
3	Syrian Arab Republic	6,119,000	1,649,000	27,000
4	Somalia	2,648,000	578,000	547,000
5	Nigeria	2,216,000	541,000	613,000
6	Central African Republic	641,000	510,000	9,300
7	Cameroon	668,000	459,000	
8	Afghanistan	2,598,000	372,000	435,000
9	South Sudan	1,869,000	321,000	6,600
10	Yemen, Rep.	2,324,000	252,000	18,000
11	El Salvador		246,000	4,700
12	Philippines	301,000	188,000	3,802,000
13	India	479,000	169,000	2,675,000
14	Iraq	1,962,000	150,000	69,000
15	Colombia	5,761,000	145,000	67,000

Figure 3. Internal Displacement Figures by Country as a Result of Disasters and Violence Source: The Internal Displacement Monitoring Center

Note: The figure above shows that the countries with the highest number of IDP's are all developing countries.

An illustration of such conditions could be identified in the case of extended drought in the Horn of Africa, where the livelihoods of pastoralists were destroyed, forcing them to migrate to urban areas in search of alternative means for income (FAO, 2009).

According to experts, as temperatures continue to increase, the movement of people will be impacted in at least 4 clear ways: 1) the intensification of natural disasters—both sudden and slow-onset—will lead to increased displacement and migration, 2) the adverse consequences of increased warming, climate variability and of other effects of climate change for livelihoods, public health, food security and water availability, 3) rising sea levels that make coastal areas uninhabitable, and 4) competition over scarce natural resources potentially leading to growing tensions and even conflict and, in turn, displacement (IOM, 2014). Smith (2007) echoes these

predictions in his work, where he found that the internal migration that took place post-hurricane Katrina is "symbolic of a larger trend occurring throughout the world" (618), as "populations on the margin begin to seek less vulnerable livelihoods in new places or as they are potentially forced from their homes by catastrophes" (Hultman and Bozmoski, 2006: 33).

Though some empirical analyses have challenged the link between climate change and migration, claiming that victims of natural disasters do not have the means to migrate and denying a direct association between the two, other evidence has shown that climate change factors will not only induce migration, but also lead to violent conflict (Reuveny, 2007). According to Reuveny, conflict as a result of migration is more likely to arise in underdeveloped countries, as the receiving country experiences increased resource scarcities that create competition between the migrants and the locals (2007). In addition, ethnic tensions between migrants and residents would also provide inclinations for conflict, as distrust and other auxiliary conditions may intensify the likelihood of violence (Reuveny, 2007). Using data provided by the Center for Research on the Epidemiology of Disasters, Reuveny computed a total number of people affected by natural disasters and were forced to migrate. The analysis showcases 38 examples of environmental migration and highlights 19 cases in which conflict occurred as a result of migration (Reuveny, 2007). The results support the researcher's theory—that environmental migration plays a contributing a role in creating conflict in receiving countries.

As worsening climate patterns increase, the surge of severe weather events will continue to spike waves of human mobility. Those who opt to migrate do so with little guarantees and no legal protection, as the current system of international law offers no legally binding agreements to support climate migrants (IDMC, 2019). As the migratory situation is amplified by environmental impacts such as natural disasters and drought, it is necessary to understand

acknowledge the full range of dangers that migration poses to human security, as "deprivations in understanding can undermine peace and stability within and between states, whereas an overemphasis on state security can be detrimental to human welfare" (Gregoratti, 2019: 53).

2.6 Violent Conflict and Climate Change

The IPCC's fifth assessment report states that there is a "strong body of evidence from development studies and political science that violent conflict undermines human security and the capacity of individuals, communities and states to cope with changes" (Adger et al., 2014: 48). While the literature has well established that armed conflict is decreasing (Gleditsch, 2012; Themner and Wallensteen, 2011), there is debate that climate change has become a new source of instability that could potentially lead to a rise in conflict (IPCC, 2019). The discussion on climate change and conflict often focuses on how natural disasters, sea-level rise, and increased resource scarcity lead to economic decline and loss of livelihood that eventually result in security issues (Thiesen, 2013). These problems combined with poor state capacity, poverty, and other inequalities breed conditions that promote instability (Thiesen, 2013; Adger et al., 2014).

Much of the literature that examines climate change and armed conflict focuses on resource scarcity, with the theory being straightforward in nature. The neo-Malthusian model of conflict proposes that as a scarcity of essential resources mount, those affected by the dearth of resources may fight over whatever is left (Thiesen, 2013). However, statistical evidence for this argument has often been inconclusive in the literature (Sirin 2011; Thiesen 2013). Rather than resource scarcity, Benjaminsen et al. (2012), suggest that restricted mobility, political negligence, corruption and rent seeking to be at the heart of violent conflict. In addition, "several statistical studies (Etsy et al., 1998; Raleigh and Urdal, 2007) focusing on civil conflicts at both

the global level and in Africa provide only limited support for the neo-Malthusian hypotheses" (Thiesen, 2013, p.:618).

Sirin (2011) credits the inconclusive nature of the evidence to the weak causal pathways between resource scarcity and conflict and suggests that null findings might be "because the causal relationship between environmental scarcity and conflict is indirect and more complex" than what is typically proposed (p. 123). In her work, Sirin integrates ethnic population pressures in examining the relationship between resource scarcity and conflict. She argues that when competing minority groups are similar in size, it creates a "parity-threat" that increases scarcity-induced domestic conflict. The empirical results of her study support this hypothesis and show that outside factors such as ethnic population pressures exacerbated scarcity issues and ultimately escalated conflict (Sirin, 2011); proving that incorporating more thoughtful theoretical frameworks provides more insightful conclusions.

In their work, *Beyond Environmental Scarcity*, researchers Hauge and Ellingsen argue that the causal pathways of climate change and security must pay close attention to the interaction of economic, political, and environmental variables. Their work reveals that while environmental degradation increases violent conflict, economic and political variables played a more impactful role in the onset of violent conflict (Hauge and Ellingsen, 1998). Thus the interactions of these variables should be further investigated in the field.

2.7 Gaps in Literature

There are several shortcomings in the various studies previously mentioned in the literature review of this work. For one, much of the research published on climate change and the various aspects of human security rarely use climactic variables such as long term average temperature or precipitation trends over the years. Instead, many of the studies have relied on

proxy variables that do not adequately capture the actual change of climate (Scheffran et al., 2012). Furthermore, many of these researchers tend to use overly aggregate research designs and fail to look at the temporal and spatial complexities of the climate-security phenomenon. Past processes such as a history of war, colonization, etc. are all part of the puzzle and should be considered and integrated into research designs. Moreover, much of the literature focuses on trends limited to one geographical space rather than investigating how climate insecurity threatens at the global scale. Many of the cited studies focus on livelihood, migration, or conflict exclusively and separate from each other. Few studies to my knowledge look at how the dimensions are related and tied to human security as a whole. In this thesis, I aim to address these research limitations by using a climactic independent variable that more accurately captures climate change as defined by the IPCC. By integrating a mixed methods approach, I aspire to capture far more than what could be seen at the aggregate level. Looking at the impacts of livelihood, migration, and conflict together and at the international level, this study could provide an improved understanding of climate change and its connection to human security.

In addition, the climate security literature urgently highlights the need for more theoretically sound empirical testing. Empirical analyses that have examined environmental security are highly criticized for being theoretically underdeveloped and "few have attempted to present an overview with focus on connecting theory to empirical testing" (Seter, 2016: 22). To adequately address this issue, Seter recommends that environmental security researchers incorporate a mixed methods research design into their studies. This means that carefully developed concepts and identification of relevant contexts are required for meaningful analysis. Seter argues that this could be accomplished by investigating in-depth qualitative case studies to

better assess the mechanisms that link climate change and human security together (Seter, 2016). This is the approach I take, as this thesis will:

1. Contribute to the methodological gaps in the field by integrating process tracing to systematically explore the causal route from climate change to the various dimensions of human security
2. Focus on states that are most vulnerable to climate change threats
3. Address the lack of large N-quantitative studies in the field

To address these gaps and the primary research questions tackled in this thesis, I explore the non-linear effects of more complex causal processes that exist between climate change and human security. I deconstruct the climate security nexus and look closely at the interactions that occur between environmental impacts and material, social, political and other areas of human security. In addition to outlining a better understanding of the causal pathways that link climate change to the various dimensions of security, I expect to find that as temperatures increase, the climactic stresses cause changes to the environments that populations rely on for their needs. When reductions of livelihoods occur, societies respond. These responses result in impacts that create social instability in a vulnerable country. To test this this theory, I offer the following series of hypotheses:

Hypothesis 1: As temperatures increase, the likelihood of livelihood reduction increases in developing states.

Hypothesis 2: As temperatures increase, the likelihood of internal migration increases in developing states.

Hypothesis 3: As temperatures increase, the likelihood of conflict increases in developing states.

2.8 Theoretical Framework

The theoretical framework of this work employs Jurgen Scheffran's (2009) *Integrated Framework of Interactions Between Climate and Society* to think about the human-security nexus. This framework analyzes the causal links between climate stress, environmental impacts, human responses, and the effects they have on society (Scheffran, 2009). The framework suggests that changes in the climate create changes in the environment, through a sequence of complex interactions; these environmental changes then affect natural resources that result in threats to humans (Scheffran, 2009). This can mean land degradation, food and water insecurity, threats to economic livelihoods, etc. (Scheffran, 2009). Depending on the degree of vulnerability of the communities experiencing these stressors, conditions may lead to social instability such as increased migration, civil unrest, ethnic/racial conflict, etc. (Sheffran, 2009). According to Scheffran the existing feedback loops that exist within the puzzle allows the impacted community to adapt to a changing situation and mitigate climate stress via institutions that apply human capital as well as apply technology to the energy system (2009). To identify the couplings along the causal chain, it is important to identify how variables in one system are influenced by changing variables in another (Scheffran, 2009). A feedback loop allows societies to adapt to the changing situation and mitigate climate stress through strategies and institutions that apply technology, human and social capital to adjust to the altered environmental conditions. To determine the couplings along the causal chain, it is important to identify the sensitivities that measure how variables in one system are influenced by changing variables in another. An example is the desertification caused by climate change, which undermines food security and forces people to migrate or respond violently.

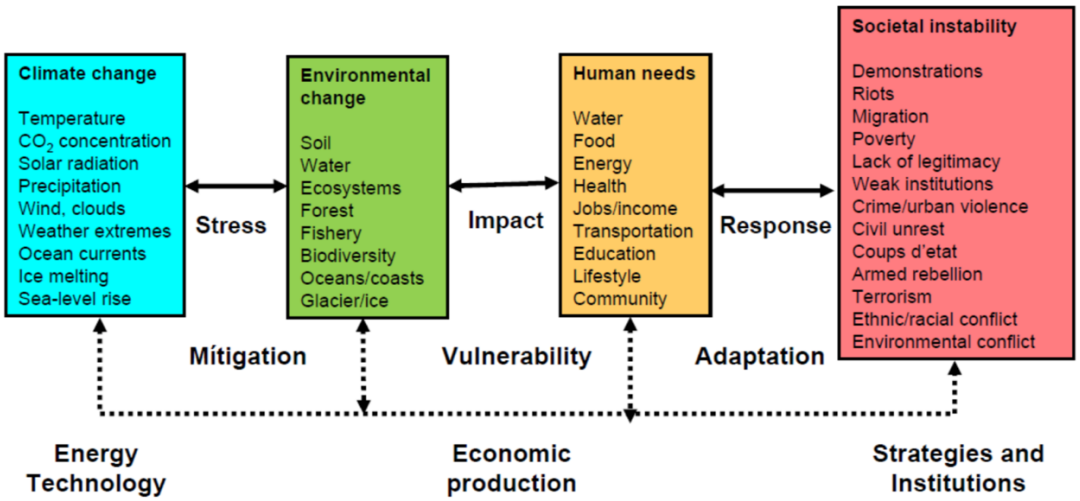

Figure 4. Scheffran's Conceptual Framework: Causal Links Between Climate Change, Environmental Stress, Human Needs, and Societal Consequences
Source: Scheffran, 2009

I utilize this framework to assess the link between climate change and human security at the macro-level and also use it to analyze specific micro-level events such as how drought in Bangladesh and Sudan diminishes livelihood, increases migration, and contributes to conflict.

CHAPTER THREE: INTEGRATING QUALITATIVE RESEARCH METHODS TO UNDERSTAND THE CLIMATE-SECURITY CONNECTION

The research design of this project uses a mixed methods approach—or a "triangulation approach, which refers to empirical research that involves the collection and analysis of both qualitative and quantitative data" (Johnson and Onwuegbzic, 2004:18). This approach obtains quantitative and qualitative data on the same topic, bringing together the strengths of the two methods (Johnson and Onwuegbzic, 2004). The triangulation design "involves concurrent but separate collection and analysis of two types of data, which are then merged at the interpretation-of-results stage" (Johnson and Onwuegbzic, 2004). The integration of both qualitative and quantitative methods will be used to address the methodological gaps highlighted by the literature. The research design will first use process tracing[6] to assess the impacts of climate change on livelihood decline, migration, and conflict. The process tracing will analyze two case studies: drought in Bangladesh and drought in Darfur (Mazo, 2009), and how these events affected the three dimensions in human security. After the process tracing analysis is completed, the findings will inform several statistical analyses that test the causal mechanisms found in each of the case studies.

This chapter begins by explaining the benefits of using case studies as a research method in social sciences. It then turns to describing process tracing and why it is a helpful tool in investigating causal factors. Details on the case selection process are also included.

[6] Process tracing is a method used to develop theories in various fields such as psychology, political science, and sociology. It involves the study of causal mechanisms that link antecedents with outcomes.

3.1 Case Studies: Advantages and Limitations

Using case studies as a method for theory development has been an increasingly prominent feature in social science research (George and Bennet, 2005). Because this thesis examines the complex causal relation between climate change and human security, the case study method serves as a valuable avenue as case studies look at a large number of intervening variables present in any particular causal mechanism (George and Bennet, 2005). Unlike statistical studies that omit contextual factors, case studies can make it easier to investigate chains of evidence to establish causation (George and Bennet, 2005), which can ultimately result in more theoretically sound testing. George and Bennet argue that when combined with statistical methods, case studies offer a complementary and more well-rounded assessment of a phenomenon.

Despite these strengths and advantages, case study methods have been criticized for having a wide array of limitations. One common critique is the argument that case studies are prone to selection-bias that statistical researchers largely frown upon (George and Bennet, 2005). These biases occur when cases are self-selected or "when cases that represent a truncated sample along the dependent variable of the relevant population of cases" (George and Bennet, 2005:31). However, case study researchers argue that selection on the dependent variable can help in identifying what variables are not sufficient or necessary conditions for an outcome (George and Bennet, 2005). In addition, selecting a case with some preliminary knowledge can result in stronger research design. For example, cases can be selected where a researcher selects cases with a view toward whether a causal relationship is "most likely" to be found or "least likely" to be found—making the process tracing test of a theory more stringent and severe (George and Bennet, 2005).

If a causal mechanism is present using the "most likely" approach, the hypothesis is pronounced "plausible", and if it is not it is deemed "falsified" (Ross, 2004). This method pays careful attention to validity as well as accounts for variables that are difficult to measure (Ross, 2004). This research design does come with trade-offs, however. Because the selection of cases are biased, one cannot make broader inferences with that sample, as they would have no external validity (George and Bennet, 2005; Ross, 2004). Still, because the "most-likely" approach can reveal internal validity in a single case, one can ease suspicion of spurious or reversed correlations (Ross, 2004).

3.2 Process Tracing

The challenge of developing comprehensive response strategies to climate security threats stems from the non-linear, long-term, and multi-faceted characteristics of climate-security. Because of this, traditional research methods can often be overwhelmed (Homer-Dixon, 1999). Experts on methodology in political science studying this phenomenon have recommended using causal process tracing (CPT) to understand the unique geographic, social, economic, and political aspects that are associated with the problem (Homer-Dixon, 1999). Process tracing is a methodological tool utilized by scholars looking to understand a causal sequence in which observations can be situated (Collier, 2011). CPT is especially useful "for between-case analysis of different causal paths in small-N case study research, including long and complicated causal chains with perhaps disproportionately large or small effects as well as the contingencies involved in different outcomes from very similar combinations of contexts and causal drivers" (Kay and Baker, 2015:1), such as those that exist in the climate-security nexus. The method of process tracing involves examining evidence selected and analyzed to answer and test hypotheses constructed by the investigator (Collier, 2011). By tracing the process that leads

to an outcome allows one to narrow down explanatory causes that lead to the event. Moreover, this method provides systemization to the qualitative approach and adds inferential leverage that is often missing in quantitative analysis (Collier, 2011).

There are various types of process tracing techniques and each should be adapted to the nature of the phenomenon being investigated (George and Bennet, 2005). While some causal processes are linear and straightforward, most phenomena deal with convergence and/or interacting causal variables. Process tracing makes it possible to investigate these processes through various pathways that can lead to a similar outcome (George and Bennet, 2005). This serves as a building block for better theories that in turn result in better quantitative analyses (George and Bennet, 2005).

Though process tracing has grown in popularity among social scientists, the method has been scrutinized for lacking specific guidelines for application (Ricks and Liu, 2018). Critiques also warn about the provisional conclusions one can reach when there is more than one hypothesized causal mechanism relating to the evidence presented in process tracing (George and Bennet, 2015). In 2018, Ricks and Liu addressed one of these shortcomings and contributed a checklist (Figure 5) that provides step-by-step instructions on how to successfully apply process-tracing to the study of an outcome of interest and an explanation based on "rigorous assessing and weighting of evidence for and against causal inference" (Ricks and Liu, 2018: 842).

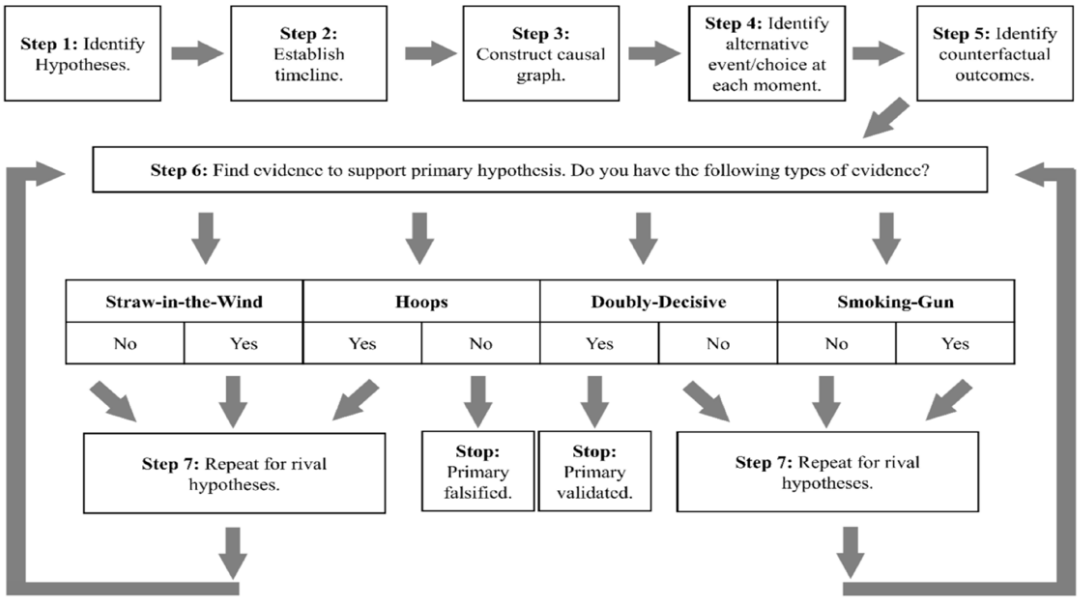

Figure 5. Process Tracing Checklist
Source: Ricks and Liu, 2018

As depicted in Figure 5, step one on the process-tracing checklist is to identify a hypothesis. This requires establishing testable hypotheses that are guided by theory. Unlike other research methods that rely on causal inference, process tracing uses rival explanations and juxtaposes them with the main hypothesis (Ricks and Liu, 2011). A recommended approach is to construct hypotheses that are simple and testable (Ricks and Liu, 2011). Theoretical expectations should be outlined before moving on to step two, which requires the investigator to sequence events (Ricks and Liu, 2011). Ricks and Liu recommend that the created timelines be bookended with theoretical expectations, for example, the conclusion of your timeline should be at your outcome of interest (the dependent variable).

After the development of the timeline, an investigator is ready to move on to step 3, constructing a causal graph. This graph will depict the causal process through which X causes Y.

It is important that the causal graph identify all moments that are "collectively sufficient to generate the outcome" (Waldner 2015: 131). The timeline will be particularly helpful in creating the causal graph, as it clarifies or help fill missing information (Ricks and Liu, 2011). Step 4 requires the investigator to develop alternative events that could have happened in each relevant moment of the causal graph (Ricks and Liu, 2011), which allows us to identify counterfactual outcomes in Step 5. Once the investigator has established a timeline, outlined causal graphs, as well as developed counterfactual outcomes, evidence for the primary hypothesis must be evaluated using the necessary tests (Ricks and Lius, 2011). The tests will either confirm or deny the hypothesis.

Applying the Process Tracing Tests

The process tracing tests are comprised of 'straw-in-the-wind' tests, 'hoop' tests, 'smoking gun' tests and 'doubly decisive' tests (Bennett 2010; Collier 2011; Van Evera 1997). Each of these tests were developed on the principles of uniqueness and certainty and help in evaluating whether the evidence is necessary and or sufficient to confirm the hypothesized theory (Collier 2011, Ricks and Liu, 2018). Tests with high "uniqueness" assist in strengthening evidence that confirms a proposed hypothesis by showing that evidence was "sufficient" to confirm it. Tests that require high certainty help in ruling out alternative justifications by determining that the evidence provided is necessary for the hypothesis to stand (Beach and Pedersen, 2013). Table 1 below provides examples of how each test can be applied to a proposed hypothesis.

Table 1. Illustrative Examples of Process Tracing Tests

Straw-in-the-wind test (low uniqueness, low certainty). This is the weakest of the four tests, neither necessary nor sufficient to confirm a hypothesis.

Example hypothesis John shot Mary because he discovered her having an affair.
Evidence constituting this type of test Evidence that affair was taking place – for example, a hotel receipt, suggestive text messages.
What happens if the hypothesis passes the test (i.e. reliable evidence of this type exists)? The investigator can be slightly more confident in the hypothesis, but this is not enough to conclusively prove it or to disprove alternative hypotheses. However, straw-in-the-wind tests can provide a valuable benchmark, and if a hypothesis passes multiple tests this can add up to important evidence.
What happens if the hypothesis fails the test (i.e. reliable evidence of this type does not exist)? This slightly raises doubts about the truth of the hypothesis, but is not enough to rule it out.

Hoop test (high certainty: necessary to confirm hypothesis).

Example hypothesis John shot Mary.
Evidence constituting this type of test John lacks a good alibi for the night of the murder – for example, he claims he was alone.
What happens if the hypothesis passes the test? It does not significantly raise the investigator's confidence that the hypothesis is true. John lacking a good alibi is not enough on its own to prove the hypothesis.
What happens if the hypothesis fails the test? It disconfirms the hypothesis. If John has a watertight alibi, we can be confident that he did not shoot Mary. Because of this, hoop tests are often used to exclude alternative hypotheses.

Smoking gun test (high uniqueness: sufficient to confirm hypothesis).

Example hypothesis John shot Mary.
Evidence constituting this type of test John was found holding a smoking gun over Mary's body.
What happens if the hypothesis passes the test? The investigator can be confident that the hypothesis is true – John did indeed shoot Mary.
What happens if the hypothesis fails the test? It does not significantly decrease confidence in the hypothesis. John may have shot Mary and escaped undetected.

Doubly decisive test (high certainty, high uniqueness). This is the most demanding test, both necessary and sufficient to confirm a hypothesis.

Example hypothesis John shot Mary.
Evidence constituting this type of test John was caught on a high-resolution, tamper-proof CCTV camera committing the crime.
What happens if the hypothesis passes the test? We can be confident that the hypothesis is true, and that all alternative hypotheses are false. John did indeed shoot Mary.
What happens if the hypothesis fails the test? It depends on the nature of the test. If someone else was caught on CCTV committing the crime, it would disconfirm the hypothesis. But if there simply was not a camera, it does nothing to increase or decrease our confidence in the hypothesis.

Source: Beach and Pedersen (2013) and Collier (2011)

3.3 Case Selection

Upon the selection of samples for this part of the study, I decided to choose cases in which climate change was affecting the various dimensions of human security. Similar to Ross (2004), I opted for examples where the dependent variables were "most likely" to be affected by climate change. The selection of these cases was highly influenced by the recommendations

made by the IPCC and the literature—which called for the need to focus on states that were most vulnerable. Both Bangladesh and Sudan are among some of the most vulnerable countries to climate change (Morgan, 2019). The Climate Risk Index ranked Bangladesh among the top ten countries most affected by climate change (Ekstein et al., 2019), and Darfur has continuously identified the first modern climate change conflict (UN, 2007; Mazo, 2009; Sova, 2017). Careful analysis of these vulnerable places may offer insights that has universal applicability to other states that are highly vulnerable to climate impacts. The first case study will trace the process of drought in Bangladesh and how it affects reduced livelihoods and impacts human migration in the state. The second case examines how climate change contributed to the civil war in Darfur through the reduction of livelihoods of Darfurian farmers and pastoralists. In this investigation, I will use one type of CPT: theory testing (Beach and Peterson, 2013), which particularly focuses on "the systematic study of the link between an outcome of interest and an explanation based on the rigorous assessing and weighting of evidence for and against causal inference" (Ricks and Liu, 2018: 2). Theory testing is deductive in nature and tests existing theories by examining whether causal mechanism predicted are present and whether they function as hypothesized (Beach and Pederson, 2013).

CHAPTER FOUR
CASE STUDY, PART I: BANGLADESH

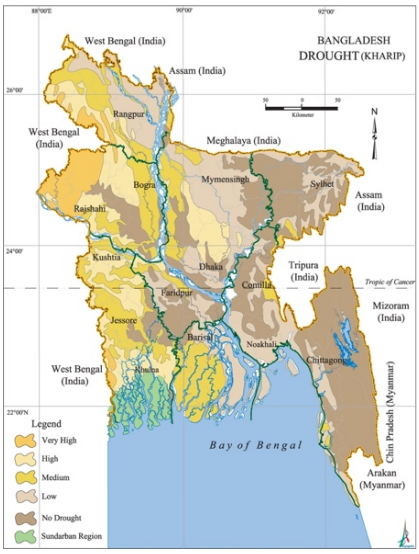

Figure 6. Map of Bangladesh
Source: University of Texas at Austin

"If the river didn't take our land, I wouldn't need to be here."

-Bangladeshi Migrant in Dhaka

The objective of this case study is to examine how environmental factors impacted by climate change, such as drought are a major cause of insecurity in Bangladesh. More specifically, the study illustrates how these events, combined with the country's political and socio-economic challenges, makes Bangladesh particularly vulnerable to increased human security risks such as reduced livelihoods and displacement that leads to migration from rural to urban areas (Walter, 2017). Because Bangladesh is a developing country that is also considered a climate-hotspot, it makes a perfect candidate for analysis, as recommended by the IPCC (Adger et al., 2014).

This case study first provides some background surrounding Bangladesh and the environmental challenges it faces. I then apply Rick and Liu's process tracing checklist to track

the relationship between drought (used as a proxy for slow-onset climate change) and human security. After completion of the checklist's seven steps, I provide a discussion on the results and provide a table that outlines some of the causal links that exist between the independent variable, climate change, and the dependent variable human security in Bangladesh.

4.1 Contextual Background

Since gaining its independence in 1971, Bangladesh has made significant progress in reducing poverty rates through expansions in its economy, improving food security, reducing population rates, and enhancing its Human Development Index score (International Organization for Migration, 2008). Despite these improvements, however, Bangladesh faces critical issues that make the state extremely vulnerable to the climate-crisis.

Situated to the east of India, on the Bay of Bengal, the country of Bangladesh is home to approximately 163 million people (World Bank, 2020), all of whom are tightly nestled in an area smaller than the state of Illinois (McDonnel, 2019). Its composition of low and flat lands serve as a network to more than 200 rivers and tributaries, making Bangladesh highly sensitive to climate catastrophes such as cyclones and floods (World Bank, 2020). Bangladesh's vulnerability to climate change is tragically illustrated by the climate related deaths that have occurred over the last 20 years. The World Bank projects that over 60 percent of worldwide deaths caused by cyclones have occurred in Bangladesh and it is projected that just a 3-feet rise in sea level would submerge more than 20 percent of the country and displace more than 30 million people (Glennon, 2017). These hardships are made worse by the country's ever-present levels of poverty—with the majority (63 percent) of the poor population being highly dependent on the agricultural workforce (International Organization for Migration, 2019). According to the Internal Displacement Monitoring Centre, in 2019 alone, Bangladesh saw a total of 1.7 million

newly displaced people (IDMC, 2020). These displacements are a product of both sudden-onset hazards such as flooding, tsunamis, and cyclones, as well as slow-onset climate impacts like drought, sea-level rise, and melting permafrost from the Himalayas (Environmental Justice Foundation, 2020). Though floods have often been cited as being Bangladesh's biggest environmental hazards; droughts have the capacity to cause more damage to crop yield than any other environmental disaster (Kanti, 1995). Because droughts are slower to manifest than cyclones or floods, they can be more pervasive in nature (Ericksen, 1993), and though droughts have been recurring in Bangladesh's history, it is projected that climate change will increase the rates and intensities of droughts in the coming years (Adger et al., 2014). In a society where agriculture is the leading economic activity, the impact of drought is observed via a first-order impact on food production (decreased crop yield) (Kanti, 1994). A second-order impact quickly follows as decreased crop yields quickly erode livelihoods in affected areas (Kanti, 1994).

As of 2018, 65 percent of the total population in Bangladesh lives in rural communities largely affected by climate impacts (World Bank, 2020). It is projected that warming in Bangladesh is expected to be pronounced; with average temperatures expected to increase between 1°C and 2°C by 2100 (Climate Knowledge Portal, 2020). A 2019 report from the U.S. Government Accountability Office found that various foreign aid agencies, including the State Department had not done enough to address climate-change induced migration in developing countries (McDonnel, 2019). The report cited Bangladesh as being one of the most vulnerable states and warned: "The effects of climate change on livelihoods, for example, could increase migration, strain governance, and contribute to conflict as a result. Bangladesh is one example where decreased yields from agriculture and fisheries have contributed to migration to the country's coastal cities, which face their own climate change challenges" (GAO, 2019: 40).

While some farmers in Bangladesh have adapted to climate change impacts by switching to dry tolerant crops, or shrimp cultivation, many other Bangladeshis have resorted to migration as a common adaptation measure to deal with the stresses of climate change (GAO, 2019). In order to find work that is less dependent on agriculture, many have migrated to the country's capital city of Dhaka and are forced to live in informal settlements that lack the resilience to overcome acute or sudden-onset climate events (GAO, 2019). "Today, Bangladesh has one of the highest rates of urbanization, and rural-urban migration is the most important factor behind it and has emerged as an important subject of concern because of the negative economic, social, environmental and human health impacts that the country is set to face" (Uddin and Firoj 2013: 90).

As climate change is projected to drive the migration of up to 200 million people worldwide by 2050, experts suggest that Dhaka serves as a warning for other refuge cities around the world (McDonnel, 2019). Political scientists at the Refugee and Migratory Research Unit at the University of Dhaka paint a bleak picture for future adaptations in the city, warning, "Dhaka is collapsing, and the government's vision is to have no vision" (McDonnel, 2019, 7). Currently there are 400,000 migrants arriving to Dhaka every year, and it is unlikely that the city will be able to absorb the millions more that are projected to arrive in the coming years (McDonnel, 2019).

Establishing a Baseline

To conduct an evaluation of climate change impacts the establishment of a baseline period in which the changes can be measured is required. However, because the onset of human induced climate change varies from region to region, it is challenging to establish what a particular country was like pre and post human induced global warming, making it difficult to establish a baseline. The time of emergence in which human induced warming trends became

clear in Asia began in the mid 1800s (Pidcock, 2016). Data on Bangladeshi drought show few events with historical significance before 1800, with most droughts occurring naturally and seasonally. We know that drought is a chronic problem whose impacts are slower to unfold. Thus, while human induced warming began in the mid 1800s, it is likely Bangladesh did not see any direct affects until much later. Table 2. below depicts the major and most severe droughts in Bangladesh. One can see that the frequency of severe droughts drastically increases after 1951. Because anthropogenic warming has been most severe in the last few decades, I use 1980 as a baseline year for this analysis and borrow from Rahman and Lateh's (2016) work to provide a detailed mapping timeline of drought in Bangladesh.

4.2 Process Tracing: From Drought to Insecurity in Bangladesh

This analysis now turns to tracing how chronic climate impacts threaten human security in Bangladesh. More specifically, the case looks at how the independent variable, drought (a proxy variable for climate change), impacts the main dependent variables of interest: livelihood reduction, migration patterns, and possible conflict. I use the IPCC's definition of drought which defines it as "a period of abnormally dry weather long enough to cause a serious hydrological imbalance" (IPCC, 2019: 558). There are different classifications of drought periods that range between mild, moderate, severe, and extreme. This case study pays close attention to the severe and extreme cases of drought, as they are known to be the most pervasive on agriculture and crop yields. These types of droughts typically last months or even years at a time. Because drought is a slow onset event, it may not immediately impact the drivers of reduced livelihood, migration, or conflict; but drought can gradually interact with or influence factors such as water availability, crop yields, etc. and lead to social disruptions and responses. Though not every drought may be a result of anthropogenic climate change, we know that global warming will increase the

frequency of drought and it is cited as being one of the main causes of the impact. Thus, tracing the historical impacts of severe drought may serve as a useful representation of how the impacts of climate change can threaten the security of humans.

Step 1: Identifying a Hypothesis

Employing Sheffran's Integrated Assessment of Climate Impacts on Human Security Theory, I expect to find to that the independent variable, drought, will produce environmental changes that have adverse impacts on human needs (decreased water resources, depleted crop yields, reduced livelihood). This will likely provoke human responses that affect Bangladesh's social systems and destabilize the dependent variable, human security. Drought is a chief climate concern whose impacts not only lead to the "shortage of water and food but also have a long-term environmental, socio-economic and health impact on the population" (Dey et al., 199: 89). After careful consideration of these elements as well as the contextual factors that surround Bangladesh's vulnerability to climate stressors, I test the following theoretical hypothesis:

> ***H1:*** *Changes in the temperature create changes in the environment, through a sequence of complex interactions; these environmental changes then affect natural resources that result in threats to humans (Scheffran, 2009). This can mean land degradation, food and water insecurity, threats to economic livelihoods, etc. (Scheffran, 2009).*

Step 2: Establishing a Timeline

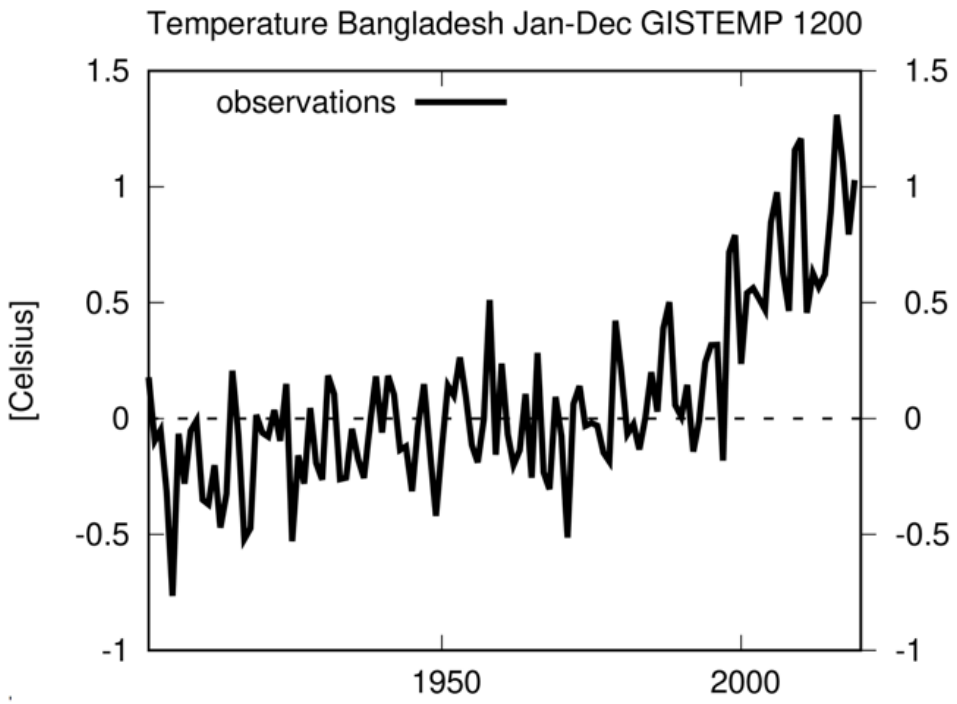

Figure 7. Average Temperature Bangladesh

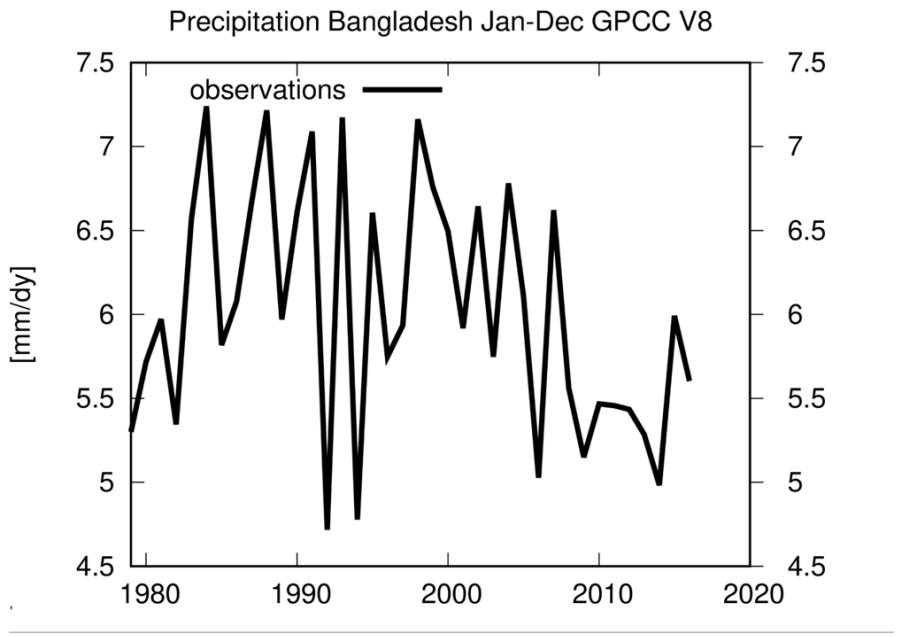

Figure 8. Average Precipitation Bangladesh

Table 2. Years of Severe Droughts in Bangladesh

Year	Impact of Drought
1791	Drought affected Jessore districts; price shocks rose to 2-3 times their normal levels
1865	Drought contributed to famine in Dhaka
1872	Severe drought in Bogra, rice production decreased significantly, price shocks rose
1951	Drought in Sundarbans, rain deficiencies led to major crop failures
1973	Bogra experiences crop failure as rainfall was extremely low
1975	Severe drought in Northwestern Bangladesh, reduced rice production
1978	One of the most severe droughts credited as being responsible for the 1974 famine of northern Bangladesh
1981	Drought affected 47 percent of the entire country
1982	Drought reduced rice productions by 2 million tons, affected 42 percent of cultivated land and affected 44 percent of the population
1989	Most rivers in Northwestern Bangladesh dry up, country experiences increased dust storms due to the drying up of topsoil
1994	Drought was cited as the worst in Bangladeshi history at the time of occurrence, the crash of major crop cash earning devastated farmers in the region

Source: Bangladpedia, 2014

While it is predicted that the global mean temperature will rise 0.3 Celsius per decade, several researchers predict that the rate of warming in Bangladesh is higher than the present rate of global warming (Ahmad and Warrick, 1996; Shahid 2010; Rahman and Lateh, 2015). This has the potential to increase water demand and drought severity in Bangladesh. In their work, Rahman and Lateh (2016), find that while mean average temperatures do not play a significant role on drought, increased maximum temperatures greatly influence the phenomenon. As of 2020, the World Bank predicts that the total annual hot days with temperatures above 35°C will rise by 35.8 days in Bangladesh by 2050 (Climate Change Knowledge Portal, 2020).

The historical data on drought in the country has been poorly documented and researchers have had to rely on different sources to make conclusions about the spaciotemporal characteristics of drought (Kamruzzaman et al., 2019). It is concluded that Bangladesh has experienced drought at regular occurrence in the past, but recent studies show an overall increase in drought and drought severity during the past 35 years (Kamruzzaman et al., 2019). In their 2016 study, Rahmen and Lateh assess drought using a standardized precipitation index (SPI) time series data set (1971-2010) using a three month spatial distribution. I use this timeline to assess drought before and after the baseline year of 1980.

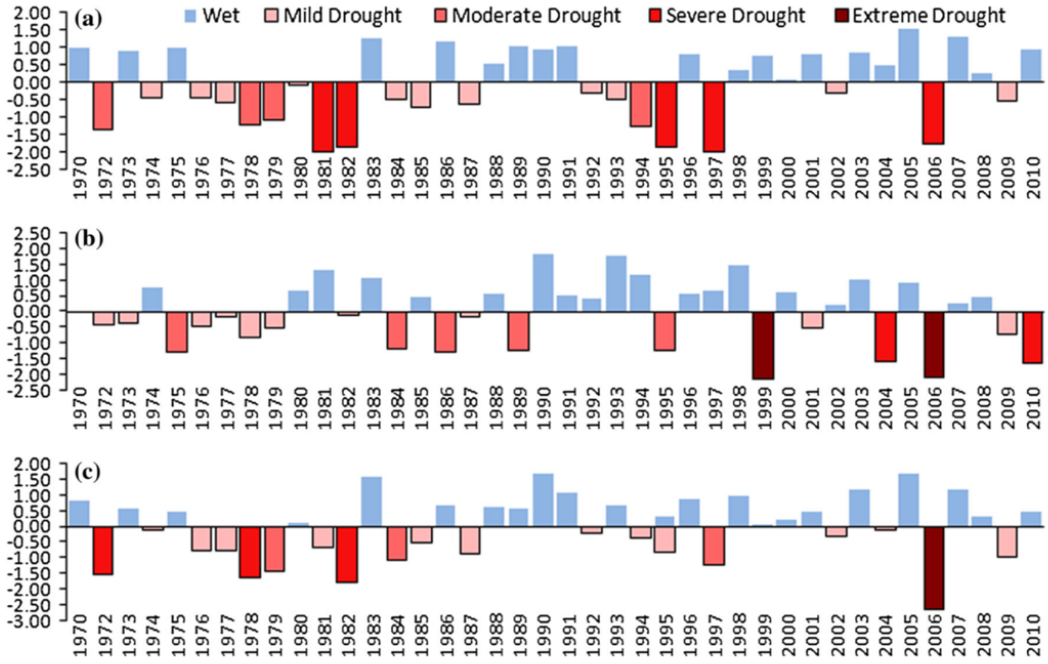

Figure 9. Drought Distribution in Bangladesh (1970-2010)
SPI-based drought distribution: a 3-month January, b 3-month April, and c 6 month April
Source: Rahmen and Lateh, 2019

In their work, Rahmen and Lateh (2016) classify drought based on the SPI index values, which indicate a 0—0.99 value is a normal or mild drought, an SPI value of -1 to—1.49 is a moderate category drought, -1.5—1.99 is of severe category, and -2 or less indicates an extreme drought. We can see that (Figure 9) extreme drought was not present prior to 1980 and severe drought occurred only a few times before the baseline year. As time continues, however, we see the frequency of severe drought increase and the onset of *extreme* drought after 1999. Rahmen and Lateh claim that this change may be linked to the impact of climate change at a regional and local scale.

As previously mentioned, drought has significant impacts on water and agriculture sectors in Bangladesh, and severe droughts have the potential of destabilizing food security in the country. Figure 10 below illustrates how different drought classes affect agriculture and crop

production, one can see that even slight drought has the potential to decrease crop output of wheat and potatoes by up to 20 and 50 percent. Other crops like T. Aman Rice and B. Aus wheat are much more sensitive to drought and see up to 70 percent of reduction when impacted by severe drought. Several examples in Bangladeshi history illustrate the devastating impacts drought has had on food production. In 1978, drought caused a reduction of about 2 million tons of rice and in 1997 drought is said to have caused the destruction of 2.6 million hectares of paddy field land (Habiba el al., 2013).

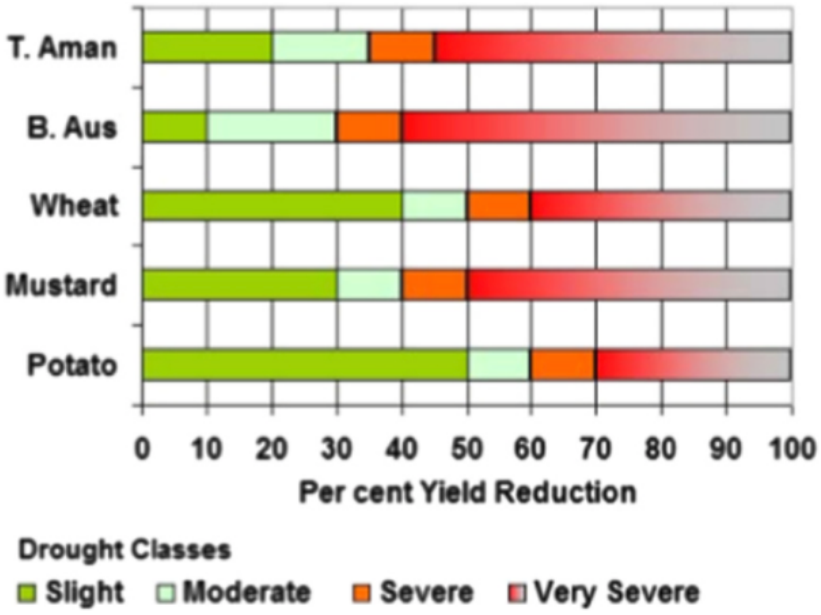

Figure 10. Impact of Drought on Agriculture and Crop Production
Source: Rahmen and Lateh, 2019

In order to assess how the independent variable, drought has impacted the dependent variables livelihood, migration, and conflict, over the years, I offer a summary of each dimension of human security in Bangladesh over the years.

Livelihood in Bangladesh

In conducting a livelihood analysis of Bangladesh through the years it is important to note that between 1947 and 1970 Bangladesh was a part of Pakistan. Referred to as East Pakistan, the country experienced economic discrimination from what was then known as West Pakistan, modern day-Pakistan (The Borgen Project, 2017)—receiving only 25 percent of the country's investments despite producing over 59 percent of the country's total exports (The Borgen Project, 2017). This oppression eventually led to the initiation of independence movements in the 1970's and would later ignite deadly massacres that killed between 500,000 and 3 million Bangladeshis (The Borgen Project, 2017). Thus, poverty is deeply engraved in Bangladesh's history due to its political instability, poor infrastructure, and lack of economic opportunity (The Borden Project, 2017); this starting point of oppression and violence has made it difficult for the people of Bangladesh to avoid long-term poverty traps. As previously noted, Bangladesh has a highly agro-based economy accounting for over 65 percent of the country's workforce (World Bank, 2020). Many of those who are not farmers are still indirectly involved in agro-based trades or industries by providing goods and services to agrarian families (Ali, 2005). Thus, when the climactic impacts of warming such as drought devastates crop yields in the country, it not only disrupts food availability, leading to food insecurity at a household level, but also devastates the entire food system affecting the economic well-being of many more people who are involved in agro-industries and food-based businesses.

To assess Bangladesh's livelihood security through the years, I use a per capita caloric proxy as an indicator for livelihood security, assuming that a household's livelihood is secure when they have the means to meet basic nutritional needs. A prevalence of undernourishment indicates high poverty rates and an erosion of livelihood security. Currently, there is a high variation in dietary intake that exists due to the differences in socioeconomic status of

households as well as rural versus urban locations (Ali, 2019). Table 3 shows the caloric intake per household from 1971 to 2009. The data were collected from the FAO and does not show too much variation before and after the 1980 baseline; however, one can observe a slight decline in k/cal per capita after the 1974-1975 drought that eventually led to a famine. While data on daily caloric household intake has improved over time, with the percentage of households that do not spend enough to meet their basic needs reducing from 56 percent in 1991 to 31 percent 2005, multiple famine events have been documented after onset of severe drought (Ali, 2005). Figure 11 illustrates caloric intake per capita in Bangladesh between 1961-2009. Generally, we see an upward trend of caloric intake through the years that is consistent with Bangladesh's developmental progress over time. However, these data aggregates may be masking the varying trends of more difficult years.

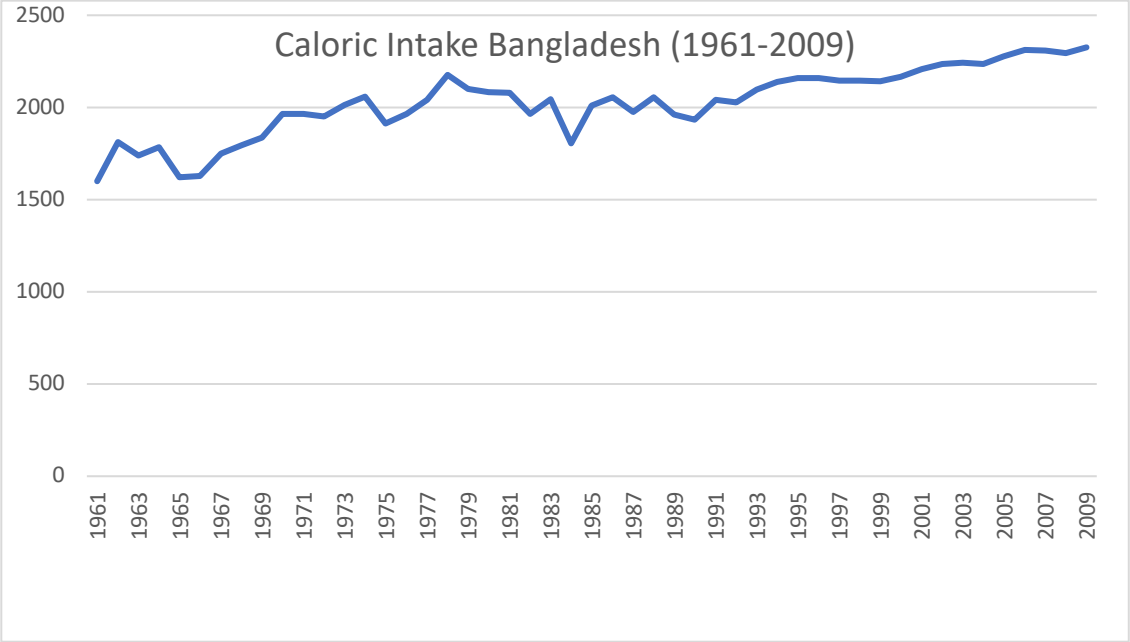

Figure 11. Caloric Intake Per Capita in Bangladesh from 1961-1999
Source: Created by author using Boehmer and Sobeck's 2007 dataset

For example, following the drought of 1974 and 1975, a period of mass starvation ensued. This famine is said to have taken place because the prices of rice skyrocketed and shocked the population (Muqtada, 1981). A similar trend was observed following when the drought of 1994 induced a chain of events that devastated the Northwestern part of the country when severe stress of the irrigation systems impacted plant grown and resulted in a decrease of rice and wheat production (3.5 x 106 ton) (Rahman and Biwass, 1995). By 1995, government food stocks fell to the lowest levels in recent times. The drastic shortage of water that Bangladesh faced had severe ecological, economic, and social impacts. At the time, 92 percent of the country was living in poverty; farmers lost their crops, pastoralists lost their livestock—destroying the livelihood security of tens of thousands. While these trends might not be adequately illustrated in aggregate data due to the fact that famines tend to be local and regional, rather than national; figure 11 does depict declines in 1972 and 1994, which were both years of severe drought.

Migration in Bangladesh

According to the UNDP migration has been a major element in Bangladesh's recent history (Marshall and Rahman, 2013). It is estimated that migration from Bangladesh to neighboring countries has reached over 600,000 people per year (Marshall and Rahman, 2013), with remittances in Bangladesh comprising over 10 percent of its GDP (Marshall and Rahman, 2013). Urbanization rates are estimated to be over 3.03 percent, which is one of the highest in the world. Researchers claim that these statistics are largely driven by the shift from agriculture to industrial production, as well as flight from environmental challenges (Marshall and Rahman, 2013). In a study conducted by the UNDP, migration patterns show that over the past two decades, internal migration to urban areas in Bangladesh has increased by 49 percent (Marshall and Rahman, 2013). Census data at a district level show that over the full period of study (1991-2011), migration to urban cities like Dhaka, have increased by over 100 percent (Marshall and Rahman, 2013). Figure 12 below illustrates migration trends between 1960-2015.

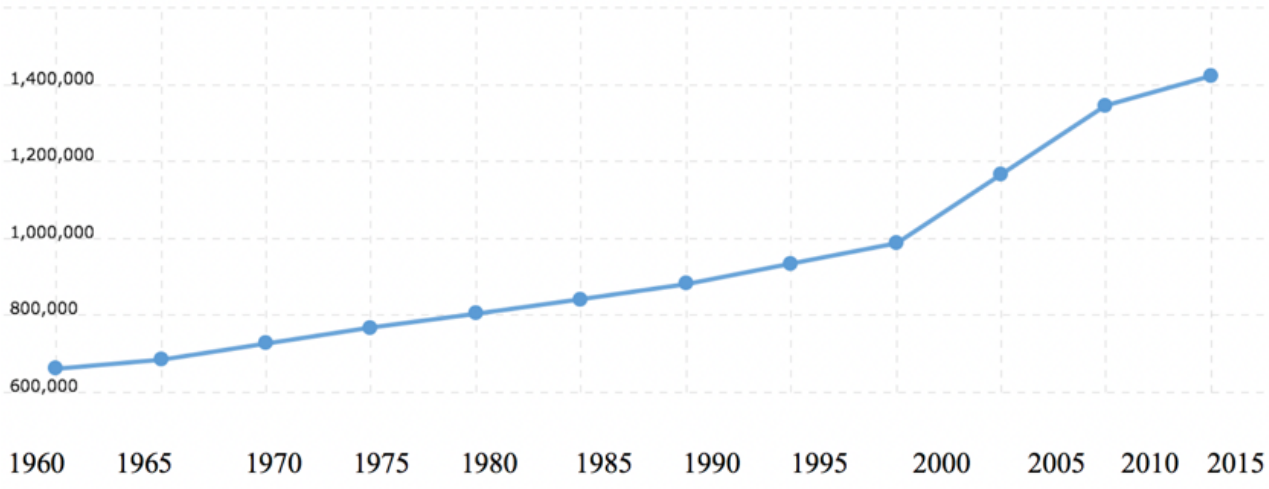

Figure 12. Migration Tends in Bangladesh
Source: The World Bank, 2020

One can see that trends in migration have been steadily increasing even prior to the baseline year of 1980. The UNDP found evidence that along with the chronic issues mentioned, economic opportunities, quality of public services were all drivers of internal migratory movement.

Conflict in Bangladesh

In 1970, West Pakistani leaders initiated the mass killings of the East Pakistani people, or modern day Bangladeshi's (The Borgen Project, 2020). Following nine months of war that led to the death of more than three hundred thousand people, Bangladesh gained its independence in 1971. Since its inception, however, Bangladesh has been plagued with political instability such as periods of martial law and military coups (Peace Insight, 2017). Despite Democracy being established in 1991, outbursts of violence have continued due to tensions between political parties, corruption, and the rise of extremist groups (Peace Insight, 2017). In 2015, an influx of migrants from Myanmar fleeing persecution drove a humanitarian crisis that continues in Bangladesh to this day. (Peace Insight, 2017). According to the Department of Peace and Armed Conflict Research, between 1975 and 2015, Bangladesh has seen 22 cases of internal armed conflict, with the majority of these events occurring before the baseline year.

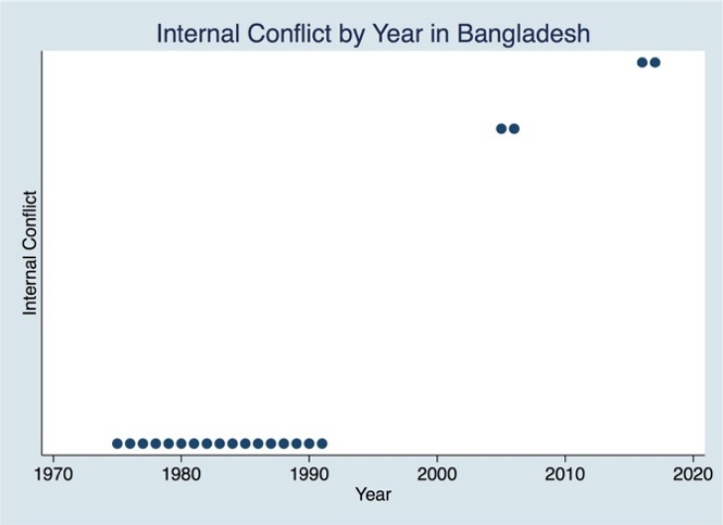

Figure 13. Conflict in Bangladesh By Year
Source: Created by author using PRIO/UPPSALA dataset

Step 3: Construct a Causal Graph

In examining the timelines of drought, livelihoods, migration, and conflict in Bangladesh—one can observe glimpses of how the variables interact. For example, various disturbances in livelihoods have been noted to spark migration, while conflicts were at times aggravated by influxes of migrations into the country. We can identify how years of poverty, political instability, and agricultural dependence may have contributed to the overall human security of the people of Bangladesh. Below I offer a causal graph on the impacts of drought on the various dimensions of human security that may have occurred during the drought of 1994 that occurred in Northwestern Bangladesh. This is still considered one of the worst in the country's history and tracing the onset of events leads to a fruitful understanding of the variables and intervening factors at play in the climate security nexus. In tracing the chain of events that occurred in 1994 (Figure 14), one can recognize the interactions offered in Scheffran's *Integrated Framework of Interactions Between Climate and Society* at play.

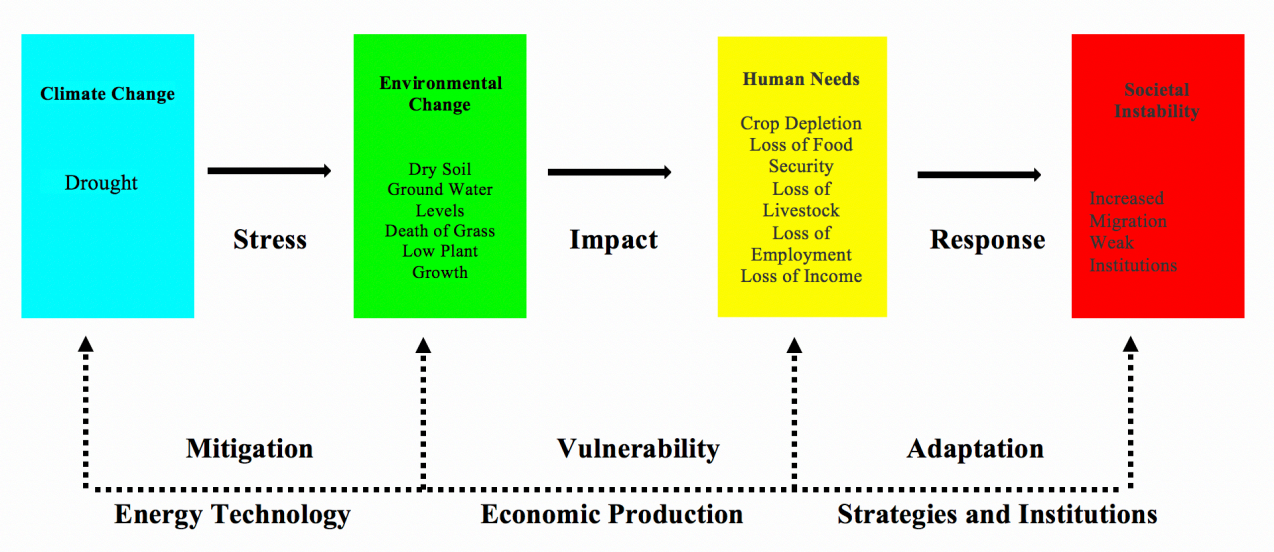

Figure 14. Scheffran's Integrated Framework of Interactions Applied to the 1994 Drought in Northwestern Bangladesh
Source: Created by author using Scheffran's Framework

The drought of 1994 is often referred to as one of the worst in Bangladesh history (Paul, 1998). The drought began in 1994 and ran into some of 1995—drying up much of the region's surface waters as well as depleting ground water to an abnormally low level (Paul, 1998). These factors sparked a chain of events that had a devasting impact on Bangladesh's food production. First, stress that the drought had on water, soil, plant growth etc., eventually led to an impact on human needs. The water depletion led to severe stress of the irrigation systems that ultimately impacted crop production severely. Rahman and Biswass claim that the drought resulted in a decrease of rice and wheat production that was over 3.5 x 106 tons (1995). At the time, the Bangladeshi government was experiencing heavy boycotting and protests, which were made worse when government food stocks fell to the lowest levels than the years before. With over 90 percent of the Bangladesh population living in poverty (World Bank 2020), the crash in crop yields and, the loss of livestock that died due to starvation due to loss of grass, only contributed to the desperate situation of those living in the drought-prone area. In their study, Reza et al.

(2014) found that about 84 percent of drought victims migrated from the affected area to urban areas looking for economic opportunity to improve their livelihood.

Step 4 and 5: Alternative Choices and Counterfactual Outcomes

Rick's and Liu recommend identifying alternatives for each relevant moment in the causal graph (2018). It is advised that these alternatives be theoretically sound and pose realistic reasons as to how events could have manifested differently. If the drought did not occur, the natural resources used for human needs may not have been depleted. Water, food, jobs and income may have been stable and migration to urban areas may have happened in such high frequency. Moreover, in Figure 13, we can identify that Bangladesh's already vulnerable state made it difficult to adapt or mitigate the effects of the drought, thus creating a negative feedback loop that exacerbated how drought impacted human security. Had there not been wide-spread political unrest due to a controversial parliamentary election (Rashiduzzaman, 1997), local governments might have been able to successfully mobilize to allocate resources to aid in relief goods. Had these events ensued, the following counterfactual outcomes may have materialized:

- Drought did not produce stresses to the environmental that impacted human needs; livelihoods were not disrupted by environmental changes; thus, social responses may have been different.

  or

- Despite the pressure drought put on human needs, Bangladesh was able to adapt to the situation through helpful strategies initiated by its government and other institutions.

Step 6: Finding Evidence for Initial Hypothesis

H1: *Changes in the temperature create changes in the environment, through a sequence of complex interactions; these environmental changes then affect natural resources that result in threats to humans (Scheffran, 2009). This can mean land degradation, food and water insecurity, threats to economic livelihoods, etc. (Scheffran, 2009).*

Straw-in-the-wind Test (Low Uniqueness, Low Certainty)

Evidence: We know that the Northern Bangladesh population was a highly agrarian community that was dependent on their crops to maintain their livelihoods. We can confirm that the same year the drought occurred, Bangladesh's crops were depleted. Figure 7 provides evidence that rising temperatures have occurred over time. With a population that is highly dependent on crops for economic stability, the reliability of evidence makes me more confident that the hypothesis is not null, and I can move on to the next test.

Hoop Test (Hi-Certainty, Necessary to Confirm the Hypothesis)

Evidence: The timeline of events shows that the 1994 drought was followed by a sequence of events that were environmental, economic (agricultural), then societal. There is high certainty among scholars that the 1994 drought adversely affected the crop production (Rahman and Biswas, 1995: 7), which resulted in food shortages. The following year, the government was forced to import rice and wheat from other countries to help offset these losses. In addition to this agricultural impact, there is also high certainty that the drought severely impacted ecological conditions that led to the death of grass, which feeds livestock (Reza, 2014). It is certain that at minimum drought posed threats to two dimensions of human security, livelihood and migration.

Smoking Gun Test (High Uniqueness, Sufficient to Confirm Hypothesis

Evidence: Dey et al. (2011) found that during the 1994 drought, average groundwater levels declined more than one meter in Kishoriganj and Bandarganj. This led to the drying up of tube wells that was used by more than 90 percent of households in the affected area (Dey et al., 2011). As these wells dried, inhabitants were forced to collect water from much greater distances. Eventually, the communities were forced to use unsafe drinking water, in addition to having to adapt to the agro-ecological impacts of the drought (Dey et al., 2011). It is said that over 84 percent of the drought victims migrated from the affected area in search of a better livelihood, then, in the years that followed, laborer out-migration surged, inflating Dhaka's population to the highest it had been (over 9 million inhabitants) (Dey et al., 2011). While social scientists rarely find evidence that is "smoking gun", the events that preceded the drought is high in uniqueness and raises my confidence that there are interactive effects that led from drought to insecurity.

Doubly Decisive Test (High Certainty and High Uniqueness):

Evidence: While it is true that climate change initiated a chain of events that disrupted human security in Bangladesh, I cannot discount alternative explanations that also contributed to that insecurity. The historical levels of poverty of the country, the rising population rates, as well as the political conditions at the time might have contributed to causation. Thus, H1 does not pass the doubly decisive test that would eliminate all alternative explanations.

Step 7: Repeat for Rival Hypothesis

Rival H1: *The drought that occurred in 1994 was a naturally occurring drought in which global warming had no part. Thus, anthropogenic climate change did not contribute to this scenario.*

Straw-in-the-Wind: No reliable evidence that supports this hypothesis. Prior to the baseline year of 1980 little to no severe droughts had yet impacted Bangladesh, so it is unlikely that warming

did not contribute to this event. Thus, rival H1 fails the straw in the wind test. The initial H1 is plausible.

CHAPTER FIVE

CASE STUDY PART II: SUDAN AND THE PROVINCE OF DARFUR

"Almost invariably, we discuss Darfur in a convenient military and political shorthand — an ethnic conflict pitting Arab militias against black rebels and farmers. Look to its roots, though, and you discover a more complex dynamic. Amid the diverse social and political causes, the Darfur conflict began as an ecological crisis, arising at least in part from climate change."-U.N. Secretary General Ban Ki Moon, 2007

Figure 15. Map of Sudan
Source: The University of Texas at Austin

I now continue to examine the causal chain that exists between climate and human security by assessing the Sudanese province of Darfur. Like Bangladesh, this region is considered highly vulnerable to the impacts of climate change, because of the unique geographical, cultural, and ecological contexts of the country. Interest in the causality of conflict due to climate impacts in Darfur have increased exponentially during recent years, with scholars coming to conflicting conclusions on the matter (Sachs, 2007; Korf, 2011). However, no study to my knowledge has employed process tracing to explore the interaction of factors at work in greater detail. This case study follows the same general structure presented in the former case

analysis, first offering contextual background on the state, then tracing the events that led up to disruptions to human security in Darfur.

5.1 Contextual Background

Darfur is a semi-arid plain that lies between the Nile and Lake Chad in the westernmost part of the Republic of Sudan. It is a part of the ecological region known as the Sahel, which stretches across Africa from Senegal to Eritrea (Mazo, 2009). The Sahel divides the Saharan desert from the tropical Sudanian Savanna and is considered one of the most sensitive climate-hotspots in the world (IPCC, 2020). Particularly, entire-land masses in the region are threatened by the extreme desertification that has been worsened by climate change, over-farming, over-grazing, as well as by the stress of ever growing population rates (Orioha, 2018). This long term challenge has vastly impacted agricultural systems in Sudan, inflaming tensions between farmers and nomadic pastoralists (World Food Program, 2020). The fast moving pace of desertification combined with the region's drought have had devastating effects on natural resources needed to sustain livelihoods (World Food Program, 2020). This has made coexistence between ethno-African agriculturalists and Arab pastoralists difficult (World Food Program, 2020), as competition has created an ethnic clash that has led to famine, widespread displacement, and violence between tribes (Mazo, 2009).

One such example occurred during the drought of 1984, when farmers tried to protect their harvests by blocking access to their fields from 'Arabs', whose pastureland had dried. Arab nomads were unable to rely on their traditional herding routes and pushed South toward more fertile land. Here, they encountered African farmers clearing the land, burning unwanted wild grass and prepping the fields for production. Aggravated by the depletion of what could have become feed for flocks in despair, the nomads clashed violently with the farmers. In 2007, the

United Nations Environmental Programme (UNEP) revealed that 29 out of the 40 violent conflicts that took place in Darfur since its independence, involved water rights and grazing (Mazo, 2009).

Since then the death toll in Darfur is estimated to be between 100,000 and 400,000 (Straus, 2015). UNEP has been highly vocal in stressing the severity of the link that exists between desertification, land degradation, and conflict in Darfur; arguing that the conditions brought on by climate change have triggered conflicts that have been inflamed and sustained by ethnic fractionalization, as well as political instability in the region (Borger, 2007). As mean temperatures and droughts continue to rise, it is projected that Darfur could see as much as a 70 percent decrease in crop production in the coming years (Sova, 2017). Adding to these pressures are the millions of internally displaced persons (IDPs) and international refugees in Sudan (UNHCR, 2020). These large scales of displacement combined with the vulnerability of the dry northern Sudanese environment make this one of the most significant cases of its type (UNHCR, 2020). Researchers warn that sustaining peace in Darfur will not be possible unless the underlying and closely linked environmental and livelihood issues are resolved (Mazo, 2009). Thus, identifying the correct causal mechanisms that exist in this phenomenon is a necessary but complicated endeavor.

Establishing a Baseline

While the exact onset of anthropogenic climate change in Africa is unknown, researchers have seen observed surface temperatures increase significantly since the late 19th century. Regions like the Sahel have seen as much as 3°C increase at the end of the dry season (Sultan et al., 2017). I use 1990 as a baseline year to determine before and after climate reference points.

The IPCC has used this year for the presentation of emissions scenarios and for calculations of future climate scenarios (IGI Global, 2020).

5.2 Process Tracing: From Drought to Insecurity in Darfur

As with Bangladesh, I expect to find that in Darfur, climate change creates changes in the environment that impact human needs. The depletion of these needs sparks responses that impact social stability—especially in highly vulnerable regions such as Darfur. While a growing number of studies have conducted statistical analyses on the relationship between environmental change and the onset of civil wars, little convergence has been found and some argue that statistical investigations are not an appropriate method of analysis due to the constraints of data and modeling (Theisen, 2018). It is possible that a connection exists between climate and conflict, but existing mechanisms are poorly misunderstood, resulting in underspecified causal theories (Theisen, 2018). Process tracing could serve as a tool that reveals intermediate mechanisms and improves statistical analysis that tend to be very general and direct (Theisen, 2018).

Step 1: Identifying A Hypothesis

Traditional agricultural systems have comprised Darfur's economic, political, and social foundation for centuries (Abdal et al., 2013). Crop shifting as well as pastoral livestock production had been an integral part of sustaining livelihoods in the region and had been done with peaceful coexistence between different ethnic groups when land availability was healthy (Abdal et al., 2013). However, as climate variability, economic, political, and demographic changes occurred in Darfur; their impacts began to erode the livelihoods of already fragile communities (Abdal et al., 2013). As a result, Darfur saw the dismantling of political and social relations, as well as the institutions that were needed to adequately adapt to the new conditions. Changes in the environment resulted in the individualization of land that increased competition

and drove violence during an ongoing political crisis (Abdal et al., 2013). Even in the complicated case of Darfur, one can see the basic framework of the Integrated Assessment of Climate Impacts on Human Security Theory, I will test this theory with the following hypothesis:

> *H1: Changes in the temperature create changes in the environment, through a sequence of complex interactions; these environmental changes then affect natural resources that result in threats to humans (Scheffran, 2009). This can mean land degradation, food and water insecurity, threats to economic livelihoods, etc. (Scheffran, 2009).*

Step 2: Establishing A Timeline

History of Drought in Darfur

Air temperatures in Sudan have steadily increased between 1960–2009, with temperatures in the 2000–2009 period between rapidly increasing by 0.8°C and 1.6°C (World Bank, 2020). Between 1941 and 2000, average annual rainfall has declined from about 425 mm/year to about 360 mm/year, a decrease of 65 mm of annual rainfall or about 1.1 mm per year; the coefficient of variability of rainfall shows an overall increasing trend, suggesting greater rainfall unreliability (World Bank, 2020). Annual variability in rainfall is most serious in the arid northern parts of the country where the average variability now exceeds 100 percent (World Bank, 2020).

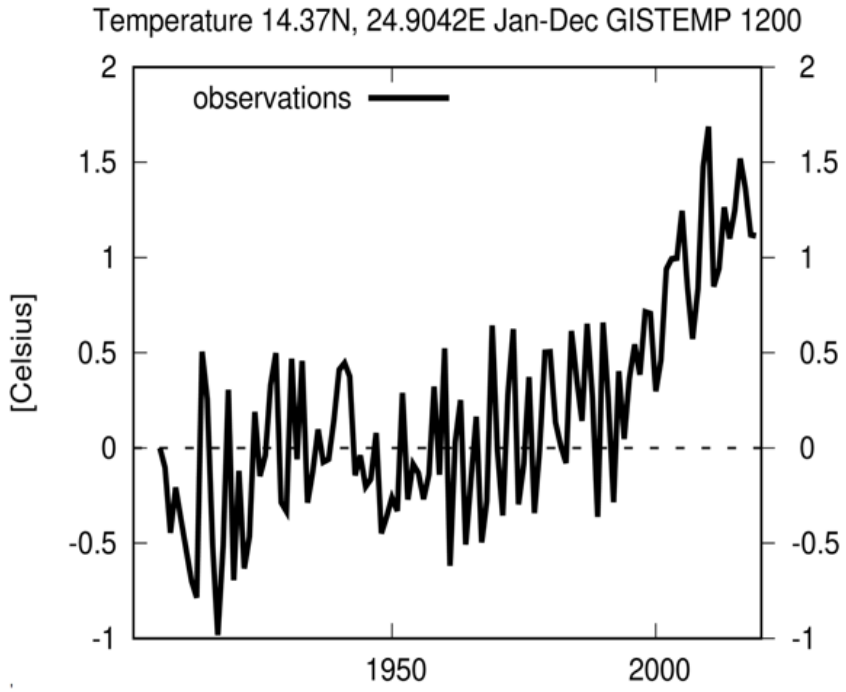

Figure 16. Surface Temperature in Darfur 1901-2020

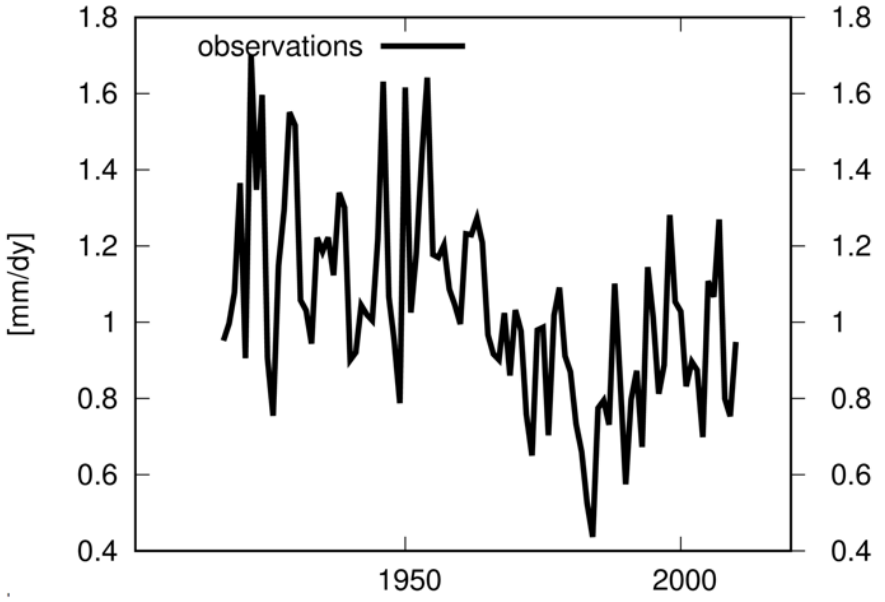

Figure 17. Precipitation Darfur
Source: KNMI Climate Change Atlas

In assessing drought in Darfur over the years, I used data provided by the KNMI Climate Change Atlas. While I could not find data that gave a specific number of droughts per year, as robust documentation of drought in Darfur is non-existent for drought years prior to 1980 (De Waal, 1993). I used these figures to compare temperature before and after the baseline of 1990. Figure 15 and 16 show that as temperatures have increased in Darfur, precipitation has decreased consistently over the years. Scholars have been able to track several famines and found that drought was the primary agent of the deadly waves of starvation that occurred between 1972 and 2001. Along with the declining rainfall in Darfur, the rural people have seen a decline of "good years" and suggest that instead of seeing a pattern of "savanna climactic systems" they are now living in a desert climactic system (De Waal, 1993).

According to Young (2005), between 1972 and 2001, Darfur saw a total of 16 drought years, and it was during this time that the region saw three times more famine deaths than normal (Young, 2005). Up until the early 1980s, land availability in the region exceeded the need of its people (Mazo, 2009). But as temperatures increased and precipitation decreased, the Sahel experienced extreme desiccation and saw the size of its population nearly double in less than twenty years (World Bank, 2020). The population pressures, along with desertification put extreme pressure on the land and it is then that crop cultivation and pastoral livestock systems began to overlap. By 1985, these complex processes resulted in a crop crash that led to famine. This also resulted in conflict between pastoralists and farmers, and a mass displacement of people. Whether the droughts of the 1970s and 1980s that contributed to the multiple famines were caused by anthropogenic climate change or natural climate variability remains a topic of scientific debate. We do know, however, that drought occurrence and severity is expected to

increase in this region. If no substantial adaptations are implemented (Young, 2005) Darfur could continue to experience devastation that exceeds even that of recent years.

Livelihood in Darfur

Systemic and accurate data on livelihood security in Darfur is limited (Lind et al., 2012); still, scholars agree that there has never been such a drastic failure of livelihood strategy and loss of assets than that brought on and exposed by the 2003 conflict (Young, 2005). In addition to the production and market failures brought on by the conflict, there was also a constraint on the remittances of migrant workers that typically would have improved the livelihoods of the people in Darfur (Young, 2005). Nearly two-thirds of Darfur's residents still live below the poverty line and some researchers suggest that the region will never fully recover to the once self-sufficient state that it was prior to the onset of conflict (Castro, 2014). Instead, poverty and chronic food insecurity are compounded by limited infrastructure and deteriorated social services (Castro, 2014).

Though I was not able to find data on Darfur's caloric consumption through the years, I was able to acquire aggregate data for Sudan between 1961-2009 (Figure 12). Since the baseline of 1990, it appears that caloric consumption has steadily increased over time. Similar to trends in Bangladesh, however, these data likely disguise much of what is going on at local levels. We know that in 2003, Darfur suffered a famine that caused the death of an estimated 50,000 people. This is not reflected in these data.

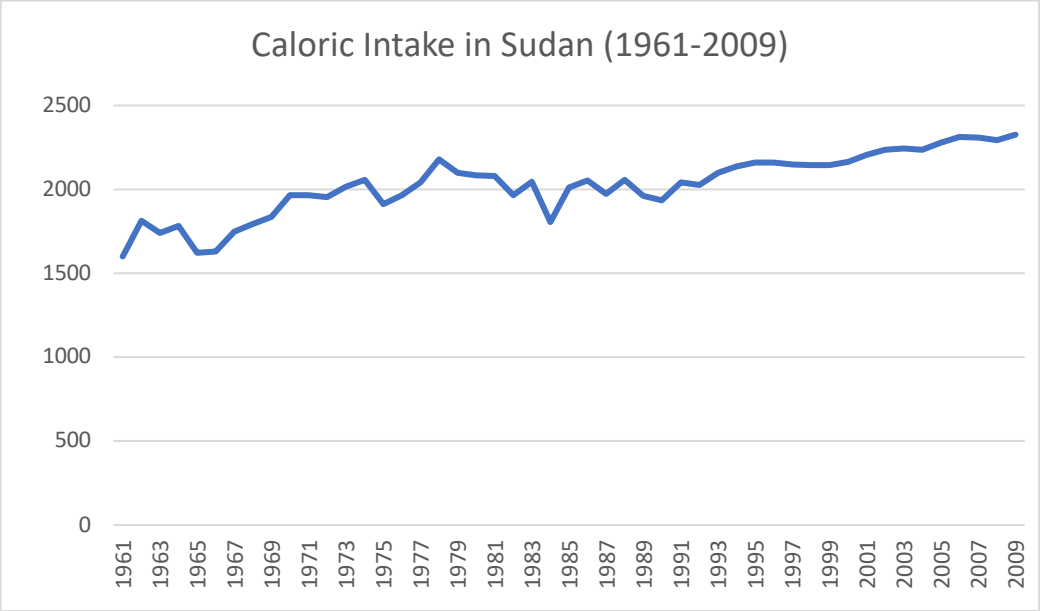

Figure 18. Caloric Intake in Sudan Between 1961-2009
Source: Created by author using Boehmer and Sobek's 2007 dataset

In a study conducted by the African Development Group between 2014-2015, household expenditures and consumption were analyzed in multiple African regions to gauge the level of poverty and deprivation in each. Using a minimum level of consumption as an indicator for poverty, the ADG found that Sudan, East, West, and Central Darfur had the lowest annual per capita consumption rates of all countries included in the analysis (African Development Bank Group, 2014). To investigate the long-term condition of livelihood security in Darfur, one must account for the multiple famines, depletion of assets, resource scarcity issues, and conflicts that have threatened livelihood security through the years.

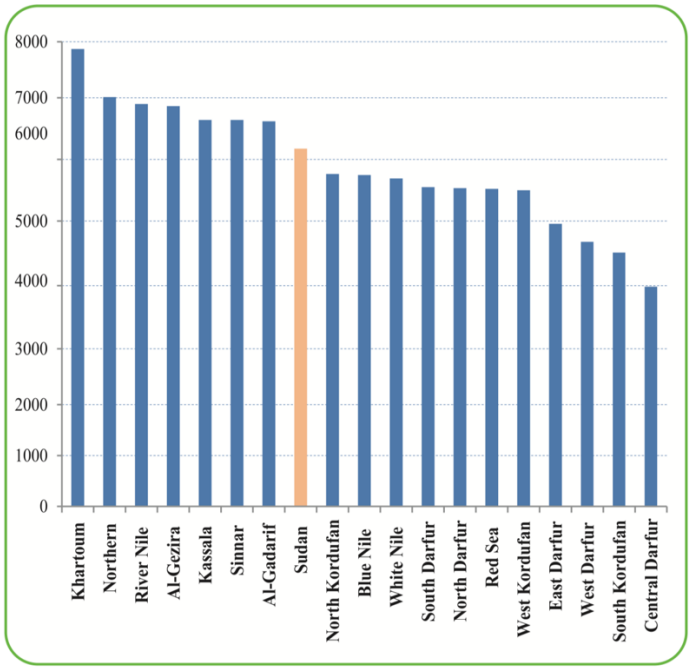

Figure 19. Annual Per Capita Consumption in Sudanese Pounds Per Capita
Source: African Development Group

Historical Migration Trends in Darfur

Migration has long been a part of the history and livelihood of the Darfur people (Jasper et al., 2018). Whether that migration has been to flee from the disastrous impacts of drought and famine or whether it has been to sustain livelihoods during seasonal labor periods—migrating has been used as an adaptation tool to survive the worsening conditions of the Darfurian home life (Jasper et al., 2018). Since the Darfur conflict began in 2003, hundreds of thousands have fled to neighboring countries like Chad and nearly two million remain displaced within the Darfur region (Patrick, 2005). The World Food Programme has estimated that the displacement has contributed to evidence of mass rape, increased disease, and starvation (Patrick, 2005). Created by De Wall in 1993, Figure 18 illustrates a surge of migration following famine and

drought years into the fast developing crash crop economy of Legediba—a village that by truck is 16 hours from Darfur (de Waal, 2008).

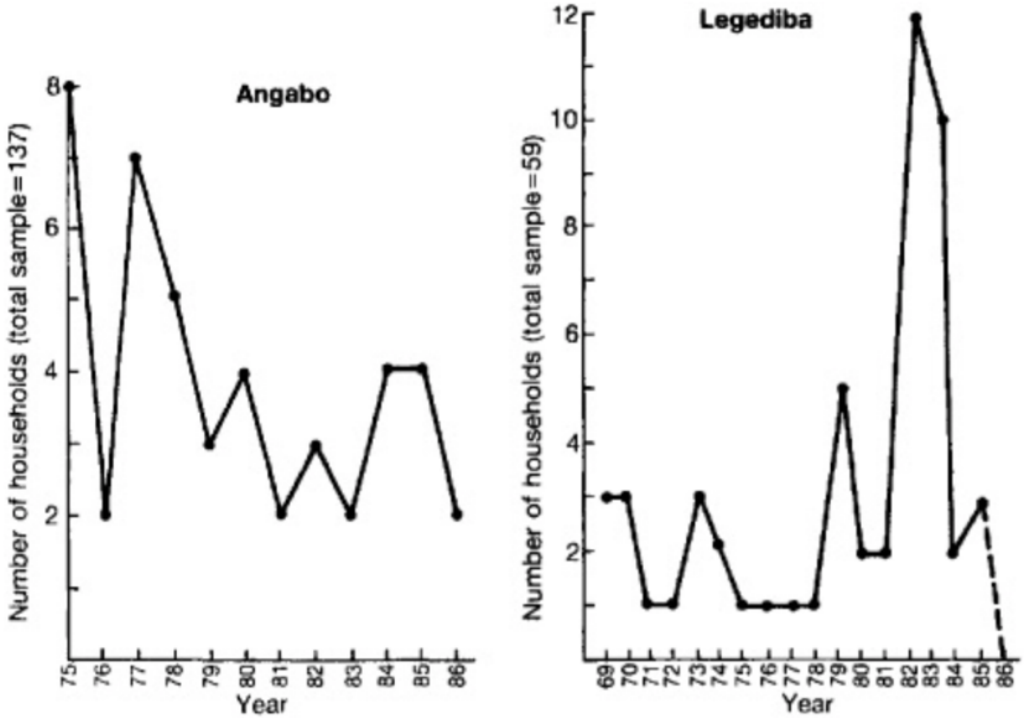

Figure 20. Migration Trends in Darfur During Drought Years
Source: (De Wall, 1993)

More recent urbanization in Darfur is said to be as a result of escalated fighting in rural areas and the search for safety and work. The arrivals mostly include poor populations looking to access assistance to maintain their livelihoods.

Conflict in Darfur

While it is true that the Darfur region has been historically plagued by tribalism and power struggles between the Masalit, Fur, and other African farmers against Arab pastoralists, tensions were kept under control until the 1970's (Human Right Watch, 2004). Between 1898 and 1956, traditional conflict resolution mechanisms were provided by the Anglo-Egyptian Condominium (Human Rights Watch, 2004). Thus, some argue that the conflict in Darfur at its

initiation was not a direct product of resource scarcity, rather a product of the systematic and exploitative nature of the Sudanese government against its people (Flint and De Waal, 2005). In recent decades, the combination of drought, resource scarcity, lack of good governance, and gun availability, have made local conflicts more deadly, turning bad situations into ones of despair.

The initiation of al-Bashir's government that began in 1989, saw a reorganization of the Sudanese government that gave Arab ethnic groups new positions of power that ultimately resulted in the oppression of non-Arab civilians. By 1998, Arab nomads began to move south, competing with long time farmers that had inhabited the area. During this period, more than sixty Masalit villages were burned, sparking bloody clashes and displacements (Human Rights Watch, 2004).

In 2003, rebel groups decided to rise up against the political and economic marginalization inflicted upon them by the Sudanese government (Flint and De Waal, 2005). In response, the government relied on the Janjaweed militias to fight against the rebels in Darfur (Higginbothom, 2013). Beyond fighting the rebels however, the militias terrorized civilians, burned villages, sparking a humanitarian crisis that left hundreds of thousands dead and millions displaced (Higginbothom, 2013). Figure 19, below, illustrates the number of resource conflicts in Darfur between 1950 and 1999. It is easily observable that the number of conflicts over resources have largely intensified over time, nearly tripling between 1970-1999. Figure 20 illustrates the number of villages destroyed between 2003-2009. One can see that the majority of the violence occurs in the more intensely rainfed agricultural areas. While the conflict in Darfur is comprised of deep-rooted societal factors such as adaptability, ethnic fractionalization, and poor governance—the case provides an illustrative example of what can happen when all of these variables intermix with environmental pressures.

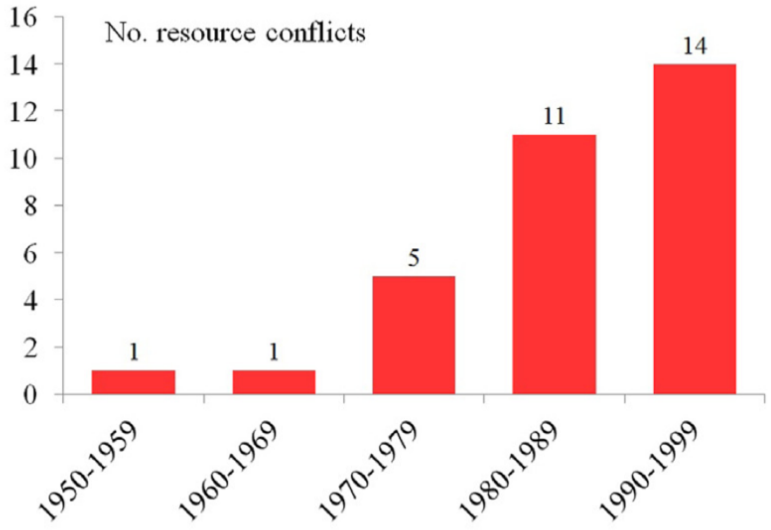

Figure 21. Number of Resource Conflicts in Darfur 1950-199
Source: De Juan, 2015

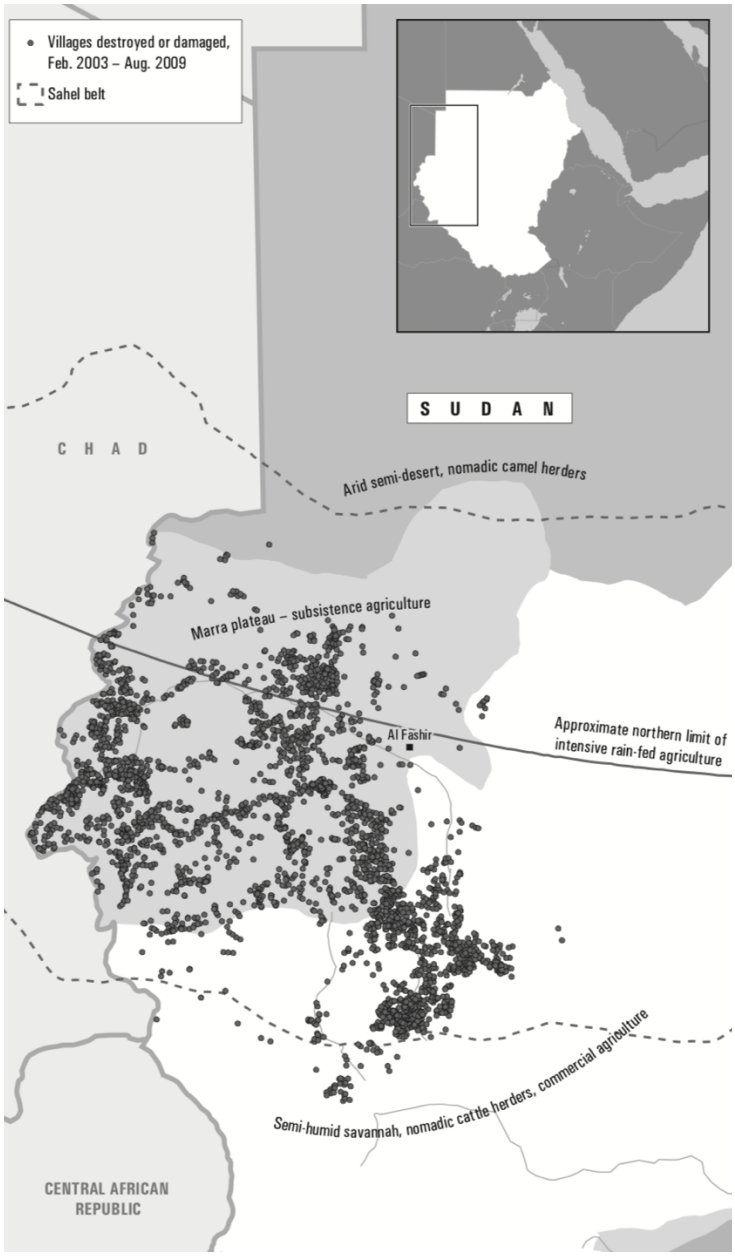

Figure 22. Villages Destroyed or Damaged in Darfur between February 2003-2009
Source: United Nations Environment Programme

Step 3: Construct a Causal Graph

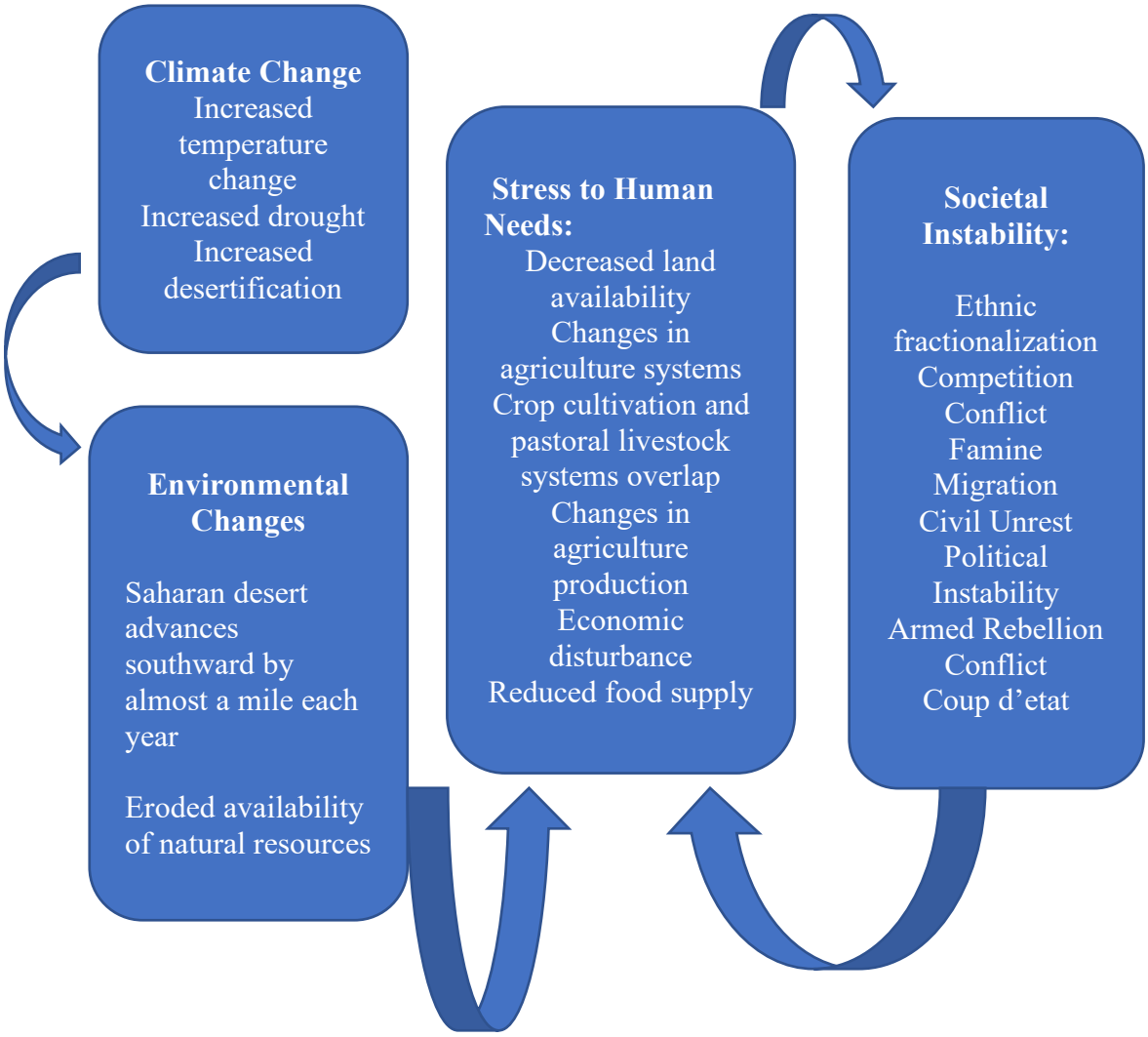

Figure 23. Causal Graph Conflict in Darfur
Source: Created by the author

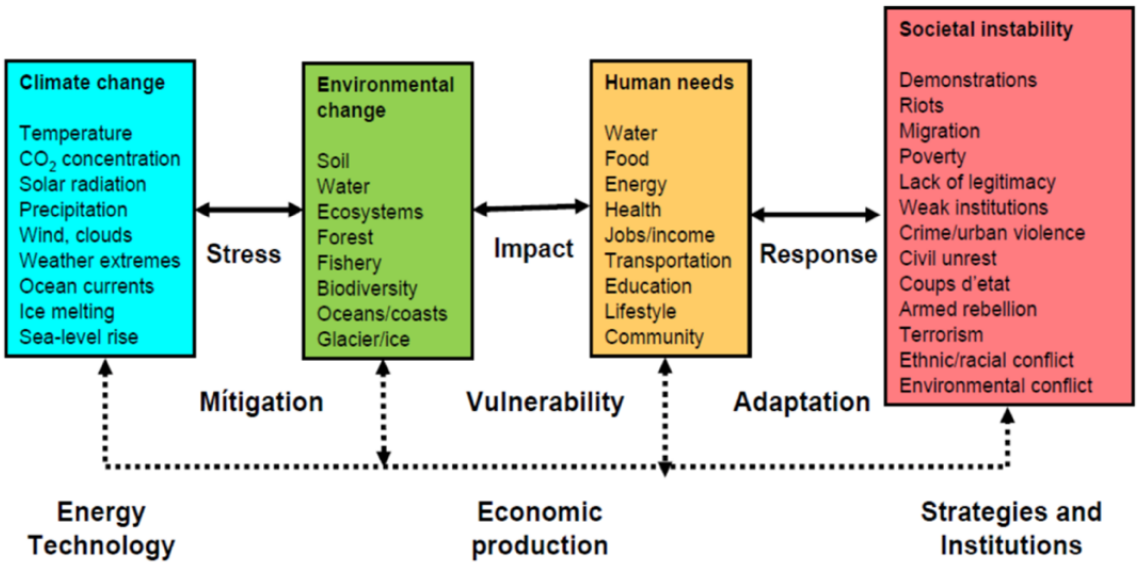

Figure 24. Scheffran's Conceptual Framework: Causal Links Between Climate Change, Environmental Stress, Human Needs, and Societal Consequences
Source: Scheffran, 2009

Step 4 and 5: Alternative Choices and Counterfactual Outcomes

Identifying alternatives for each relevant moment in the causal graph (2018) would result in far different outcomes for Darfur. Multiple researchers have found that prior to the changes in land availability, traditional African farmers and Arab nomadic pastoralists coexisted peacefully and sometimes even symbiotically (Faris 2007; Abdal et al., 2013). If climate variability had not caused an ecological crisis in the region, it is possible that competition between the two groups might not have resulted in conflict. Had agriculture patterns remained the same, food security may have prevented a famine. Ethnic tensions might have not been inflamed by governments and rebels, and the Darfur conflict might have been avoided. However, given the history of poverty and civil war, the region would have still been highly vulnerable.

Step 6: Finding Evidence for Theoretical Hypothesis H1: *Changes in the temperature create changes in the environment, through a sequence of complex interactions; these environmental changes then affect natural resources that result in threats to humans (Scheffran, 2009). This can mean land degradation, food and water insecurity, threats to economic livelihoods, etc.* (Scheffran, 2009).

Straw-in-the-wind Test (low uniqueness, low certainty):

Evidence: Tracing the temperatures in Darfur show us that temperatures have been increasing over time as precipitation has decreased. Competition over land between farmers and pastoralists was a result of warming temperatures that resulted in desertification. The competition lead to violence, that was aggravated by the government and rebels. This evidence provides a valuable benchmark and allows the hypothesis to move on to the next phase of testing, as it provides some certainty that disruptions associated with the drought did occur.

Hoop Test (high certainty: necessary to confirm hypothesis):

Evidence: During the period that preceded the conflict in Darfur, and during the conflict period (2000 – 2009) itself, Darfur saw warming between 0.8°C and 1.6°C compared to the 1960 – 1969 period (World Bank, 2020). This level of warming, paired with low precipitation rates, accelerated desertification—with the Sahara Desert advancing southward by almost a mile each year; reducing land availability for farmers and pastoralists. This evidence compounded with the political inequalities and instabilities that went on during the time raises my confidence in the hypothesis.

Smoking Gun Test (high uniqueness; sufficient to confirm hypothesis):

Evidence: By 2003, the ecological crisis had worsened, and Sudan's population had ballooned to 30 million inhabitants. The changes to the agricultural systems had reduced economic assets of the population, increased ethnic tensions, decreased food production, and left many people displaced. There is evidence that shows the al-Bashir's Arab-centric regime oppressed and displaced African farmers in favor of Arab pastoralists (Mazo, 2009). This motivated the SLM movement rebel group to rise up against the government, leading to the onset of war. While I cannot confirm the smoking gun as climate change did not cause conflict directly, one can see that the drought at least contributed to a reduction of human security in a variety of ways.

Doubly Decisive Test (high certainty; high uniqueness):

Evidence: Because doubly decisive tests require establishing necessity of the independent variable for the dependent variable to occur, the hypothesis cannot be confirmed. For example, if climate conditions were stable in Darfur, we cannot be sure that conflict would not have happened. As shown in the timeline above, ethnicity and tribalism as well as land and local power struggles have been part of the history of the region since 1916. Thus, there may me many

other independent variables that could have led to conflict and human insecurity, if climate change had not been a factor. It is important to note however, that even if the events had not led up to the onset of conflict, reductions of livelihoods and increased migration created feedback loops signaling that the drought impacted other dimensions of security.

Step 7: Repeat for Rival Hypothesis:

Rival Hypothesis: *Climate change did not result produce changes in the environment that impacted human needs in Darfur. Changes in the environment did not contribute to ethnic tensions, natural resource competition, or migration.*

Straw in the Wind:

Evidence: There is no reliable evidence to support this hypothesis, scientific evidence shows that climate change has contributed to an ecological crisis in Darfur. Because the population is so dependent on agriculture, the environmental changes seen in the region depleted available land for farmers and pastoralists, creating tension that led to conflict. While increased temperatures may not be the direct cause of conflict in the region, it contributed to instability, and made other issues in the region worse.

Summary Discussion

In assessing how climate change and human security are related in the case of Bangladesh and Darfur, one can see that the relationship is not deterministic. The link is instead comprised of a causal sequence that starts with a climactic event and ends with social instability and increased human security risks. The case studies do reveal that the sequencing of Scheffran's theoretical explanations are plausible in the case of drought impacts. We can identify that increased temperatures resulted in changes in the environment that impacted human need. It is then that societal responses are initiated and resulted in instability. We can also identify that the

political conditions of both Bangladesh and Darfur limited adequate adaptation and mitigation strategies. In addition, the study groups' growing population and high levels of poverty increased their vulnerability and made the situation far worse.

Though climate change may not have directly impacted insecurity, I believe that it contributed to insecurity overall. When the stresses of global warming multiply with social elements such as historical poverty, political vacuums, ethnic tensions, etc. that all contribute to human behavior, we can see problems worsen. So, while environmental changes caused by drought in these scenarios did not mechanically determine the social responses that followed, overtime, the evidence appears to show that the drought contributed and perhaps accelerated the progression of livelihood reduction, migration, and conflict. These two cases corroborate the importance of strong governance and institutions to aid in a country's adaptability and resilience. One identifiable pattern in both the cases of Bangladesh and Darfur is that all of the dependent variables of interest were impacted by their relationship to the country's dependence on agriculture. For example, livelihoods in Bangladesh and Darfur were largely dependent on farming, crop production, and livestock production. The relationship between livelihood security and agriculturally dependent states also influence patterns of migration and conflict. Thus, an interactive relationship between livelihoods and agriculture is identified.

While Darfur and Bangladesh are extremely complicated examples of the climate-security nexus, the case studies were helpful in illustrating the many intervening variables at play that lead us from drought to the onset of risk. More importantly, one can observe that the reduction of livelihood is a central component in the causality chain. The disruption of livelihood could trigger the onset of migration and/or conflict and a feedback loop exists in that migration

and conflict could affect livelihood, creating a potential cyclical pathway, as theorized by Scheffran et al.

In addition to these insights, these case studies offered me a sense of the temporal dimension between climate change and human security. In both the cases, we see evidence of temperatures rising, but we see significant time lapses before environmental changes affect people's livelihoods. Because global warming is not a static attribute at a certain point in time, it does not immediately induce social outcomes. We see that environmental changes such as desertification in the Sahel region are a product of many years of chronic drought and heat. What this tells me is that I need to be careful to match the time frame used to measure the independent variable with that of the expected outcome. Because I am looking at chronic impacts of climate change, this will require a longer time frame than an analysis studying sudden-onset impacts would require.

Overall, the findings of these case studies, make me more confident that the core hypotheses of this thesis will be supported by my statistical results. Table 3 below consolidates the causal observations found in the cases of Bangladesh and Darfur. I use these results to inform the theoretical testing of explanatory variables in the quantitative analysis, as well as the sequence in some of the modelling featured in part two of the empirical study.

Table 3. Case Study

Observations

Impacts	Description	Outcomes
Climate Change	Temperatures in Bangladesh and Darfur have steadily increased over the baseline years and are projected to continue to rise.	Increased Drought Severity and Frequency
Environmental Changes	Changes to ecological conditions such as water availability, changes in the soil, ecosystem disturbance, desertification, etc. emerge as a result of changes in patterns and long-term trends in climate.	Loss of Water Impacts to Plants, Agriculture, Crop Yields Impacts to Livestock
Human Needs	Data has shown that many of the conflicts in Sudan and Darfur dealt with water rights and land availability. Over 70% of the Bangladeshi and Darfurian population live in rural areas (World Bank, 2020), depletion of rice and crops in the region left many without jobs and without secure food sources.	Reduced food production Increased Malnutrition Job loss Natural Resource Pressure
Societal Responses and Instability	These elements of instability were all present in Bangladesh and Darfur and create feedback loops that reduce adaptation and resilience, making it difficult to address challenges posed by climate change.	Famine Civil Unrest Migration Conflict

CHAPTER SIX: QUANTIFYING THE CONNECTION, A STATISTICAL ANALYSIS ON CLIMATE CHANGE AND HUMAN SECURITY

6.1 Why Quantitative Analysis?

Quantitative analyses make up nearly 60 percent of peer-reviewed articles researching the relationship between climate and security (Detges, 2017). As highlighted before, it is this type of research that has the most bearing on policy. While statistical assessments on the topic offer "comprehensive and systematic assessments of climate-security risks, results remain ambiguous" (Detges, 2017: 1), as the research has not converged toward a single robust conclusion. However, absence of causal effect evidence is not evidence of absence, and it is important to continue improving toward more comprehensive models. According to Detges, and other researchers, this will require a systematic cross evaluation of statistical findings with qualitative data (a key aspect of this research design).

6.2 Research Design

The central argument I make in this thesis is that anthropogenic climate change leads to various changes that disrupt traditional means of livelihood and create conditions that ignite social responses that ultimately increase human security risks. As illustrated by the case studies in earlier chapters, climate change can worsen the threat of insecurity against a backdrop of poor socioeconomic conditions and may be a driver of increased migration and conflict, as livelihood security is reduced. As can be seen in both cases in Bangladesh and Sudan, the effects that increased temperatures have on human security are both direct and indirect. I utilize these observations to inform the design and selection of explanatory variables of this quantitative analysis, which is comprised of two parts. The first, tests the core hypotheses of this thesis

and investigates the direct relationships that exist in the phenomenon. I then examine the more indirect links and causal processes that begin with the effects that increased temperatures have on the environment and end in heightened security risk outcomes.

This analysis examines 110 developing countries between 1990 to 2019 using a cross-sectional time-series dataset. The unit of analysis is state-year, with each observation measuring a state in a specific year. The main response variable of this study is human security. I conceptualize and measure human security using the dependent variables, livelihood, internal migration, and civil conflict. For this reason, I include sets of models to test corresponding hypotheses for each respective *Y*. The main independent variable, climate change is measured using an annual mean surface temperature indicator. The operationalization of both the dependent and independent variables are described in more detail below.

Dependent Variable: Human Security

To operationalize the first dimension of human security, I use Chambers and Conways (1992) definition of *Livelihood* as the comprised capabilities, comprised assets, and activities used by a household for means of living. According to Chambers and Conways, a household's livelihood is secure when it can cope with and recover from stresses and shocks, as well as maintain its capabilities and productive asset base. Capturing the impact that a climate change variable has on food security is an acceptable proxy for livelihoods, as households that are not meeting their basic nutritional needs, are likely not meeting other economic necessities. To capture Livelihoood, I utilize Boehmer and Sobek's (2007) dataset that contains a daily per capita caloric intake variable, originally generated by the Food and Agriculture Association of the United Nations (FAO). This indicator transforms the total amount of food available to the population into total calories and then divides that by the total population and days of the year to

create a daily per capita intake variable. I transform this variable and use the natural log of daily per capita intake to account for any relative decreasing effects.

To capture the second dimension of human security, *Migration*, I initially collected various data on migration stock flows. However, the data were found to be highly limiting, with some variables solely providing information for Organization for Economic Co-operation and Development (OECD) countries, and other variables resulting in too few observations in the modelling. In selecting a proxy variable to represent internal migration, I referred to the literature, and my own case studies, which indicate that economic deterioration often leads to displacement and migration of rural farming families to urban areas (Gleick, 2014). Because rural-to-urban migration is an important adaptation measure taken when security is threatened, I chose to use *Urbanization* as a proxy for internal migration. A similar approach was taken by Barrios et al. (2006), who found empirical evidence showing that environmental conditions related to climate change influenced internal migration and eco-refugee patterns in sub-Saharan Africa. The urbanization variable used in this analysis was constructed by measuring the annual percent of urban population growth of each country per year and was calculated using World Bank population estimates and urban ratios from the UN World Urbanization Prospects (World Bank, 2019). As with daily caloric intake, I transform the urbanization variable to its natural log and use it in the modelling to account for any skews or outliers that may exist in the data.

Finally, I examine the third dimension of human security, *Violent Conflict*, by employing the use of an internal armed conflict variable that counts the number of civil conflicts in a state per year. I borrow from Strand et al. who define civil conflict as "two organized parties of which at least one is a recognized government, over a stated political incompatibility, where at least 25 people are killed in battle-related circumstances" (Strand et al., 2006: 4). The decision to use an

intra-state conflict variable rather than an inter-state conflict variable stems from fact that wars between states has become a rare event and civil wars have seen an upward trend in recent decades (Guillen, 2016). Additionally, civil wars are particularly more devastating in the developing world than the developed world because they destroy existing institutions and ways of life in already strenuous conditions (Guillen, 2016).

In the second part of this study, I explore the environmental outcomes that arise from increased temperatures. These outcomes have the potential to negatively affect food production, livelihood, and the provision of other ecosystem goods and services. For example, research has shown that land degradation and desertification stresses the world's arable lands and pastures essential for food production, as well as water and air quality (WHO, 2020). I use *Arable Land* as a dependent variable and explore whether temperature produces changes to the environment. Specifically, this variable measures the "percentage of land under temporary agricultural crops, temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category" (FAOSTAT, 2015). This indicates the amount of land available for *actual* rather than potential agricultural uses, or the total percent of land available for agriculture production in every state per year between 1961 and 2016.

Independent Variables

Past research has heavily relied on proxy meteorological variables such as precipitation to measure human induced warming. However, in an attempt to more accurately anthropogenic climate change as it is defined by the IPCC, I utilize an *Annual Mean Temperature* in degrees Celsius per country by year variable, sourced by Dr. Tim Michell of the Tyndall Centre for Climate Change Research. Because climate change does not produce instantaneous effects, I

created a three-year time lag variable to capture temperature effect trends over time. To forecast any long-term trends and account for any outliers in the data, I created a three-year moving average, which was calculated by finding the mean growth rates from the first three years of temperature data. In addition to these main independent variables, I also include various theoretically relevant explanatory variables in my models. For example, I utilize a GDP Per Capita (PPP) to measure a country's level of *Development*. This is an important control, as it acts as a proxy for the resiliency of a state to absorb the costs of natural disasters (and other acute events), as well as the chronic and long term natural trends such as global warming. I use GDP Per Capita (PPP) as a standard control for all models. This variable was originally constructed by the World Bank and provides a measurement of "prices in different countries that uses price of specific goods to compare the absolute purchasing power of the country's currency" (Krugmen and Obstfeld, 2009: 85).

In the models that test for variation in civil conflicts, I also include a *Democracy* variable, as Democratic states are typically more stable and rarely go to war. To operationalize Democracy, I use "Boix-Miller-Rosato Dichotomous Coding of Democracy, 1800-2015". A country is coded as 1 "Democratic", if it meets the following conditions for both contestation and participation: 1) The executive is directly or indirectly elected in popular elections and is responsible either directly to voters or to a legislature, 2) The legislature is chosen in free and fair elections, 3) A majority of men and women have the right to vote. If these conditions are not met, the country is coded as 0 "Dictatorship".

Table 4. Variable Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Temperature	2,037	19.65	7.82	-6.1	29.4
Temperature (3 Year Lag)	1,746	19.59	7.84	-6.1	29.4
Temperature (3 Year Moving Average)	1,645	.0038	9.35	-199.53	82.54
Caloric Intake Per Capita	3,984	2376	428.33	1426	3766
Caloric Intake Per Capita (Logged)	3,984	7.75	0.1782	7.26	8.23
Urbanization	5,402	3.23	3.51	-187.142	48.93
Urbanization (Logged)	5,068	1.04	.77797	-7.30	3.89
Civil Conflict	8,027	0.196	0.7107	0	10
Arable Land	5,089	35.12	24.38	0.44	97.31
Arable Land (Logged)	5,089	3.21	.984	-.8209	4.57
GDP Capita (PPP)	2,963	6500.1	6173.02	247.76	427933.95
Democracy	4,315	0.3633	0.481	0	1

Modelling

To test both Hypothesis 1 (H1) and 2 (H2), which make the provisional suppositions that: *H1: as temperatures increase, livelihood security will likely decrease in developing states,* and that *H2: as temperatures increase, internal migration likely increases in developing states,* I use an Ordinary Least Square (OLS) linear regression estimator with random effects due to the way in which the dependent variables are measured. Caloric intake is a continuous number of calories consumed per capita, and urbanization is a ratio scalar variable of percent growth in urbanization. To test hypothesis 3 (H3), which predicts *that as temperatures increase, the likelihood of conflict increases in developing states,* I change the regression estimator, as the dependent variable, *Civil Conflict* is an observed count of conflict that follows negative binomial distribution. Thus, the values of *Y* are discrete and non-negative integers such as: 1, 2, 3, 4, and

so on. All three models use robust standard errors clustered by country codes to control for any issues of heteroskedasticity. To avoid issues of multicollinearity, I use Pearson's correlation coefficient test[7] and made sure correlation coefficients between variables were less than or equal to 0.3. Finally, all of the models presented in the results were tested for goodness of fit using the Hausman specification test and the Breusch-Godfrey test for higher-order serial correlation.

6.3 Empirical Findings

Table 5 provides the results of model estimates that test the relationship between climate change and livelihood (caloric intake) over time. To make the caloric intake data conform more closely to natural distribution, I utilize a log-transformation of the variable. The estimates for model 1 yields the finding that the linear effect of climate change and caloric intake (livelihood) is negative and significant ($p<0.05$). More specifically, the findings show that for every unit increase in temperature, there is a -.0047 log unit decrease in livelihood. This provides evidence that the null hypothesis for H1 can be rejected. As we would expect, livelihoods are more secure in wealthier states, and results show that as GDP Per Capita increase there is a corresponding log unit increase of 0.00 in caloric intake.

Because the effects of increased temperature on food consumption might not be instantaneous, I conducted a second regression and third regression that tested the relationship with a three-year time lag and a three-year moving average, respectively. Results in Model 2 were similar to those found in Model 1, with temperature being significant and resulting in a -.0049 log unit decrease of caloric intake consumption over time. In this model, the temperature variable that was lagged three years is highly significant, with a probability coefficient of

[7] Pearson's *r*, is a statistic that measures linear correlation between two variables *X* and *Y*. It has a value between +1 and −1, where 1 is total positive linear correlation, 0 is no linear correlation, and −1 is total negative linear correlation.

p<0.00, and has a negative effect on *Livelihood.* Model 3, which uses a 3-year moving average of temperature to smooth out short-term fluctuations and highlight longer-term trends, was not

Table 5. The Direct Effects of Climate Change on Livelihood

	Model 1			Model 2			Model 3		
Y= Livelihood	Coef.	Std Error	Prob.	Coef.	Std Error	Prob.	Coef.	Std Error	Prob.
Temperature	-.0047	0.00	**0.05**						
Temperature Lag				-.0049	.001	**0.00**			
Temperature Moving Avg							0.00	0.00	0.16
Development	0.0001	4.03	**0.00**	0.00	4.03	**0.00**	0.0018	3.840	**0.00**
Constant	7.808	0.0610	**0.00**	7.81	.045	**0.00**	7.71	0.22	**0.00**
Observations		898			898			894	
Prob>Chi2		0.00			0.00			0.00	

Note: Ordinary Least Squares with random effect and robust standard errors. Values are bolded if =<.05 P-value, in italics if =<0.10.

significant. *Development* was also significant ($p<0.00$), in both models 2 and 3, which show that for every unit increase in GDP per capita, there is a .000 log unit increase in *Livelihood.*

The second set of models calculate the direct relationship between temperature change and urbanization as a proxy for *Internal Migration*. These series of regressions (Table 6) used a logged transformation of the dependent variable, urbanization, to test the effects of *x*, temperature, as well as lagged predictors of *x* to estimate the variation in *y* over time. The estimates in Model 4 show that that the effect of temperature is positive and highly significant ($p<0.00$) and that for every unit increase in temperature there is a .047 log unit increase in urbanization. Models 5 shows that temperature (lagged by three years), is highly significant, and that for every unit increase in temperature there is a .063 log unit increase in internal migration. Model 6 demonstrates a similar pattern, with the 3-year moving average of temperature being a significant and positive driver of internal migration. Here, however, the moving average temperature term loses significance at $p<0.08$, and the log unit increase is .006. In addition to temperature showing to be a significant driver of migration, these models also show that *Development* is a significant deterrent of internal migration. In all of these models, Development was highly significant at $p<0.00$, but had a negative effect on urbanization. The models show that for every unit increase in GDP Per Capita, there is a log unit decrease in urbanization. This finding makes sense, as populations that are financially secure have less motivation in seeking economic opportunity elsewhere. These results provide empirical evidence that as temperatures increase, internal migration increases in developing states, and confirm that I can reject the null for *H2*.

Table 6. The Direct Effects of Climate Change on Internal Migration

	Model 4			Model 5			Model 6		
Y= Internal Migration	Coef.	Std Error	Prob.	Coef.	Std Error	Prob.	Coef.	Std Error	Prob.
Temperature	.047	.018	**0.00**						
Temperature Lag				.063	.018	**0.00**			
Temperature Moving Avg							.006	.004	*0.08*
Development	-0.00	.000	**0.00**	-0.00	0.00	**0.00**	-.000	0.00	**0.00**
Constant	.065	.435	0.88	-.262	.439	0.55	1.04	.124	**0.00**
Observations		899			899			895	
Prob>Chi2		0.00			0.00			0.00	

Note: Ordinary Least Squares with random effect and robust standard errors. Values are bolded if =<.05 P-value, in italics if =<0.10.

The last series of models in this part of the study test *H3* and explore the relationship between temperature and conflict. To capture the effects of climate change on *Civil Conflict* over time, I include a 3-year time lag predictor in Model 8 and a 3-year temperature moving average in Model 9. In addition to the *Development* control variable used in the previous models, I also introduce the *Democracy* control variable to the analysis. A total of 64 percent of the states included in this analysis are under Dictator regimes and 36 percent are considered Democratic.

Regression estimators for this series of tests reveal that temperature is not a significant driver of conflict. *Democracy* was also insignificant, and surprisingly, the coefficient estimates were positive rather than negative. This is an interesting result that indicates economic stability is more important than regime type in maintaining peace in developing countries. Models 6, 7, and 8 show *Development* to be the only significant predictor in the regression that has a negative effect on the onset of civil conflict. Findings indicate that for one unit change in *Development*, the difference in the logs of expected counts of *Civil War* is likely to decrease, given the other predictor variables in the model are held constant.

In conclusion, the results of these models fail to reject the null hypothesis of H3. I argue that these findings are largely due to the complexity in the relationship that exists between climate and conflict, which is likely comprised of more indirect causal processes. These links are explored in the next part of this study.

Table 7.The Direct Effects of Climate Change on Civil Conflict

	Model 7			Model 8			Model 9		
Y= Civil Conflict	Coef.	Std Error	Prob.	Coef.	Std Error	Prob.	Coef.	Std Error	Prob.
Temperature	.014	.031	0.64						
Temperature Lag				.011	.032	0.73			
Temperature Moving Avg							.015	.022	0.51
Development	-0.00	.000	**0.00**	-0.00	0.00	**0.00**	-.000	0.00	**0.00**
Democracy	.082	.349	0.81	.085	.349	0.80	.106	.346	0.75
Constant	19.59	235.8	0.93	20.23	102.0	0.84	18.70	238.6	0.93
Observations		989			989			985	
Prob>Chi2		0.00			0.00			0.00	

Note: Negative Binomial with random effect and robust standard errors. Values are bolded if =<.05 P-value, in italics if =<0.10.

Quantitative Analysis Part II. The Indirect Effects of Climate Change on Livelihood, Internal Migration, and Conflict

This part of the statistical analysis attempts to make inferences about the indirect effects and causal relationship that exist between climate change and the various dimensions of human security. These causal models are largely informed by the findings of the earlier case studies as well as *Sheffran's Conceptual Framework*. The models presented in this section make predictions about the behavior of the climate-security system and focus on the ways in which the effects of climactic interventions on the environment can impact a sequence of social outcomes.

I start by investigating the effects of temperature on environmental factors relied upon for human need. Specifically, I look at the variation between *Arable Land* and *Temperature*. I then explore the relationship between *Arable Land* and *Livelihood*. After that, I explore how food, or *Livelihood*, affect *Internal Migration* (urbanization proxy), and *Civil Conflict*. I utilize *Livelihood* as the main independent variable in both the migration and conflict models because livelihood appears to be the common denominator that sparks social responses. The sequencing of this modelling follow Sheffran's theory, which specifies that climate change creates stress that lead to environmental changes. These environmental changes lead to impacts on human needs, such as water, food, jobs, and income. It is these impacts that then trigger social responses such as migration and conflict.

The findings of this analysis largely support this theory. Model 1 in Table 8 shows that increased temperatures have negative impacts on the environment. Here, the independent variable temperature coefficient is highly significant ($p<0.00$) and negatively effects the dependent variable, arable land. More specifically, Model 1 suggests that for every unit increase in temperature, there is a unit decrease in arable land percentage. In this model, temperature

proves to be even more impactful than *Development*, which also negatively impacts land, but is less significant at $p<.006$.

Because arable land is essential for agriculture and food security, Model 2 captures the effects that it has on caloric intake per capita. Findings show that an increase in *Arable Land* percentage has a highly significant and positive effect on *Livelihood*. More specifically, for every unit increase in Arable Land percentage, there is a unit increase in caloric intake. In this model, land shows to be of equal importance to *Development*, which also has a positive effect on *Livelihood*.

The next sets of models in Table 8 detail the effects that *Livelihood* has on *Urbanization* and *Civil Conflict*. As previously mentioned, I decided to use *Livelihood* as the main independent variable in these tests, because social responses such as migration and conflict often stem from poverty and issues of livelihood security. While Model 3 does not support this claim in the case of livelihood and urbanization, with none of the explanatory variables being significant; Model 4 suggests something different. This model looks at the effects of x (caloric consumption) on y (civil conflict) and provides evidence that increased livelihood security reduces the likelihood of conflict in the developing world. Estimates of this model show caloric consumption to be significant at ($p<0.00$), holding more explanatory power than Democracy, which was also significant at ($p<0.05$)—highlighting the importance of improving livelihood sustainability in these countries.

Table 8. The Indirect Effects of Climate Change on Livelihood, Internal Migration, and Civil Conflict

	Model 1			Model 2			Model 3			Model 4		
	Y= Arable Land			Y= Caloric Consumption			Y=Urbanization			Y= Conflict		
Independent Variables	Coef.	Std Error	Prob.	Coef.	Std Error	Prob.	Coef.	Std Error	Prob.	Coef.	Std Error	Prob.
Temperature	-.1978	0.1027	**0.005**									
Arable Land				0.007	0.0030	**0.0000**						
Caloric Intake							-.0021	0.0002	0.3060	-.099	0.0035	**0.005**
Development	-.0044	0.0002	*0.06*	.0001	6.0100	**0.0000**	0.0000	0.0000	0.1380	-.005	0.00004	0.183
Democracy										.3726	0.19617	**0.05**
Constant	40.700	3.320	**0.00**	7.720	0.017	**0.0000**	1.430	0.5089	**0.0050**	20.68	244.37	0.933
Observations		989			2050			2050			1,941	
Prob>Chi2		0.0000			0.0000			0.0000			0.933	

Note: Values are bolded if =<.05 P-value, in italics if =<0.10.

6.4 Summary of Empirical Results

The results of this quantitative analysis provide evidence that climate change has direct and indirect effects on livelihood, internal migration, and civil conflict. In present time, these effects have the ability to undermine human security in developing countries and will continue to do so in the future if climate projections are correct. Despite the ambiguity that exists in the literature regarding this connection, this study underscores several important facets that can aid in reducing uncertainty among researchers. First, it is important to note that livelihood is at the center of the climate security puzzle. Both part one and part two of this quantitative study highlight the clear connection that exists between increased temperatures and livelihood security. Unlike with internal migration and civil conflict, where climate effects were either direct or indirect; the livelihood dimension of human security was highly affected by both. In part one of the analysis, we see that rising temperatures have the ability to reduce per capita caloric intake in developing countries. In the literal sense, this suggests that climate change affects household food consumption, but a deeper interpretation indicates that if a household cannot meet its minimum nutritional necessities, it is likely not meeting other requirements needed for human survival.

Part two of the analysis provides additional insight, as we see temperature affect the percentage of arable land available for food production. As temperatures increase and the total arable land decreases, we see that household caloric consumption also decreases. This not only highlights the importance of a healthy environment to support natural resources, but also emphasizes how important natural resources are for human need. These findings alone constitute a valuable contribution to the literature, as they provide the empirical evidence needed to

establish a starting point for examining climate-security processes across space, time, and multiple scales.

A second notable finding in this analysis that contributes to our understanding of climate related insecurity is the significant association between increased temperatures and increased internal migration. Part one of the quantitative analysis revealed the direct effect that climate change had on urbanization growth. While we know that migration may be one response of people whose livelihoods are undermined by climate change (Barnett and Adger, 2007), the results of this study signal that increased temperature in itself might be an important push factor in the decision to migrate to urban areas. This is a meaningful aspect of the human security research agenda that we should pay close attention to in the future, as migration to urban areas increases demand on services and can increase political pressure on a state with limited resilience to manage amplified changes in population.

In addition to these advancements in understanding the connections, the empirical results of this investigation provide thought provoking conclusions about climate change and the risk of violent conflict. While there was no evidence that showed increased temperatures would directly contribute to the increase of civil war, I did find an indirect association in the causal modelling portion of the analysis. The highly significant connection that links livelihood and conflict together offers researchers in the field an opportunity for continued exploration. Through the direct effects on the environment and on livelihood, climate change has the potential to indirectly increase the risk of conflict. These findings make a valuable contribution and provide the empirical evidence needed to establish the relationship, as highlighted by Barnett and Adger in 2007. Additionally, this finding arguably highlights the need to investigate how states who are

dependent on climate sensitive natural resources for livelihood security can build resilience so that the consequences of livelihood reduction never transpire to violent conflict.

CHAPTER SEVEN: DISCUSSION AND CONCLUSION

7.1 Synthesis of Findings and the Study Limitations

In sum, the findings of both the qualitative and quantitative studies included in this thesis provide "systematic, comparative, and cross-scale research that enhances the understanding of the connections between climate change, human security, and violence" (Barnett and Adger, 2007: 651). In their work, Barnett and Adger (2007) highlight that these connections were not yet empirically proven in the literature; this study makes a contribution to this area and showcases the ways in which climate change threatens human security and peace.

The mixed-methods approach that I took in this work assisted in my understanding of the ways in which the bio-physical factors that are produced by climate change affect socio-economic political factors that contribute to elements of insecurity. Results in the case studies illustrate how different scenarios of climate change affect bio-physical elements such as soil and crop growth upon which humans depend on for survival. When high temperatures cause changes in the environment that damage crops or depress grazing fields in an already fragile system, risk of hunger, malnutrition, and even famine is vastly increased, while poverty and despair are multiplied. It is these circumstances that initiate responses that can create social instability. The chain of events that I observed in both Bangladesh and Darfur were supported by the statistical findings of the causal modelling, providing a considerable advancement to the understanding of the climate security nexus. Thus, while there were some clear advantages of incorporating a mixed-methods approach to assess the phenomenon, there were also some trade-offs and disadvantages that are note-worthy.

To start, as I mentioned in Chapter 3, selecting cases where the phenomenon of interest was "most likely" to be observed, affects the external validity and the applicability of

conclusions found outside the context of my case studies. Nevertheless, I found it useful to trace the effects of environmental factors on human society and observed many valuable causal mechanisms that I had hoped to include in my statistical testing. For example, I anticipated utilizing environmental indicators such as water availability and ecosystem vitality in the statistical regressions, as I observed the importance of these factors in the case studies. In doing so, however, I ran the risk of overfitting the models and violating the fundamentals of inferential statistics. To avoid this, as well as issues of multicollinearity, I was required to choose a limited subset of predictors that I thought best explained the connections. For each dimension of human security examined, I utilize a limited number of theoretically relevant explanatory variables. Therefore, one will notice issues associated with gender disparities, racial inequalities, education, unemployment, etc., are not included in this particular project, but are elements that should be addressed in future research.

In addition to these methodological drawbacks, some of the variables I selected also suffer from a few limitations. For example, the caloric intake per capita used as a proxy for livelihood, fails to account for food security issues in vulnerable localities such as those featured in the case studies. Because aggregate data mask some of the key trends and problems that might be occurring at local and regional levels, issues like famine are not be captured at macro-level, since famine rarely affects an entire nation-state (Boehmer and Sobek, 2007). Moreover, the caloric intake per capita also fails to account for matters of food quality, such as protein intake. For instance, in places like Bangladesh or Darfur, it is likely that the majority of calories come from sources like wheat and rice, which are prominent dietary staples in those areas. So, even if the data show the countries doing relatively well, one cannot gauge any livelihood or nutritional deficiencies that might be associated with food quality. Bogard et al.(2017) note that fish is the

main source of protein in Bangladesh but reflects a lower overall nutritional quality. This challenges the standard narrative that increases in food supply lead to improvements in diet and nutrition. In the future, researchers could benefit from bridging the connection in qualitative and quantitative livelihood data by perhaps looking at the FAO and UN country reports. These reports might provide more detailed data on specific regions or states that could improve these findings.

Furthermore, the data used to measure internal migration could also be improved, as the effect estimates of urbanization are merely a distant proxy to migration. However, when I attempted to use variables such as migrant stock percentages, or raw numbers of internally displaced persons per state, model observations dropped to as low as 200, which was not a true representation of the overall population sample. In the next iteration of this work, I hope to acquire more robust migration datasets to investigate this dimension more rigorously.

Despite the trade-offs that come with utilizing a mixed-method research design, I found that in large, the qualitative and quantitative studies featured in this thesis complement one another and provide us with a more thorough pathway that facilitate the continued exploration of this social problem. Because the interactions between climate, agro-ecosystems, and human behavior are so complex, statistical assessments provide only a glimpse of a much larger picture and incorporating more holistic methodological approaches help in revealing connections that might be missed in aggregate studies.

An example of this is illustrated in part one of my quantitative study, where rising temperatures were not a significant driver of civil conflict. This result contradicts what was found in the case of Darfur, where climate change worsened desertification and land degradation, and triggered a succession of conflicts. Ultimately, the findings in the case study led me to search

for indirect connections in part two of my quantitative work, where I found that climate change directly contributes to a decrease in arable land that is essential for food production, which in turn, affect trends in violent conflict. Had I not integrated qualitative methods into the research design, I might have missed this important link.

In addition to the drawbacks already mentioned, there were more general study limitations that researchers in this field should be aware of. One of the major challenges of this work stems from the multifaceted nature of climate change and the complexity of drought. There are a number of ways that drought is induced, including warmer temperatures that lead to increased soil evaporation, as well as lower precipitation rates (Center for Climate Energy Solutions, 2020). Thus, pinpointing the exact moment or way that rising temperatures manifest into drought to establish a baseline for a case study is a daunting task. This is especially true when drought has been so poorly documented in developing countries such as Bangladesh and Darfur. Moreover, there was also the challenge of differentiating between drought induced by anthropogenic climate change versus naturally occurring drought. How can we definitively differentiate between natural and man-made? Regardless of this uncertainty, there is a value in continuing to trace the impacts that drought has had on human security in the past, as we can confirm that "there is a general consensus for future droughts to become more frequent, longer lasting, and severe due to expected increase in atmospheric temperature and evaporation" (Mortuza et al., 2018: 855).

Finally, it is important that to note the spatiotemporal challenges that come in assessing the climate-security relationship. While all of the states observed in this analysis are developing countries, there is no geographic homogeneity between states, and the way in which a state mitigates and adapts to the challenges of climate change very likely vary from one state to

another. Hence, looking at the phenomenon by region and conducting comparative analyses may be fruitful way of improving and advancing this work. In addition to addressing these limitations, I also plan to expand the quantitative portion of this thesis in the near future and explore the statistical relationships more deeply.

7.2 Conclusion

In this thesis I have presented an assessment about the current state of anthropogenic climate change and the association that it has with a wide range of human and environmental systems such as drought, land availability, agriculture, food production and security. My research builds on the existing framework that suggests that there is a strong interaction between climate and society; though these interactions are at times ancillary, they are meaningful and deserve further investigation.

Empirical results of this study show that there are both direct and indirect effects that increased temperatures have on human security dimensions. More specifically, climate change showed to be a direct driver of decreased livelihood, increased urbanization, and an indirect determinant of civil conflict in developing countries. In addition to these contributions of knowledge, my research addresses several missing components highlighted by the literature and contributes a large-N study that incorporates a mixed-methods approach and focuses on the countries that experience the highest risks of climate change outcomes.

As the rising temperatures continue to threaten the most vulnerable populations in the world, we must remember that they are the least responsible and least equipped to deal with the perils of a climate crisis. As Tropper (2002) reminds us, in order for a country to be resilient, "societies must generally demonstrate the ability to (1) buffer disturbance, (2) self-organize, and (3) learn and adapt". But how can communities enhance their resilience in midst of external

social, economic, political pressures? With lower capacity to reduce their vulnerability, developing countries need international partners to assist in implementing strategies such as sustainable economic development to alleviate poverty. These countries are in great need of pro-resilience initiatives that promote alternative means of livelihood in times of climate-related disruptions. Research has shown that substantial international cooperation and investments can have big payoffs in development outcomes, and this collective effort would be no different (World Bank, 2020).

While these long-term solutions may provide a safe-guard for developing countries as temperatures continue to rise at an accelerated pace, they ultimately should be a small part of a much larger initiative to combat the root causes of global warming. The advancement of this research agenda through more rigorous testing and with the utilization of more accurate data can guide better policy outcomes and help us improve our understanding of how to prevent and even solve the problems that may arise from a potential climate crisis. It is my hope that this study serves as a catalyst to further deconstruct the climate-security connection in more distinctive ways so that this can be achieved.

EPILOGUE

During the last few months of completing this project, the world as we knew it came to a hauling stop. Much of the global population was caught off guard as what became identified as COVID-19 spread rapidly across the world, with more than a million cases in the United States alone. While many civilians were shocked that a virus could destroy economies and alter our everyday lives, some of us knew that scientists had warned of the threat of pandemics for decades. Much like the current warning scientists offer us about anthropogenic climate change, forewarnings about disease and epidemics went largely ignored—leaving the world population completely vulnerable to the deadly impacts of coronavirus. Though the COVID-19 situation is still unfolding, I think it is useful to draw on the parallels that exist between this crisis and a possible climate crisis in the future so that improved crises management outcomes are achieved.

Since the initiation of the pandemic wave, the deep flaws of governments and institutions in even the wealthiest and most powerful states in the world have been exposed. In the United States, we became quickly aware of the weakness of our healthcare systems, our supply chains, as well as the inadequacy of the Federal government to protect the healthcare workers on the frontlines. In a country that prides itself on being these "united" states, we witnessed an internal arms race with states outbidding each other to secure their own reserves of personal protection equipment (Soergel, 2020).

On a more global scale, we can arguably see how a lack of global cooperation may have contributed to the rapid spread of the virus. A lack of collective action has been noted by the Council on Foreign Relations who claim that during the early months of China battling coronavirus, global solidarity was "AWOL" (Patrick, 2020). Rather than taking multilateral steps

to build solidarity against the pandemic, global leaders remained divided, sometimes blaming one another for who caused the pandemic, rather than organizing against it (Patrick, 2020).

What does this all mean for the climate change and human security? To me, it highlights the severe consequences that delayed responses and flat out ignorance could mean for our society in the future. Solution aversion and the dismissal of scientific evidence have proven to be costly, chaotic, and deadly. While the parallels between the COVID crisis and the climate crisis are clear, it is also evident that by the time that the most dangerous impacts of climate change are staring every single person in the eye, it will likely be too late to adequately respond, and there will not be vaccine to save us. Thus, we should act in a timely manner. Solutions to each of these threats requires collaborative organization, leadership, and aggressive initiatives by global leaders.

As the world tries to recover from the damage of the pandemic, the international sphere has an opportunity to learn from this and initiate more significant mitigation measures to address climate change and future disease outbreaks. One of the first and most simple things accessible to world leaders is to fortify science based evidence and the role it plays on policy making. Furthermore, recognizing that like COVID-19, carbon emissions know no border, a more collective approach should be taken to address the negative impacts that climate change has on the most vulnerable populations. Finally, it is important for world governments to understand that doing nothing about a problem results in the costliest outcomes. However expensive a shift to renewable energy may be, it is cheaper than the immeasurable damage the climate crisis threatens to cost in the long run.

BIBLIOGRAPHY

Abdal, O., Monium K., Young, H., Houser, R., Coats, J. (2013). "Agricultural Change, Land, and Violence in Protracted Political Crisis: Anexamination of Darfur,". *Oxfam America Research Backgrounder.*
http://www.oxfamamerica.org/publications/darfur-land-research

Abedin, M.A., Collins, A.E., Habiba, U. (2019). *Int J Disaster Risk Sci.* 10, 28-42.
https://doi.org/10.1007/s13753-018-0211-8

Abel, G.J., Brottragerb, M., Cuaresmac, J.C., Muttarak, R., Climate, Conflict and Forced Migration. (2019). *Global Environmental. Change*. 54, 239–249.
https://pure.iiasa.ac.at/id/eprint/15684/1/1-s2.0-S0959378018301596-main.pdf

Adams, C., Ide, T., Barnett, J., & Detges, A. (2018). Sampling Bias in Climate–Conflict Research. *Nature Climate Change*, 8, 3, 200.
https://www.nature.com/articles/s41558-018-0068-2

Adger, W.N., Puhlin, J.M., Barnett, G.D., Dabelko, G.K., Hovelsrud, M., Levy, Ú., Spring, O., Vogel, C.H. (2014). Human Security in: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. *Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 755-791.
https://www.ipcc.ch/report/ar5/wg2/human-security/

Ahmad, Q.K., Warrick, R.A. (1996). *The Implications of Climate and Sea-Level Change for Bangladesh*. Springer.

Ali, A. (2005). Livelihood and Food Security in Rural Bangladesh.
https://edepot.wur.nl/121729

Ali, N. B., Tahsina, T. Hoque, D. M. E. (2019). "Association of Food Security and Other Socio-Economic Factors with Dietary Diversity and Nutritional Statuses of Children Aged 6-59 Months in Rural Bangladesh." *PloS One*, 14, 8.
https://pubmed.ncbi.nlm.nih.gov/31465509/

Banglapedia. (2014). Drought.
http://en.banglapedia.org/index.php?title=Drought

Barnett, J. (2007). The Geopolitics of Climate Change. *Geography Compass*. 1, 6, 1361- 1375.
https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1749-8198.2007.00066.x

Barnett, J., Adger, N.W. (2007). Climate Change, Human Security, and Violent Conflict. Political Geography. 26, 639-655.

https://reader.elsevier.com/reader/sd/pii/S096262980700039X?token=D5653BAE7474326725A95D4168CF59DD12F14BB171966DA8072112A7D13DC74680A7FFA36CADAEBAD52AEB8F946B0BBA

BBC News. (2018). Final Call to Save the World from 'Climate Catastrophe'. https://www.bbc.com/news/science-environment-45775309

Beach, D., Pedersen, R. (2013). *Process-Tracing Methods*. Ann Arbor: University of Michigan Press.

Benjaminsen, T. A. (2012). Does Supply-Induced Scarcity Drive Violent Conflicts in the African Sahel? The Case of the Tuareg Rebellion in Northern Mali. *Journal of Peace Research*. 45, 6, 819–836. https://journals.sagepub.com/doi/10.1177/0022343308096158

Boehmer, C. R., Sobek, D. (2007). If They Only Had Cake: The Effect of Food Supply on Civil War Onset 1960-1999. https://www.semanticscholar.org/paper/If-They-Only-Had-Cake%3A-The-Effect-of-Food-Supply-on-Sobek-Boehmer/cb86b80b1a02fe4ca8cac2409b6b19103f76754c

Bogard, J. R., Farook, S., Marks, G. C., Waid, J., Belton, B., Ali, M., Toufique, K., Mamun, A., & Thilsted, S. H. (2017). Higher Fish but Lower Micronutrient Intakes: Temporal changes in Fish Consumption from Capture Cisheries and Aquaculture in Bangladesh. *PloS one*, *12*(4). https://doi.org/10.1371/journal.pone.0175098

Boix, C., Miller, M., Rosato, S. (2018). "Boix-Miller-Rosato Dichotomous Coding of Democracy, 1800-2015". Harvard Dataverse. https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/FJLMKT

Borger, J. (2007). Darfur Conflict Heralds Era of Wars by Climate Change UN Report Warns. The Guardian. https://www.theguardian.com/environment/2007/jun/23/sudan.climatechange

Buhaug, H. (2015). Climate-Conflict Research: Some Reflections on the Way Forward. Wires Climate Change. https://www.hbuhaug.com/wp-content/uploads/2015/03/Buhaug_WIREsCC_2015.pdf

Buzan, B. (1997). Rethinking Security after the Cold War. *Cooperation and Conflict*. 32, 1, 5–28.

Carter, M., Little, P., Mogues, T., Negatu, W. (2007). Poverty Traps and Natural Disasters in Ethiopia and Honduras. *World Development*. 35, 5, 835-856.

Center for Climate Energy Solutions. (2020). Drought and Climate Change. https://www.c2es.org/content/drought-and-climate-change

Chambers, R., Conway, R. (1992). Sustainable Rural Livelihoods: Practical Concepts for the 21st Century. *IDS Discussion Paper*. 296, 127-130.

Climate Change Knowledge Portal. (2020). Bangladesh Overview. Retrieved from: https://climateknowledgeportal.worldbank.org/country/bangladesh

Cockburn, H. (2019). Climate Change Crisis: Thawing Permafrost Forcing Alaskan Villages to Relocate. The Independent. https://www.independent.co.uk/environment/climate-change-permafrost-melting-alaska-relocation-arctic-ice-environment-a8965091.html

Collins, B. (2005). Mobile Coverage Maps. Retrieved on: https://www.collinsbartholomew.com/mobile-coverage-maps/

Commission on Human Security. (2003). Human Security Now: Final Report, New York: CHS.

Conway, T., Moser, C., Norton, A., Farrington, J. (2002). Rights and Livelihood Approaches: Exploring Policy Dimensions. *Natural Resource Perspective Journal*. https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/1814.pdf

Dalby, S. (2009). *Security and Environmental Change: Dimensions of Security*. Polity.

Dave, D., Doytch, N., Kelly, I. (2016). Nutrient Intake Through Time and Cross Regions. CEPR Policy Portal. https://voxeu.org/article/nutrient-intake-cross-national-analysis-trends-and-economic-correlates

Denchak, M. (2019). Paris Agreement: Everything You Need to Know. https://www.nrdc.org/stories/paris-climate-agreement-everything-you-need-know

Detges, A. (2017). *Climate and Conflict: Reviewing the Statistical Evidence*. Adelphi Publishing. https://www.adelphi.de/en/publication/climate-and-conflict-reviewing-statistical-evidence

De Weijer, F. (2007). Afghanistan's Kuchi Pastoralists: Change and Adaptation. *Nomadic Peoples*. 11, 1, 9-37.

De Waal, A. (1989). *Famine that Kills: Darfur, Sudan, 1984-1985*. Oxford, UK: Clarendon Press.

Dey, N., Alam, M., Sajjan, A., Bhuiyan, M., Ghose, L., Ibaraki, Y., Karim, F. (2012). Assessing Environmental and Health Impact of Drought in the Northwest Bangladesh. *Journal of Environmental Science and Natural Resources*. 4, 2, 89-97. https://doi.org/10.3329/jesnr.v4i2.10141

Dixon, J. (2009). What Causes Civil Wars? Integrating Quantitative Research Findings.

International Studies Review. 11, 4, 707-735.
https://www.jstor.org/stable/pdf/40389163.pdf?refreqid=excelsior%3A2dfc6d4d3d2f258bfa96d6130a2a75cc

DTM Global Network. (2019). Lake Chad Basin Crisis.
http://www.globaldtm.info/lake-chad-basin-crisis-monthly-dashboard-1-april-2018/

Dunlop, I. & Spratt, D. (2017). Disaster Alley: Climate change, Conflict and Risk.
https://www.breakthroughonline.org.au/publications

Eckstein, D., Hutfils, M., Winges, M. (2018). Global Climate Risk Index 2019.
https://germanwatch.org/files/Global%20Climate%20Risk%20Index%202019_2.pdf

Environmental Justice Foundation. (2020). Climate Displacement in Bangladesh.
https://ejfoundation.org/reports/climate-displacement-in-bangladesh

Ericksen N.J., Ahmad Q.K., Chowdhury A.R. (1996). Socio-Economic Implications of Climate Change for Bangladesh. In: Warrick R.A., Ahmad Q.K. (eds) *The Implications of Climate and Sea–Level Change for Bangladesh*. Springer.

FAO STAT. (2020). Temperature Change.
http://www.fao.org/faostat/en/#data/ET

Faris, S. (2007). The Real Roots of Darfur. The Atlantic.
https://www.theatlantic.com/magazine/archive/2007/04/the-real-roots-of-darfur/305701/

Feng, S., Krueger, A.B., Oppenheimer, M. (2010). Linkages Among Climate Change, Crop Yields and Mexico-US Cross-Border Migration. *Proceedings of the National Academy of Sciences of the United States of America*. 107, 32, 14257-14262.

Floyd, R. (2008). The Environmental Security Debate and its Significance for Climate Change.
http://dx.doi.org/ 10.1080/03932720802280602

Food Agriculture Organization. (2009). Horn of Africa Drought Response Update.
http://www.fao.org/fileadmin/user_upload/newsroom/docs/Horn%20of%20Africa%20Crisis%20Report%20February%202009.pdf

Fountain, H. (2015). Researchers Link Syrian Conflict to a Drought Made Worse by Climate Change.
https://www.nytimes.com/2015/03/03/science/earth/study-links-syria-conflict-to-drought-caused-by-climate-change.html

Gasper D. (2020). Human Development Thinking About Climate Change Requires a Human Rights Agenda and an Ontology of Shared Human Security. In: Crabtree A. (eds) *Sustainability, Capabilities and Human Security*. Palgrave Macmillan.

Gentle, P., Maraseni, T. N. (2012). Climate Change, Poverty and Livelihoods: Adaptation Practices by Rural Mountain Communities in Nepal. *Environmental Science and Policy*. 21, 24-34.
https://doi.org/10.1016/j.envsci.2012.03.007

George, A., Bennett, A., (2005). *Case Studies and Theory Development in the Social Sciences*. MIT Press.

Gilmore, E.A., Herzer, L., Tennant, E. (2018). *Current Climate Change Rep.* 4, 313. https://doi.org/10.1007/s40641-018-0119-9

Gingerich, P. D. (2019). Temporal Scaling of Carbon Emission and Accumulation Rates: Modern Anthropogenic Emissions Compared to Estimates of PETM Onset Accumulation. *Paleoceanography and Paleoclimatology*. 34, 329– 335.
https://doi.org/10.1029/2018PA003379

Gleditsch, N.P. (2012). Whither the Weather? Climate Change and Conflict. *Journal of Peace Research.* 49, 1, 3-9.

Gleick, P. (2014). Water, Drought, Climate Change, and Conflict in Syria. *Weather, Climate, and Society*. 6, 3, 331-340.
www.jstor.org/stable/24907379

Glennon, R. (2017). The Unfolding Tragedy of Climate Change in Bangladesh. *Scientific American.*
https://blogs.scientificamerican.com/guest-blog/the-unfolding-tragedy-of-climate-change-in-bangladesh/

Grandoni, D., Sonmez, F. (2019). Senate Defeats Green New Deal, as Democrats Call Vote a 'Sham'.
https://www.washingtonpost.com/powerpost/green-new-deal-on-track-to-senate-defeat-as-democrats-call-vote-a-sham/2019/03/26/834f3e5e-4fdd-11e9-a3f7-78b7525a8d5f_story.html

Gosling, S.; Arnell, N. (2013). A Global Assessment of the Impact of Climate Change on Water Scarcity. *Climatic Change*, 134, 371–385.
https://link.springer.com/article/10.1007/s10584-013-0853-x

Government Accountability Office. (2019). Climate Change: Activities of Selective Agencies to Address Potential Impact on Global Migration.
https://www.gao.gov/assets/700/696460.pdf

Gregoratti, C. (2019). Human Security.
https://www.britannica.com/topic/human-security

Gronewold, N. (2019). Boris Johnson's Stance on Climate Change Has Flip Flopped.

https://www.sciencemag.org/news/2019/07/boris-johnson-s-stance-climate-change-has-flip-flopped

Guillen, M. (2016.) Wars Between States Are Down, but Civil Wars Are Up. The New York Times.
https://www.nytimes.com/roomfordebate/2016/09/06/is-the-world-becoming-safer/wars-between-states-are-down-but-civil-wars-are-up

Habiba, U., Shaw, R. and Takeuchi, Y. (2011). "Chapter 2 Socioeconomic Impact of Droughts in Bangladesh", Shaw, R. and Nguyen, H. (Ed.) *Droughts in Asian Monsoon Region (Community, Environment and Disaster Risk Management.* Emerald Group Publishing Limited.
https://www.emerald.com/insight/content/doi/10.1108/S2040-7262(2011)0000008008/full/html

Hauge,W., Ellingsen, T. (1998). Beyond Environmental Scarcity: Causal Pathways to Conflict. *Journal of Peace Research*. 35, 3, 299-317.
https://journals.sagepub.com/doi/10.1177/0022343398035003003

Higginbotham, M. (2013). Darfur Conflict Timeline.
https://enoughproject.org/blog/darfur-conflict-timeline

Homer-Dixon, T. (1999). *Environment, Scarcity, and Violence.* Princeton University Press.
www.jstor.org/stable/j.ctt7pgg0

House Resolution 109. (2019). Recognizing the Duty of the Federal Government to Create a Green New Deal.
https://www.congress.gov/bill/116th-congress/house-resolution/109/text

Hsiang, S., Burke, M., Miguel, E. (2013). Quantifying the Influence of Climate on Human Conflict. *Science*. 341.

Hultman, N. E., & Bozmoski, A. S. (2006). The Changing Face of Normal Disaster: Risk, Resilience and Natural Security in a Changing Climate. *Journal of International Affairs*. 59, 25–41.

Human Rights Council. (2015). Summary Report of Office of the United Nations High Commissioner for Human Rights on the Outcome of the Full Day Discussion on Specific Themes Related to Human Rights and Climate Change.
https://www.ohchr.org/EN/HRBodies/HRC/RegularSessions/Session29/_layouts/15/WopiFrame.aspx?sourcedoc=/EN/HRBodies/HRC/RegularSessions/Session29/Documents/A_HRC_29_19_en.doc&action=default&DefaultItemOpen=1

IGI Global. (2020). What is Baseline Climate?.
https://www.igi-global.com/dictionary/climate-change-impact-on-the-water-resources-of-the-limpopo-basin/61469

Internal Displacement Monitoring Centre. (2019). Global Report on Internal Displacement. https://www.internal-displacement.org/sites/default/files/publications/documents/2019-IDMC-GRID.pdf

International Institute for Sustainable Development. (2003). Livelihoods and Climate Change. https://www.iisd.org/pdf/2003/natres_livelihoods_cc.pdfInternational Organization for Migration. (2008). Migration and Climate Change. https://www.iisd.org/pdf/2008/migration_climate.pdf

International Organization on Migration. (2014). Outlook on Migration, Environment, and Climate Change. https://environmentalmigration.iom.int/iom-outlook-migration-environment-and-climate-change-1

International Organization on Migration. (2019). IOM in Bangladesh. *International Studies Review*. 15, 2, 185-203. https://academic.oup.com/isr/article-abstract/15/2/185/1796597?redirectedFrom=fulltext

IPCC. (2012). Managing the Risk of Extreme Events and Disasters to Advance Climate Change Adaptation. https://www.ipcc.ch/report/managing-the-risks-of-extreme-events-and-disasters-to-advance-climate-change-adaptation/

IPCC (2018). Global Warming of 1.5°C. Special Report. https://www.ipcc.ch/sr15/

Jan, T., Dahlberg, S., Holmberg, S., Rothstein, B. Pachon, A.N., Axelsson, S. (2020). The Quality of Government Standard Dataset, version Jan. 20. University of Gothenburg: The Quality of Government Institute. http://www.qog.pol.gu.se

Jaspars, S., Buchanan Smith, M. (2018). Darfuri Migration from Sudan to Europe. https://www.odi.org/sites/odi.org.uk/files/resource-documents/12384.pdf

Johnson, R., & Onwuegbzic, A. (2004). Mixed Methods Research: A Research Paradigm Whose Time Has Come. Educational Researcher. 33, 7, 14-26. http://www.jstor.org/stable/3700093

Kamal, B. (2017). Climate Migrants Might Reach One Billion by 2050. http://www.ipsnews.net/2017/08/climate-migrants-might-reach-one-billion-by-_2050/

Kanti, P. (1995). Farmers' Responses to the Flood Action Plan of Bangladesh: An Empirical Study. *World Development*. 23, 299-309. https://www.sciencedirect.com/science/article/abs/pii/0305750X9400119J

Kaufmann, D., Kraay, A., Mastruzzi, M. (2010). The Worldwide Governance Indicators. https://info.worldbank.org/governance/wgi/Home/Reports

Kay, A. and Baker, P. (2015).What Can Causal Process Tracing Offer to Policy Studies? A Review of the Literature. *Policy Stud J*. 43, 1-21.

Keating, J. (2018). The Sinking State. The Washington Post. https://www.washingtonpost.com/news/posteverything/wp/2018/07/26/feature/this-is-what-happens-when-climate-change-forces-an-entire-country-to-seek-higher-ground/

Kenrick, C. (2008). NASA Scientist Cites 'Global-Warming Emergency'. Palo Alto Online. https://www.paloaltoonline.com/news/2008/11/22/nasa-scientist-cites-global-warming-emergency

KNMI Climate Explorer. (2020). Climate Change Atlas. https://climexp.knmi.nl/plot_atlas_form.py?id=

Korf, B. (2011). The Imaginative Geographies of Climate Wars. *Procedia Social and Behavioral Sciences*. 14, 35-39. https://www.sciencedirect.com/science/article/pii/S187704281100187X

Krause, R. (2015.) Climate Change Contributed to Conflict in Syria. Deutsche Welle. https://www.dw.com/en/climate-change-contributed-to-war-in-syria/a-18330669

Lagorio, J. (2007). UN Brief Presses for Climate Action. The Age. https://www.theage.com.au/world/ un-chief-presses-for-climate-action-20071112-ge6a2d.html

Mann, G.; Wainwright, J. (2018) *Climate Leviathan: A Political Theory of Our Planetary Future*. Verso Books.

Marshall, R., Rahman, S. (2013). Internal Migration in Bangladesh: Character, Drivers, and Policy Issues. United Nations Development Programme. https://www.semanticscholar.org/paper/Internal-Migration-in-Bangladesh%3A-Character%2C-and-Rahman/22cb62109941a5e442c398c9b752978bfaa92e78

Mazo, J. (2009): Climate Change and Security. The Adelphi Papers. 49. 409, 73-86.

McDonnel, T. (2019). Climate Change Creates New Migration Crisis for Bangladesh. National Geographic. https://www.nationalgeographic.com/environment/2019/01/climate-change-drives-migration-crisis-in-bangladesh-from-dhaka-sundabans/

McGrath, M. (2019). Climate Change: 12 years to Save the Planet? Make That 18 Months. https://www.bbc.com/news/amp/science-environment-48964736

Meierding, E. (2013). Climate Change and Conflict: Avoiding Small Talk about the Weather. International Studies Review. 15, 2.

Morgan, H. (2019). Sudan: One of the 10 Countries Most Vulnerable to Climate Change. https://www.aljazeera.com/news/2019/11/sudan-10-countries-vulnerable-climate-change-191121123822186.html

Mortuza, M.R., Moges, E., Demissie, Y., Hong-Yi, L. (2019). Historical and Future Drought in Bangladesh Using Copula-Based Bivariate Regional Frequency Analysis. *Appl. Clim*. 135, 855–871.

Muqtada, M. (2020.) Poverty and Famines in Bangladesh. *The Bangladesh Development Studies.* 1, 1-34. https://www.jstor.org/stable/pdf/40794308.pdf?refreqid=excelsior%3A4d33b26c77cd503a0cbff564d299f88d

NASA. (2020). NASA, NOAA Analyses Reveal 2019 Second Warmest Year on Record. https://www.nasa.gov/press-release/nasa-noaa-analyses-reveal-2019-second-warmest-year-on-record

Nuccitelli, D. (2019). Yale Climate Connections. Climate Change Poses Security Risks, According to Decades of Intelligence Reports. https://www.yaleclimateconnections.org/2019/04/the-long-history-of-climate-change-security-risks/

Orioha, M. K. (2018). "Managing Climate Reality in Sub-Sahara Africa" (PDF).

Our World in Data. (2019). Improving Food Supply in Early Modernized Countries. https://ourworldindata.org/food-per-person

Our World in Data. (2020). Average Global Temperature. https://ourworldindata.org/grapher/temperature-anomaly

Patrick, E. (2005). Intent to Destroy: The Genocidal Impact of Forced Migration in Darfur, Sudan. *Journal of Refugee Studies*.18, 4.

Patrick, S. (2020). The Multilateral Still Cannot Get Its Act Together Against Covid-19. https://www.cfr.org/blog/multilateral-system-still-cannot-get-its-act-together-covid-19

Patton Walsh, N. (2019). The Amazon is Burning. The Climate is changing. And We're Doing Nothing to Stop it. https://www.cnn.com/2019/09/04/americas/brazil-amazon-npw-intl/index.html

Paul, B. K. (1998). Coping Mechanisms Practiced by Drought Victims (1994/95) in North Bengal, Bangladesh. *Applied Geography*. 18, 355 –373.

Peace Insight. (2017). Bangladesh: Conflict Profile. https://www.peaceinsight.org/conflicts/bangladesh/

Pidcock, R. (2016). Greenhouse Gases Began Warming the World's Oceans in the Early 1800s, Decades Earlier Than Previously Thought, According to New Study. Carbon Brief. https://www.carbonbrief.org/scientists-clarify-starting-point-for-human-caused-climate-change

Pitney, J. (2020). Trump's Science Denial Is Un-American. Just Ask Benjamin Franklin and Thomas Jefferson. https://www.usatoday.com/story/opinion/2020/04/28/coronavirus-trump-flouts-science-core-american-value-column/3033941001/

Rahman, A., Biswas, P.R. (1995). Devours Resources. Dhaka Cour. 11, 42, 7–8.

Rahman, M.R., Lateh, H. (2017). Climate Change in Bangladesh: A Spatio-Temporal Analysis and Simulation of Recent Temperature and Rainfall Data Using GIS and Time Series Analysis Model. *Theory Application Climatol*. 128, 27–41. https://link.springer.com/article/10.1007%2Fs00704-015-1688-3

Rashiduzzaman, M. (1997). Political Unrest and Democracy in Bangladesh. Asian Survey. 37, 254-268. https://as.ucpress.edu/content/37/3/254

Raleigh, C., Jordan, L., Salehyan, I. (2008). Assessing the Impact of Climate Change on Migration and Conflict. World Bank Group for the Social Dimensions of Climate Change Workshop. 5-6.

Redclift, M., Grasso, M. (2013). *Handbook on Climate Change and Human Security*. Edward Elgar Publishing.

Redman, C. (1999). *Human Impact on Ancient Environments*. The University of Arizona Press.

Reuveny, R. (2007). Climate Change Induced Migration and Violent Conflict. *Political Geography*. 23, 6, 656-673. https://doi.org/10.1016/j.polgeo.2007.05.001

Reza, A. (2014). Drought in Northern Bangladesh: Social, Agroecological Impact and Local Perception. *International Journal of Ecosystem*. 4, 3, 150-158. doi: 10.5923/j.ije.20140403.07

Ricks, J., Liu, A. (2018). Process-Tracing Research Designs: A Practical Guide. *Political Science and Politics.* 58, 8, 42-846. https://ink.library.smu.edu.sg/soss_research/2521

Roser, M., Ritchie, H. (2020). Food Supply. Our World in Data. https://ourworldindata.org/food-supply

Ross, M. L. (2004). What Do We Know about Natural Resources and Civil War?. *Journal of Peace Research*, 4, 3, 337–356. https://doi.org/10.1177/0022343304043773

Sachs, J. (2007). Poverty and Environmental Stress Fuel Darfur Crisis. *Nature.* 449, 24. https://doi.org/10.1038/449024a

Scheffran, J., Brzoska, M., Link, J., Link, P. (2012) Climate Change and Violent Conflict. *Science*. 336, 869. https://science.sciencemag.org/content/336/6083/869.abstract

Scheffran, J., Link, P., Schilling, J. (2009). Theories and Models of the Climate-Security Link. https://www.researchgate.net/publication/228417148_Theories_and_models_of_the_climate-security_link

Schewe, J., Heinke, J., Gerten, D. (2014). Multimodel Assessment of Water Scarcity Under Climate Change. *Proc Natl Acad Sci USA*. 111, 3245–50. https://www.thelancet.com/action/showPdf?pii=S0140-6736%2815%2960854-6

Sekeris, P. (2015). The Tragedy of the Climate Commons. https://www.project-syndicate.org/commentary/tragedy-of-the-climate-commons-by-petros-sekeris-2015-06?barrier=accesspaylog

Seter, H. (2016). Quantifying the Influence of Climate on Human Conflict. *Political Geography.* 53, 1, 9. https://www.sciencedirect.com/science/article/abs/pii/S0962629816000032

Shahid, S. (2010). Probable Impacts of Climate Change on Public Health in Bangladesh. *Asia Pacific Journal of Public Health*. 22, 3, 310–319. https://journals.sagepub.com/doi/10.1177/1010539509335499

Shetty, S. (2019). Amnesty International. Most Dangerous Journey: What Central American Immigrants Face When They Try to Cross the Border. https://www.amnestyusa.org/most-dangerous-journey-what-central-american-migrants-face-when-they-try-to-cross-the-border/

Siegler, K. (2019). Rethinking Disaster Recovery After a California Town is Leveled by Wildfire. NPR. https://www.npr.org/2019/05/28/724404528/rethinking-disaster-recovery-after-a-california-town-is-leveled-by-wildfire

Sirin, C. (2011). Scarcity-Induced Domestic Conflict: Examining the Interactive Effects of Environmental Scarcity and 'Ethnic' Population Pressures. *Civil Wars.* 13, 2,122-140. https://www.tandfonline.com/doi/abs/10.1080/13698249.2011.576141

Smith, P. (2007). Climate Change, Mass Migration, and the Military Response. *Orbis*. 51, 617-633.
https://www.sciencedirect.com/science/article/abs/pii/S0030438707000786?via%3Dihub

Soergel, A. (2020). States Competing in 'Global Jungle' for PPE. U.S. News.
https://www.usnews.com/news/best-states/articles/2020-04-07/states-compete-in-global-jungle-for-personal-protective-equipment-amid-coronavirus

Sova, C. (2017). The Fist Climate Conflict. World Food Program USA.
https://www.wfpusa.org/articles/the-first-climate-change-conflict/

Spratt, D. (2016). Climate Reality Check: After Paris Counting the Cost.
https://www.breakthroughonline.org.au/publications
See also: https://reneweconomy.com.au/warming-past-1-5c-quantifying-our-faustian-bargain-with- fossil-fuels-24784/

Stalley, P. (2003). Environmental Scarcity and International Conflict. Conflict Management and Peace Science. 20, 2, 33–58.
https://journals.sagepub.com/doi/10.1177/073889420302000202

Strand, H., (2006). 'Onset of Armed Conflict: A New List for the Period 1946–2004, with Applications', Reassessing the Civil Democratic Peace, PhD thesis, Department of Political Science, University of Oslo & Centre for the Study of Civil War, PRIO.
https://www.prio.org/global/upload/cscw/data/onset.pdf

Straus, Scott (2015). *Making and Unmaking Nations: War, Leadership, and Genocide in Modern Africa.* Cornell University Press.

Stripple, J., Bulkeley, H. (2013). *Governing the Climate*. Cambridge University Press.

Sultan B., Lalou R., Amadou S., Oumarou A. (2017). *Rural societies in the face of climatic and environmental changes in West Africa*. IRD Orstom.

Szayna, T. O'Mahony, A., Kavanagh, J. Watts, S., Frederick, B. Norlen, T. Voorhies, P. (2017). *Understanding Conflict Trends: A Review of the Social Science Literature on the Causes of Conflict.* RAND Corporation.
https://www.rand.org/content/dam/rand/pubs/research_reports/RR1000/RR1063/RAND_RR1063.pdf

The Borgen Project. (2017). 10 Facts About Poverty in Bangladesh.
https://borgenproject.org/10-facts-about-poverty-in-bangladesh/

The Economist. (2018). Why Climate Migrants Do Not Have Refugee Status.
https://www.economist.com/the-economist-explains/2018/03/06/why-climate-migrants-do-not-have-refugee-status

Theisen, M., Helge, H., Buhaug, H. (2013) Drought, Political Exclusion, and Civil war. Oslo Centre for the Study of Civil War, PRIO, Under Journal Review.

Themnér, L., Wallensteen, P. (2013). Armed Conflicts, 1946–2012. *Journal of Peace Research*, 50, 4, 509–521. https://journals.sagepub.com/doi/10.1177/0022343313494396

Trombetta, M. (2008). Environmental Security and Climate Change: Analyzing the Discourse. *Cambridge Review of International Affairs*. (21,4, 585-602) https://www.tandfonline.com/doi/full/10.1080/09557570802452920

Uddin, N. and Firoj, M. (2013). "Causes and Consequences of Rural- Urban Migration in Bangladesh: An Empirical Study in Chittagong City". *International Journal of Ethics in Social Sciences*. 1, 1, 89-104.

Union of Concerned Scientists. (2011). Climate Hot Spot Map. https://www.climatehotmap.org/global-warming-locations/

United Nations. (1998). Guiding Principles on Internal Displacement. https://www.unocha.org/sites/dms/Documents/GuidingPrinciplesDispl.pdf

United Nations. (2007). A Climate Culprit in Darfur. https://www.un.org/sg/en/content/sg/articles/2007-06-16/climate-culprit-darfur

United Nations. (2015). Adoption of the Paris Agreement. https://www.un.org/ga/search/view_doc.asp?symbol=FCCC/CP/2015/L.9/Rev.1&Lang=E

United Nations. (2020). Climate Change. https://www.un.org/en/sections/issues-depth/climate-change/

United Nations. (2019). Drought Pushing Food Prices Sharply in Africa. https://www.un.org/africarenewal/news/drought-pushing-food-prices-sharply-east-africa

United Nations. (2020). The Paris Agreement. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

United Nations. (2020). World Migration Report. https://www.un.org/sites/un2.un.org/files/wmr_2020.pdf

UN Refugee Agency. (2020). Sudan. http://reporting.unhcr.org/sites/default/files/UNHCR%20Sudan%20Fact%20Sheet%20-%2013JAN20.pdf

University of Texas at Austin. (2020). Bangladesh Maps. https://legacy.lib.utexas.edu/maps/bangladesh.html

University of Texas at Austin. (2020). Sudan Maps.
https://legacy.lib.utexas.edu/maps/sudan.html

Van Evera, S. (1997). *Guide to Methods for Students of Political Science*. Cornell University Press.
www.jstor.org/stable/10.7591/j.ctvrf8bm7

Vince, G. (2019). The Heat is On Over the Climate Crisis. Only Radical Measures Will Work. The Guardian.
https://www.theguardian.com/environment/2019/may/18/climate-crisis-heat-is-on-global-heating-four-degrees-2100-change-way-we-live

Waldner, David. (2015). What Makes Process-Tracing Good? Causal Mechanisms, Causal Inference, and the Completeness Standard in Comparative Politics. In *Process-Tracing*. Cambridge University Press.

Washington Post. (2020). U.S. Intelligence Reports from January and February Warned About a Likely Pandemic.

Wallace-Wells, D. (2019). *The Uninhabitable Earth: Life After Warming*. Penguin Random House.

Walter, P. (2015). Floods and Rural-Urban Migration in Bangladesh.
http://labos.ulg.ac.be/hugo/wp-content/uploads/sites/38/2017/11/The-State-of-Environmental-Migration-2015-51-64.pdf

Werz, M., Conley, L. (2012). Climate Change, Migration, and Conflict.
https://www.americanprogress.org/issues/security/reports/2012/01/03/10857/climate-change-migration-and-conflict/

Woodward, A. (2020). Greta Thunberg Turns 17 Today. Here's How She Started a Global Movement in Just 18 Months.
https://www.businessinsider.com/greta-thunberg-bio-climate-change-activist-2019-9

World Bank. (2018). Climate Change Could Force Over 140 Million to Migrate Within Countries by 2050. World Bank Report.
https://www.worldbank.org/en/news/press-release/2018/03/19/climate-change-could-force-over-140-million-to-migrate-within-countries-by-2050-world-bank-report

World Bank. (2019). World Development Indicators.
https://datacatalog.worldbank.org/dataset/world-development-indicators

World Bank. (2020). Climate Data: Sudan.
https://climateknowledgeportal.worldbank.org/country/sudan/climate-data-historical

World Bank. (2020). Net Migration—Bangladesh.
https://data.worldbank.org/indicator/SM.POP.NETM?locations=BD&name_desc=false

World Bank. (2020). The World Bank in Bangladesh.
https://www.worldbank.org/en/country/bangladesh/overview

World Resources Institute. (2019). Africa.
https://www.wri.org/our-work/topics/africa

Worland, J. (2019). Donald Trump Called Climate Change a Hoax. Now He's Awkwardly Boasting About Fighting It. Time Magazine.
https://time.com/5622374/donald-trump-climate-change-hoax-event/

Zhang, J., Wang, D., Eldridge, A. L., Huang, F., Ouyang, Y., Wang, H., & Zhang, B. (2017). Urban-Rural Disparities in Energy Intake and Contribution of Fat and Animal Source Foods in Chinese Children Aged 4-17 Years. *Nutrients*. 9, 5, 526.

APPENDIX

Developing Countries Included in the Statistical Analysis

Afghanistan
Albania
Algeria
Angola
Antigua and Barbuda
Argentina
Armenia
Azerbaijan
Bangladesh
Belarus
Belize
Benin
Bhutan
Bolivia
Bosnia and Herzegovina
Botswana
Brazil
Bulgaria
Burkina Faso
Burundi
Cambodia
Cameroon
Cape Verde
Central African Republic
Chad
Chile
China
Colombia
Comoros
Congo
Congo, Democratic Republic
Costa Rica
Cuba
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Eritrea

Eswatini (former Swaziland)
Ethiopia (-1992)
Ethiopia (1993-)
Fiji
Gabon
Gambia
Georgia
Ghana
Grenada
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
India
Indonesia
Iran
Iraq
Jamaica
Japan
Jordan
Kazakhstan
Kenya
Kiribati
Korea, North
Korea, South
Kyrgyzstan
Laos
Latvia
Lebanon
Lesotho
Liberia
Libya
Lithuania
Madagascar
Malawi
Maldives
Mali
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia
Moldova
Mongolia

Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nepal
Nicaragua
Niger
Nigeria
North Macedonia
Pakistan (1971-)
Palau
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Portugal
Romania
Russia
Rwanda
Samoa
Sao Tome and Principe
Senegal
Serbia
Sierra Leone
Solomon Islands
Somalia
South Africa
South Sudan
Sri Lanka
St Lucia
St Vincent and the Grenadines
Sudan (-2011)
Sudan (2012-)
Suriname
Syria
Tajikistan
Tanzania
Thailand
Timor-Leste
Togo
Tonga
Tunisia
Turkey
Turkmenistan

Tuvalu
Uganda
Ukraine
Uruguay
Uzbekistan
Vanuatu
Venezuela
Vietnam
Yemen
Yemen, South
Zambia
Zimbabwe

CURRICULUM VITA

Erica Martinez holds a Bachelor of Arts degree in Political Science from the University of Texas El Paso. Her research interests focus on environmental policy, international relations, conflict analysis, and environmental justice for vulnerable populations. During her time as a graduate student she participated in several local environmental projects that focused on improving water access in border colonias by incorporating alternative water sources such as rainwater harvesting as solutions for water insecurity. Erica's other research projects include the study of air pollution in the El Paso/Juarez region, as well as how the challenges of implementing arsenic removal systems affect small water utility companies in the state of Texas.