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Climate Change and Intrastate Conflict in Africa

A Thesis

Presented to

The Faculty of the Josef Korbel School of International Studies

University of Denver

In Partial Fulfillment

of the Requirements for the Degree

Master of International Studies

by

Eli Margolese-Malin

August 2011

Advisor: Associate Professor Frank Laird

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Abstract

Africa has the dubious distinction of being the continent most likely to experience the worst climate change has to offer while having the population most vulnerable to its effects. Many of the continent's sub regions and countries also have recent histories of violence or are currently mired in conflict. Africa's proneness to conflict and its vulnerability to climate change provide the best model for showing how climate change, by the way it interacts with other, better understood drivers of conflict, will likely become an important source of conflict within the region and around the world over the rest of this century.

This paper's aim was to identify some possible causal pathways by which the effects of climate change might be linked to the outbreak of conflict. To achieve this, this paper sought to answer five main questions: 1) why do conflicts occur when and where they do? 2) How might climate change impact human societies in Africa? 3) Can those impacts lead directly to conflict occurrence, or 4) might they instead act indirectly, through other, more central drivers of conflict? 5) Should there be a climate-conflict relationship, can we build a model to identify potential future conflict 'hotspots' in Africa or around the world? By providing some answers to these questions, we were able to identify several possible climate-conflict pathways. We found that the economic impacts

of climate change, particularly on a country's agricultural sector and economy through direct disaster related damage do provide a realistic pathway to conflict in vulnerable countries as peoples' livelihoods are negatively impacted, the impacts are not equally shared among all ethnic groups, and the state itself may not be able to correct such imbalances.

The economic impact of climate change coupled with its negative impact on food and water security may also drive increased levels of migration, and with the movement of large numbers of people comes a greater probability of conflict. The impacts of climate change may also weaken states to the point that they can no longer provide basic services demanded by its population, leading to a loss of legitimacy and potentially the rise of rebellion. The pace of climate change can also affect the likelihood of conflict occurrence with more rapid pace developments and disasters being more likely to cause conflict due to less possibility of successful adaptation. In each pathway, climate change acts as a threat multiplier, acting through other sociopolitical, economic, democratic, security and systemic drivers to increase the likelihood of conflict, rather than driving conflict outright.

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Introduction

To an outsider, the outbreak of violence within or between communities might appear to have come from nowhere; one minute, people are living together peacefully, the next, they are at each others' throats. It is as if someone had turned a dial from 'peace' to 'conflict.' But talk to the people involved, ask them why they fight, and you will find that the outbreak of violence was neither spontaneous nor random. Instead, the people will likely point to a long list of grievances against and transgressions by an opposing party that often stretch back generations. Such lists are used by combatants to rationalize their actions and to mobilize more people to their cause, but the existence of grievances, transgressions, and even deep-rooted animosities cannot, in and of themselves, explain why conflict occurs when and where it does, as there are many examples of societies wracked by group grievances where violent conflict fails to manifest. And there are many societies that, while having suffered violent conflict in the past have managed to remain peaceful for decades or even centuries afterwards. Group grievances, therefore, are only part of a complex and tangled web of factors that can turn our hypothetical dial to conflict.

Underlying every conflict, violent or nonviolent, large or small, are a number of driving factors (*drivers*) that can influence, if not outright determine, the who (*actors*), what (*type of conflict and intensity*), where (*territory affected*), when (*timing and*

duration), why (*reasons*), and how (*mobilization* and *resources*) of conflict occurrence.

Thus, the key to understanding, halting and even preventing violent conflict is to identify the primary drivers involved, to map the causal pathways leading from each driver to conflict and to establish the basic ‘who what here when and why’ of the given situation. But such identification and mapping is rather difficult, as the drivers and pathways tend to be complex, indirect, interdependent, and case-specific in nature. It should come as little surprise then despite the vast amount of scholarship and research devoted to the task, that there remains a great deal of uncertainty and disagreement over the reasons why conflicts occur when and where they do.

Conflict researchers use a number of different qualitative and quantitative approaches to identify the drivers of conflict, and to date have found a whole host of demographic, economic, security, sociopolitical and systemic drivers that may or may not be behind the world’s violent conflicts. Despite these efforts, the exact relationship between many drivers and violent conflict remains rather murky. Murkiest of all is the relationship between environmental change and conflict. This shortfall is unfortunate as it is becoming clear our changing climate poses a grave challenge to the wellbeing and development of communities, societies, and countries around the world. Given that, as we will see, there are a number of compelling arguments as to why environmental changes and climate change in particular, may increase the possibility of violent conflict, it seems important to clear away the remaining murk.

The possibility of more frequent and more damaging weather related disasters, increasing food and water scarcities, and growing floods of environmental migrants and

refugees in the future is very real, and may be here already, though it is impossible to tell whether specific events are being driven by climate change or are ‘natural’ events.¹ Such impacts can strain the resources of even the strongest states; therefore, it is imperative to tease-out any causal pathways that may exist between climate change and the outbreak of violent conflict. By doing so, we can better identify leverage points for future interventions to reduce the possibility of conflict should the international community’s attempts to mitigate serious climate change fail—which appears all too likely. Our ability to find these leverage points hinges on our ability to answer several important questions: first, what does the existing literature say about why conflicts occur when and where they do (generally)? Second, how might the effects of climate change impact human societies, particularly those seen as most vulnerable today? Third, could those impacts lead directly to violent conflict? Or, might they instead act as *indirect drivers*, acting through more *direct drivers* of conflict? Finally, can we model the climate-conflict relationship so that we can identify potential ‘hotspots’ for future conflicts around the world?

The African continent is one of the most conflict-prone regions of the world (see Section 1.2 and Section 1.3) and is widely believed to be the region most susceptible to the effects of climate change (see Section 3.2) due to its ecological fragility, the low levels of human development across much of the continent, the number of *fragile* and *weak states* it contains, and the size, growth and distribution of its population. Africa, based on recent climate forecasts, is also expected to endure some of the more extreme climate changes in the world (outside the poles) over the rest of this century—together,

¹ The extent to which global climate change has been or is affecting our weather remains controversial

these characteristics make Africa the best place to start in our attempt to answer the questions posed above. Alongside a more theoretical and general approach to identifying and mapping the drivers of conflict and the linkages between climate change and conflict, this paper will also look at current and past conflict trends in Africa, examine the reasons behind the continent's greater vulnerability to climate change and the likely consequences it will have on human societies throughout the region, and whether these consequences could spark new conflicts or reignite dormant ones.

Section one of this paper looks at how conflicts are defined and measured, and reviews recent and historical conflict trends around the world and in Africa in particular. Section two provides a framework for understanding the causes of conflict and details the causes of conflict field's current understanding of conflict drivers. The third section underscores Africa's vulnerabilities to climate change, the current climate forecasts for the continent's regions, and their implications for African societies. Section four contains the central analysis of this paper; it seeks to identify the linkages, both direct and indirect, between climate change and conflict. Sections Five and Six then use these findings to construct a conceptual model for forecasting climate related conflicts and makes the case for establishing a climate-conflict early warning system so that more targeted adaptive measures might be taken to forestall climate-related conflicts—or at the least, to ease climate-driven hardship.

Section 1: Background

What do we mean by the term ‘conflict’? How are conflicts measured? How many conflicts have there been in recent years? What has been their distribution, both in terms of time and space? Section 1.1 overviews the definitions of conflict most often used in causes of conflict analysis. Section 1.2 describes conflict trends around the world from 1946 to 2010, while section 1.3 looks at conflict trends in Africa only, from the end of the Cold War to today (1990-2010).

Section 1.1 Giving a Name to Conflict

Analyzing trends in conflict occurrence and duration is an essential first step in any attempt to identify the general underlying factors that may drive conflict. By such analysis, one should be able to find common drivers even among very different seeming conflicts. A number of organizations now track global and regional conflict trends. The reports they produce identify the actors involved and their goals (if known), the intensity of the conflict, and how the conflict has evolved over time. This provides vast data sets for those interested in studying the causes of conflict, but such reports and associated data also raise the seemingly simple question of what one means by the term ‘conflict’. How do we define and measure it? Are nonviolent conflicts included? Or is only organized,

systematic violence considered a conflict? Do we measure conflicts by the number of deaths incurred? The economic toll inflicted? And how do we distinguish one type of conflict from another? These are all important questions for understanding the causes of conflict, as the methodology(s) and definition(s) used to answer them will color any patterns found.

The most widely used definition of intrastate conflict comes from the Uppsala Conflict Data Program. Uppsala researchers define armed conflict as a contested incompatibility or disagreement over the form of government or control over territory where armed force occurs between at least two parties—one of which must be a state government, and one a non-state entity—that causes at least 25 battle related deaths in a year. To be considered an interstate conflict, the fighting must involve at least two state actors.² While this definition seems to have become the field standard, it does have some major limitations. It does not include massacres and genocides because the victims of the violence are unarmed and unorganized (usually), nor communal riots and pogroms, as there is no government involvement (at least not direct involvement).

While many causes of conflict researchers use the Uppsala definition verbatim, others take it as a starting point for building their own definitions. Wallensteen and Sollenberg, for example, add a severity ranking to their definition, where *minor armed conflicts* are those that result in at least 25 battle-related deaths per year (BRDPY) but less than 1,000 total deaths over the course of the entire conflict. *Intermediate armed conflicts* are those with BRDPYs of more than 25 but less than 1,000 and that result in at

²L. Harbom and P. Wallensteen, “Armed Conflicts, 1946-2009,” *Journal of Peace Research* 47, no. 4 (2010): 501-509.

least 1,000 deaths over the lifespan of the conflict. *War* includes those conflicts with BRDPYs over 1,000. Together, *intermediate armed conflict* and *war* form the category *major armed conflict*.³ Eldadawi and Sambanis define civil war as a violent conflict resulting in more than 1,000 total deaths where an organized non-state actor challenges the sovereignty of an internationally recognized state, where the fighting takes place within the state's territory and where the combatants were concerned with having to live together after the conflict is over, i.e. must be a non-secessionist conflict.⁴ This last criterion may not be very helpful, as it would seem the aim of many civil wars is to secede from the current political unit rather than remain within it. Separating civil wars and wars of independence may be splitting hairs a little too finely. Byman and Van Evera also use the thousand-death threshold, but add the condition that the combatant parties must be geographically contiguous in order to exclude colonial wars.⁵

These definitions of conflict all tend to be rather precise in their requirements, and therefore limit the types of conflict included. The definition used by the Heidelberg Institute for International Conflict Research (HIICR), on the other hand, is much broader, and includes non-violent as well as violent incidents and drops the requirement that state actors be directly involved. The HIICR defines conflict as a clash of some duration and magnitude between two or more parties with ideational and positional differences over

³ Peter Wallensteen and Margareta Sollenberg, "Armed Conflict, 1989-2000," *Journal of Peace Research* 38, no. 5 (2001): 629 -644.

⁴ I. Elbadawi and N. Sambanis, "How Much War Will We See? Estimating the Prevalence of Civil War in 161 Countries, 1960-1999," *Journal of Conflict Resolution* 46, no. 3 (2002): 307-334.

⁵ D. Byman and S. Van Evera, "Why They Fight: Hypotheses on the Causes of Contemporary Deadly Conflict," *Security Studies* 7, no. 3 (1998): 1-50.

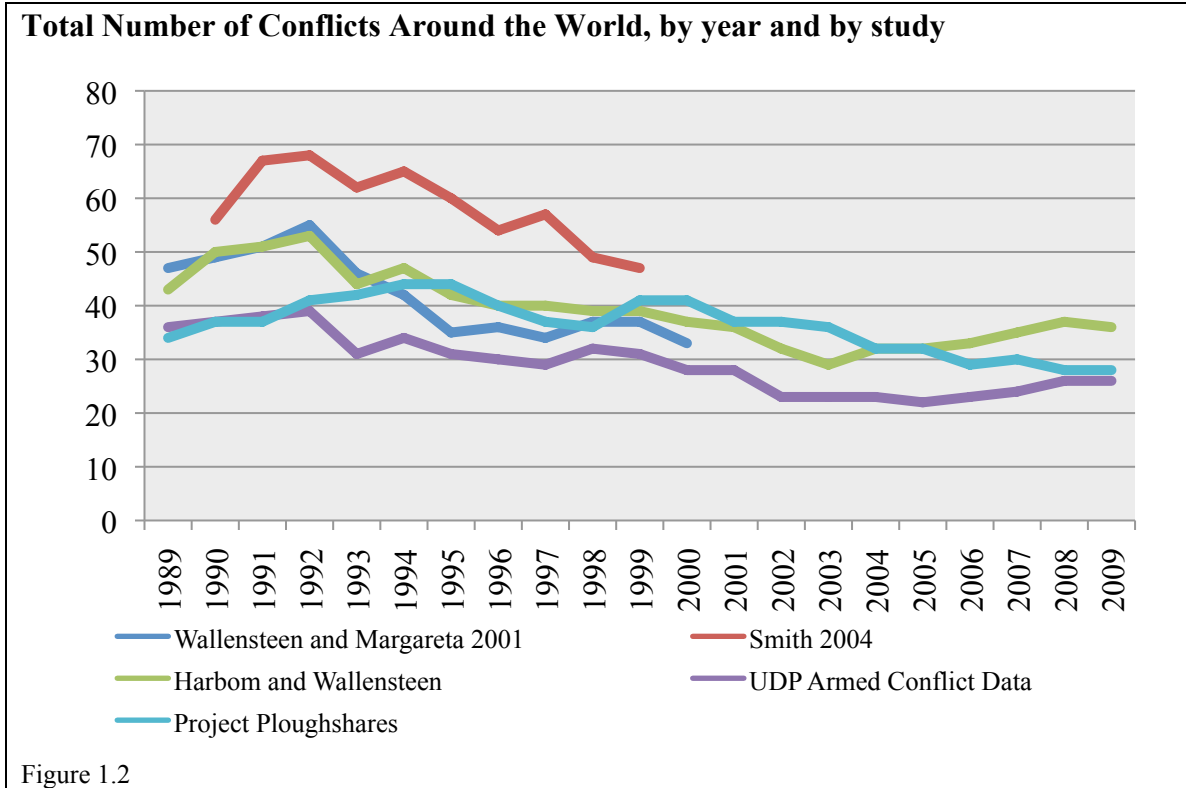
national values and that are determined to pursue their own goals. To organize their conflicts, the HIICR uses a five-point intensity scale where conflicts of intensity 1 to 2 represent non-violent conflicts (*latent* and *manifest*), 3 through 5 violent conflicts (*crisis*, *severe crisis*, and *war* respectively). *Latent conflicts* are those where a party has made demands for change and an opposing party at least takes those demands as serious; *manifest conflicts* are those situations which may be on the verge of violence, includes: intergroup pressure, threats of violence, economic sanctions, boycotts, etc. A *crisis* occurs when armed force is used in a sporadic fashion by at least one party; a *crisis* becomes *severe* if force is used repeatedly and in an organized way; *war* is a violent conflict in which force is used with a certain continuity and in an organized and systematic way, where the extent of destruction and loss of life is massive and of long duration.⁶ As opposed to earlier definitions, HIICR's may be overly broad, and certainly raises some questions about how one might measure these criteria—but the HIICR is careful to provide a detailed description of their methodology.

Other organizations, like USAID, eschew any set definition of conflict and avoid identifying conflict typologies due to the complex nature of conflicts in general, preferring to focus on the underlying causes of conflicts in general, regardless of conflict severity⁷—after all, conflict prevention relies on early detection of conflict generating conditions and it is hard to know how a conflict will evolve once it begins.

⁶ HIICR, *Conflict Barometer 2009*, Annual Flagship Report, Conflict Barometer (University of Heidelberg: Heidelberg Institute for International Conflict Research, 2009).

⁷ USAID, *Conducting a Conflict Assessment: A Framework for Strategy and Program Development*, Conflict Management and Mitigation (Washington, DC: USAID, 2005).

Section 1.2 A History of Violence Around the World



Given the various definitions of conflict currently in use, the organizations and researchers that provide comprehensive accountings of modern conflicts tend to produce different numbers when it comes to the total number of conflicts recorded over a given period of time and in a given region. Therefore, this section will provide a summary of historical and recent trends in conflict occurrence, nature, and duration rather than detailing the exact number of conflicts year to year, though section 1.3 on conflict in Africa will provide a more detailed look at conflict trends within Africa.

Several major trends dominate the conflict record from 1946 to 2009. The first is the impact of the ending of the Cold War both on the number of conflicts and the type of conflicts experienced. The second trend is a growing regional concentration of conflicts,

with the bulk of conflicts increasingly limited to certain regions of the world. The third trend is that conflicts are becoming increasingly complex, as more recent conflicts have come to include more than two actors, and a final trend is the rising number of conflict reoccurrences as opposed to new conflict outbreaks.

From 1946 to 1992, the number of violent conflicts worldwide increased steadily, reaching an all time high in 1992. But after 1992, with the shockwaves of the Soviet Union's collapse beginning to dissipate, the number of conflicts underwent a sharp decline. But the drop in the overall number of conflicts appears to have bottomed out by the early 2000s. In 2003, the number of conflicts began to rise again, and by 2009, the number of active conflicts had increased by 24% over the 1992-2003 trough.⁸ Along with a general decline in the number of conflicts after 1992, the post Cold War period also saw a shift in the type and intensity of the new conflicts that occurred. Before 1992, interstate conflicts were the dominant form of conflict around the world, with colonial wars for independence being the most common and deadliest form of interstate conflict⁹ between 1946 and 1961.¹⁰

As the Cold War and the wars for independence came to an end, intrastate conflicts gradually become the norm. These conflicts tended to have much smaller death tolls than interstate conflicts, but they also had a disproportionate impact on civilians¹¹.

⁸ Harbom and Wallensteen, "Armed Conflicts, 1946-2009."

⁹ Counted either as interstate or extrastate

¹⁰ Human Security Center, *Human Security Brief 2006*, Annual Flagship Report, Human Security Brief (University of British Columbia: Human Security Center, 2006).

¹¹ According to Marshall and Cole (2009) the magnitude of conflict in terms of lives lost and economic losses incurred decreased by 60% since peaking in the 1980s, reaching the lowest levels since 1960 in 2009. M. G Marshall and B. R Cole, *Global Report 2009*:

Interestingly, the intensity (in terms of lives lost) of one-sided violence like acts of genocide, massacres, and pogroms reached its lowest level since 1989 during the 2005 to 2008 period, after undergoing a major surge from 1993 to 1998.¹²

The shift from interstate to intrastate conflicts coincided with a greater regional concentration of conflict. Africa and Asia have accounted for the majority of conflicts around the world, especially after the 1960s, and continue to remain the regions most affected by conflict today. Africa, by itself, accounts for far and away the majority of non-state conflicts, with the number of conflicts on the continent peaking in 1992 to 1993, and again in 2000 to 2003. Asia endured the second highest number of conflicts, though from 2001 to 2005, Latin America was a very close third; after 2005, Asia's lead widened significantly.

Along with greater regional concentration, the shift to intrastate conflict also coincided with an increase in conflict complexity. In the 1970s, only 10% of all recorded conflicts involved more than two actors (or multiple dyads), with the majority of conflicts consisting of state versus state or state versus a single armed rebel faction. By 2003, over 30% of all conflicts were fought between multiple rebel factions and states, with some conflicts involving four or more distinct rebel movements.¹³ The growth in multiple dyad conflicts and in overall conflict duration during the 1980s can probably be linked to third

Conflict, Governance, and State Fragility (George Mason University: Center for Systemic Peace and Center for Global Policy, 2009).

¹²Uppsala Conflict Data Program, "Definition of Armed Conflict - Uppsala University," *Department of Peace and Conflict Research*, n.d., http://www.pcr.uu.se/research/ucdp/definitions/definition_of_armed_conflict/ (accessed July 24, 2011).

¹³Harbom and Wallensteen, "Armed Conflicts, 1946-2009."

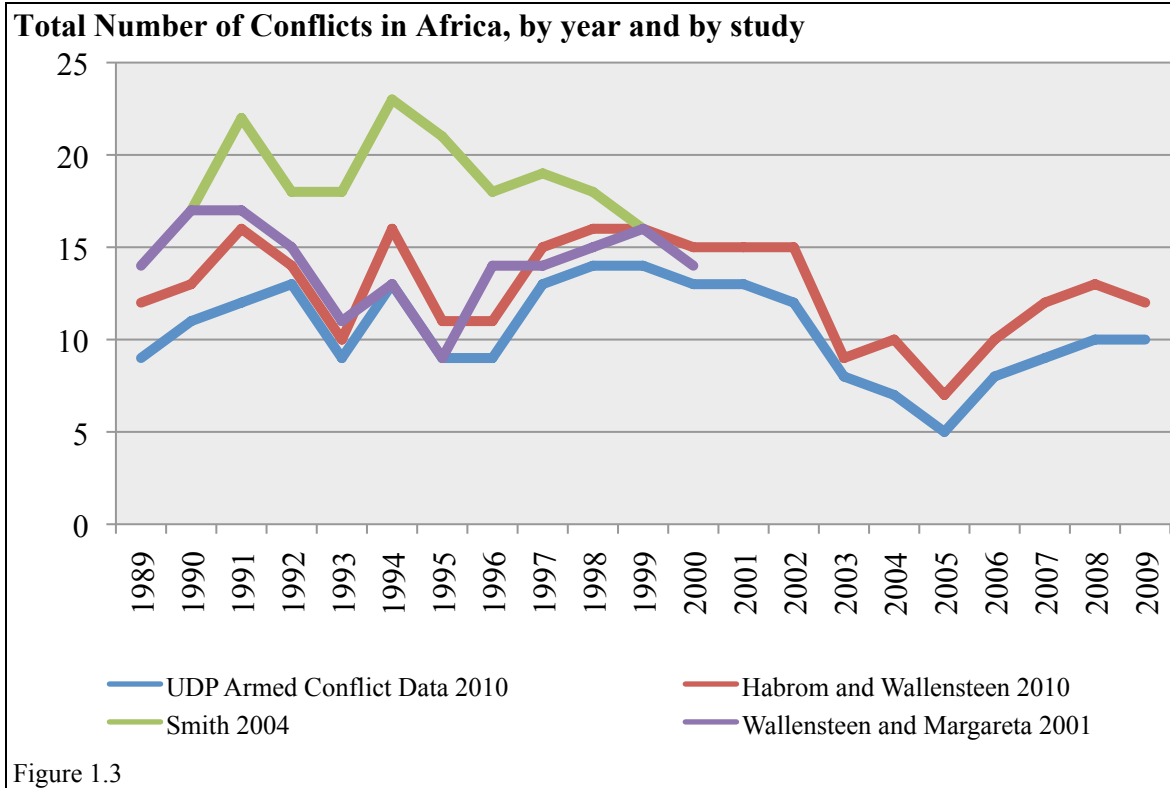
party intervention (i.e. the US and USSSR) via funding, arming and training rebel factions. Post Cold War, however, increasing conflict complexity would seem to go hand in hand with the growing number of fragile and weak states around the world, and the proliferation of small arms.¹⁴

Complex conflicts tend to be harder to resolve than more straightforward ‘one-on-one’ conflicts. They also tend to not stay ‘resolved’. From 2000 to 2010, the majority of conflict occurrences were actually reoccurrences of earlier conflicts (a reported ratio of 5 to 1), and of the conflicts that have ended since 2000, 2/3rds were also conflict reoccurrences.¹⁵

¹⁴ See Section 2

¹⁵ J Hewitt, Ted Gurr, and Jonathan Wilkenfeld, *Peace and Conflict 2010: Executive Summary* (University of Maryland: Paradigm Publishing, 2010).

Section 1.3 A History of Violence in Africa



Conflict trends in Africa largely mirrored global trends over the last half-century, with the continent seeing increasing numbers of conflicts throughout the 1950 to 1990 period, as the process of decolonization and the Cold War shaped the Africa’s geopolitical landscape. During the end of colonial period and early Cold War, nearly one-fourth of all countries in Africa were affected by conflict (not counting wars for independence). By the late Cold War in the 1980s, more than half of all countries were currently or had recently been affected by conflict¹⁶, and many of those had multiple conflicts going on at once. As with most regions of the globe, conflict in Africa reached

¹⁶S. Fukuda-Parr et al., “The Conflict-Development Nexus: A Survey of Armed Conflicts in Sub-Saharan Africa 1980-2005,” *Journal of Peacebuilding and Development* 4, no. 1 (2008): 1–16.

its peak in terms of both numbers and lives lost in 1992 and 1993, and saw some declines in overall numbers after 2004.¹⁷ Like the rest of the globe, the general trend has been away from interstate to intrastate conflict, though true interstate conflicts were never very common in Africa as compared to most other regions. Of the 126 different conflicts recorded by the UCDP/PRIO Armed Conflict Dataset, all but six were armed intrastate conflicts.¹⁸ And unlike most other regions, a number of countries in Africa have actually expanded their cross-border military activities, though whether this will mean a rise in interstate conflict is unclear. Conflicts in Africa tend to be particularly complex and long lasting. Many countries have been host to multiple independent conflicts at once, and many conflicts have spilled over into regional wars (the Great Lakes, Southern Africa, Mano River Basin and Central East Africa)¹⁹ as rebel groups and state-actors not only crossed national borders but established themselves outside their home state.

¹⁷ Monty Marshall, *Conflict Trends in Africa, 1946-2004 a Macro-Comparative Analysis*, Report prep. for Africa Conflict Prevention Pool (ACPP) (Arlington, VA; London: Center for Systemic Peace; Department for International Development, 2006).

¹⁸ Fukuda-Parr et al., "The Conflict-Development Nexus."

¹⁹ Ibid

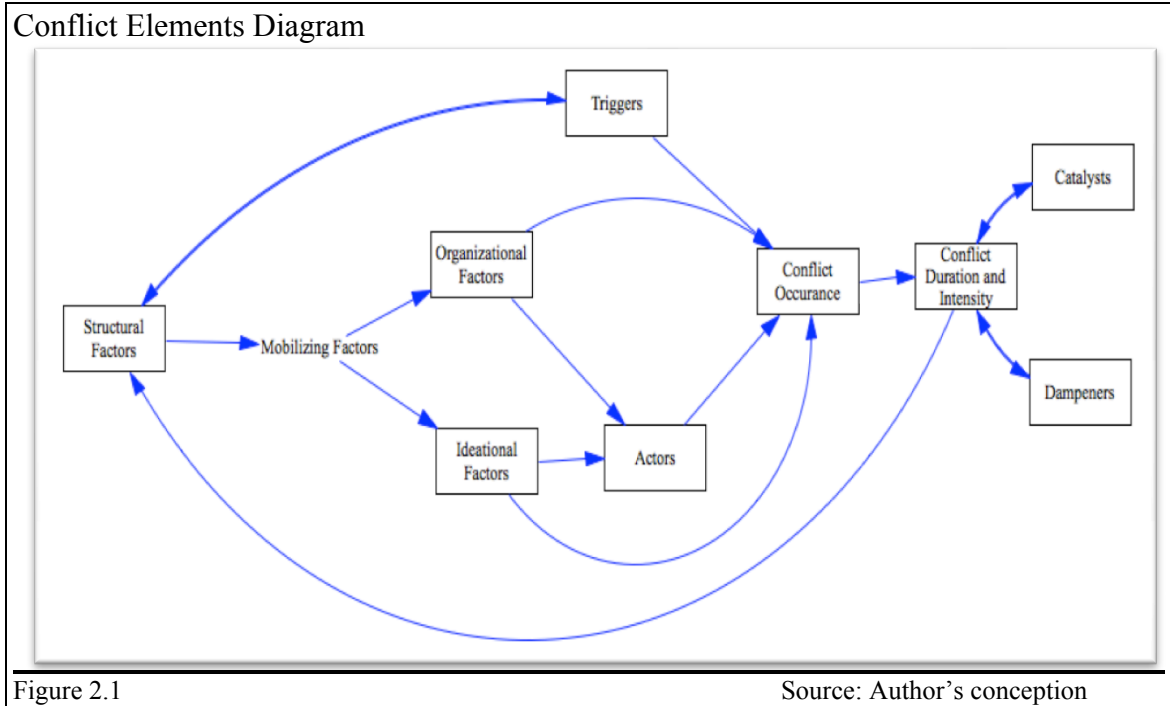
Section 2: Why Do Conflicts Occur When and Where They Do?

*Conflicts are historical, dynamic, and multi-dimensional, they have multiple causes and consequences of which a number are unexpected and unintended. They also involve a multitude of actors and have to be approached from different levels of analysis and intervention.*²⁰

The introduction to this paper talked about the importance and difficulty of answering the ‘who what where how and when’ of conflict occurrence in order to halt or prevent violent conflict. This section attempts to provide some answers to these questions, while keeping in mind the cautionary quote above. The 5 Ws and 1 H themselves suggest the best place to start our analysis: a conceptual framework where each interrogative represents certain factors that either give rise to conflict or governs how conflicts evolve. This broad framework will make the identification of individual conflict drivers much easier. The framework described below is made up of a synthesis of existing conflict frameworks and causes of conflict analysis. Six factors are used: *structural, mobilizing, actors, triggers, catalysts, and dampeners*. Each is described in detail below.

²⁰ P. Douma, G. Frerks, and L. Van de Goor, *Causes of Conflict in the Third World: Synthesis Report* (The Hague, 1998), vii.

Section 2.1 A Conflict Framework



Structural factors are the ‘why’ of conflict occurrence. They encompass a broad range of elements that in certain configurations create an environment conducive to conflict by giving rise to societal divisions and grievances. At their most general, structural factors are the characteristics of the systems in which we live: the culture, society, domestic and international political systems, and the natural environment. More often than not, we hardly notice the presence or effects of specific elements; it is only when these elements have a negative effect on our lives or livelihoods that they come to our attention—and, as we will see, declines in livelihoods can easily become a source of grievance for those affected towards the actor(s) and or system(s) seen to be responsible. Structural factors operate on many levels, from the local to the international, which together can create a complex web of interactions. Given the wide range of possible

structural factors, our primary focus here will be on those intra-national and international structures that tend to generate horizontal inequalities—social, political, and or economic inequalities between defined groups within a society rather than between income levels.²¹

The structural factors examined in this paper are organized into five categories: demographic, economic, sociopolitical, security, and systemic/other, each of which contains a number of individual conflict drivers.

Mobilizing factors represent a crossing over from the ‘why’ to the ‘who.’

Mobilizing factors address the question of why certain groups, when faced with divisionary structural factors become receptive to calls for violence as a means of solving their issues while other groups do not. There are two main types of mobilizing factors: *ideational and organizational*. *Ideational factors* are the set of beliefs, grievances, and greed held by an individual or group that together can make that individual or group more likely to engage in violent conflict. Ideational factors tend to be the direct result of structurally generated inequalities. But just because one group may harbor a strong dislike or even hatred for another, even if the group feels worse off than another, that doesn’t mean violence is the automatic outcome. Such groups still require mobilization.

Organizational factors are the *resources* and *opportunities* required to mobilize the masses. To undertake a campaign of sustained violence, a group must be able to mobilize both human and financial resources. The need for financial resources is obvious,

²¹ The notion of horizontal inequalities has largely been developed in D. Smith, “Trends and Causes of Armed Conflict,” in *The Berghof Handbook for Conflict Transformation*. (Berlin: Berghof Research Center for Constructive Conflict Management, 2003).^{and} F. Stewart, D. Holdstock, and A. Jarquin, “Root Causes of Violent Conflict in Developing Countries Commentary: Conflict—from Causes to Prevention?,” *British Medical Journal* 324, no. 7333 (2002): 342.

as any would-be rebel or militant group has to be able to acquire weapons and pay its fighters. Human resources, in this conception, come in two main types: the young men and boys that represent a group's recruitment pool, and the political entrepreneurs who exploit existing social cleavages in order to stir up resentment and violence between groups. Political entrepreneurs can both touch off a conflict and act as a catalyst (see below) by their tendency to become highly visible figureheads for one side or another, enhancing that side's ability to gather funding and recruits.²²

The term *mobilization strategy*, as used in the literature, concerns this ability of political entrepreneurs to frame structural factors in such a way as to further their own interests. *Mobilization strategies* also capture the ways in which groups themselves frame and understand structural factors, whether they see it as worth taking up arms or whether they might seek a more peaceful form of redress. *Organizational opportunities* meanwhile, are factors whose presence enhances the viability of the 'conflict option' while also potentially widening a conflict once it has begun. Example *organizational opportunities* include the presence of valuable and easily lootable natural resources, illicit drug production sites or distribution pathways, and a lack of security provision from the central government.²³

Actors represent the parties who drive conflict and suffer from it. Identifying all the potential actors in a conflict can be a daunting task. It requires identifying and analyzing the interests (goals, hopes, fears), relations, and capacities of local, national and international groups already involved or that may become involved as the conflict

²² Smith, "Trends and Causes of Armed Conflict."

²³ We will revisit each of these in Section 2.2

evolves. A given conflict may concern everyone from local tribal groups, to neighboring states, and even the United Nations.

Triggers are singular events or sudden shocks to a society or state that disrupt established structures, systems, and power relationships by enhancing uncertainty and inequality, and by weakening state capacity to respond to further shocks. Together these effects can push already aggrieved groups into violence, in other words, triggers make violent conflict a more attractive option than it was prior to the event. A triggering event, by itself, cannot explain the underlying reasons for a conflict, but it can explain why a conflict occurred at that particular moment and in that particular place. Triggers are therefore an essential part of conflict formation; they are the ‘when’ of conflict occurrence, they are what turn the proverbial dial from ‘peace’ to ‘conflict.’

Unfortunately, triggers are also the hardest factor for those who wish to prevent conflict to prepare for. Triggering factors go by a number of names in the literature: *windows of opportunity, proximate reasons, dynamics, etc.*²⁴ A natural disaster, an economic downturn, the assassination of a prominent politician, a looming election or the release of election results can all act as conflict triggers in certain situations.

Catalysts are a part of the dynamic nature of conflict. They are escalatory factors that can enhance a conflict’s intensity or size. Most often, catalysts come in the form of actions taken by the conflicting parties themselves that either intensify the conflict or make it that much harder to resolve. In intrastate conflicts where the state is involved, the

²⁴ USAID, *Conducting a Conflict Assessment: A Framework for Strategy and Program Development*. T. Ohlson, “Understanding Causes of War and Peace,” *European Journal of International Relations* 14, no. 1 (March 2008): 133-160. Marshall, *Conflict Trends in Africa, 1946-2004 a Macro-Comparative Analysis*.

most common catalyst tends to be the overly heavy or otherwise botched response of the government to a new-formed conflict. A government's failure to address a triggering event can also cause a nascent conflict to intensify. Also, the longer the conflict, the greater the chance that new catalysts come into play, creating a positive feedback loop, forcing the conflict ever larger. Examples of 'new' catalysts include: the development of a war economy and greater arms trade, increased human rights abuses, and the formation of radical or paramilitary groups, etc.²⁵

Dampeners are those factors whose presence could help bring the parties to a conflict to the negotiating table, or at least to deescalate from current levels of violence. Dampening factors include peace-building interventions from third parties, the mutual exhaustion of the parties involved (a hurting stalemate), or the loss of funding and or political backing by an outside party. But perhaps the most important dampening factor is a state's ability to maintain peace and stability inside its borders. A state's capacity is most often expressed in terms of security and especially human security. The question here is whether existing political, military, and economic institutions are able to remedy the factors driving the unrest—assuming they themselves are not completely responsible—if they can provide remedy, then it is a good chance the state itself can act as a dampener, but if it cannot or does not, its failure to do so may instead become a catalyst for further conflict.

²⁵ J. Goodhand, T. Vaux, and R. Walker, *Conducting Conflict Assessments Guidance Notes* (Department for International Development, 2002).

Section 2.2: Identifying the Causes of Conflict

*There are very few necessary conditions for war and very many sufficient conditions of which only a few of these may apply at a time.*²⁶

As the above conflict framework illustrates, violent conflicts tend to arise from a complex web of structural, mobilizing, and triggering factors whose linkages may not be readily apparent and may on the surface even appear contradictory. This can make identifying potential conflict ‘hotspots’ difficult. It can also make discerning the influence of non-standard factors like climate change on the array of preexisting drivers an even greater challenge. Therefore, the next step in addressing these challenges is to build a discreet set of the ‘most significant’ conflict drivers—also no easy task given the amount of disagreement that remains over just which the most important drivers might be—using the conceptual framework outlined above as a means of organization. The set of conflict drivers described in this paper are those most frequently cited as important in the causes of conflict literature. In general, the most frequently cited drivers all fall into the *structural factors* portion of the framework, which makes sense, as structural factors are the most easily quantified and measured of conflict components, as opposed to, say, ideational factors. The conflict drivers described below are grouped into four main categories: demographic, economic, sociopolitical, security. Each entry below includes a brief summary of the driver’s role (as best understood and keeping in mind the complex and overlapping nature of most drivers) in conflict formation as well as a list of authors who cite it in their studies.

²⁶ Smith, “Trends and Causes of Armed Conflict,” 5.

Section 2.2.a: Demographic Drivers

People are at the heart of any conflict, whether they are combatants or civilians caught in the middle. Thus, it would stand to reason that a society's demographic characteristics would be important and straightforward drivers of conflict. Demographic drivers include the primary characteristics of a given population: its size, distribution, density, rate of growth, and age and sex structures, as well as secondary characteristics like ethnic and religious diversity. Together, these characteristics should not only be important drivers of conflict, they should be essential in determining which groups might turn to violent solutions. That's how demographic drivers ought to behave, in reality, however, their exact role isn't so clear.

Population Size, Density, and Growth Rate: Nearly every study finds a strong correlation between the number of people living in a country and the probability of violent conflict: the more people, the greater risk of conflict occurrence. The effect of population density is slightly less clear. Most studies find density to be positively associated with conflict occurrence, but to a lesser degree than overall population size. Interestingly, the distribution of population densities may play a role. Countries with only a few areas of high density and a majority of rural areas may actually see less chance of conflict occur, whereas countries with more evenly distributed population densities may see a greater risk.²⁷

²⁷ J. Dixon, "What Causes Civil Wars? Integrating Quantitative Research Findings," *International Studies Review* 11, no. 4 (2009): 707–735.

Ethnicity: As Wimmer et al (2009) describe it, there are three standard schools of thought when it comes to the role of ethnic and religious diversity in driving conflict: the *greed-and-opportunity* school, the *diversity-breeds-conflict* school, and the *minority mobilization* school of thought. In the *greed-opportunity-school*, ethnic diversity is seen as an insignificant driver as the number of ethnicity related grievances around the world greatly outweigh the number of conflicts that do occur. More important than ethnicity, under this view, is the presence of a weak government and lootable goods that together allow for ethnic based mobilization that would otherwise have been tamped down. The *diversity-breeds-conflict* school holds that there is a direct connection between the level of ethnic diversity within a country and the probability of violent conflict, with higher levels of diversity making conflict more likely. The *minority-mobilization* school holds that ethnicity only matters under certain situations of minority discrimination and exclusion. Wimmer et al make the argument that all three schools fail to adequately address the role of the state in creating ethnic conflicts—rather than a high degree of diversity, it is the exclusion of ethnic groups from state power and group competition for state resources that drive conflict.²⁸

In general, most analysts have found that whether ethnic diversity actually becomes a driver of conflict depends on the amount of the diversity within the state, region, or community. Like other inverted-u drivers (regime type), ethnic diversity becomes a driver of conflict in ‘middle situations. I.e. the most conflict prone situation

²⁸ A. Wimmer, L.-E. Cederman, and B. Min, “Ethnic Politics and Armed Conflict: A Configurational Analysis of a New Global Data Set,” *American Sociological Review* 74, no. 2 (April 2009): 316-337.

occurs when a population includes a large majority ethnic group plus a sizable minority ethnic group; situations where the majority can't wholly dominate the minority and the minority can't overwhelm the majority. In highly diverse populations, on the other hand, no one ethnic group can dominate the others and there are plenty of groups to check the ambitions of other ethnic groups. In highly homogenous populations, ethnicity, as a conflict driver, naturally tends to fall by the wayside. The question is, what is the 'amount' of diversity needed for ethnicity to become a driver? Collier finds that the risk of conflict occurrence doubles when the majority group comprises between 45 to 90% of the population and the largest minority group makes up between 10 and 15%.²⁹ Gurr et al find that large countries with medium to high levels of diversity are five to eight times more likely to experience conflict than smaller or more homogenous countries, but they do not provide specific quantification.³⁰

Migration: The movement of peoples from one area to another has long been seen as a source of conflict as the arrival of new peoples to an area can disrupt established social and political systems. The arrival of migrants can also breed mistrust and ethnic division when the distribution of resources and power is at stake. Migration can also lead to the rise of Diaspora groups in other countries. Depending on size and economic clout, such groups can and have provided funding for parties involved in the conflict back home,

²⁹ P. Collier and A. Hoeffler, "Greed and Grievance in Civil War," *Oxford Economic Papers* 56, no. 4 (2004): 563.

³⁰ T. R Gurr, M. Woodward, and M. G Marshall, "Forecasting Instability: Are Ethnic Wars and Muslim Countries Different?," in *Annual Meeting of the American Political Science Association, September, 2005*, 1–4.

most often rebel groups.³¹ A number of push-pull factors go into determining when people move. Push factors are those economic, social, environmental and security factors present in a person's home country or region which may at least plant the seed for migration. Pull factors are present when conditions in a neighboring region or country are, or at least conceived, to be better than they are at home. Generally, both push and pull factors need to be present before people move.³² The exception to this is what is known as forced migration, where conditions in a person's home region or country are such that his or her life is in immediate danger.

Age and Sex Structure: A youth bulge occurs when young people between the ages of 15 and 29 make up a sizeable portion of a country's total population (usually pegged at 40% or more). Countries undergoing a youth bulge seem to be at greater risk for conflict than countries lacking such a demographic feature, one estimate suggests that youth bulge effected countries are 2.3 times more likely to experience conflict over a given time period than those countries without.³³ Recently, there is growing evidence that youth bulges tend to affect the intensity of conflict rather than the probability of conflict occurrence, with the greatest impact being on low intensity conflicts.³⁴ This makes sense

³¹ Collier and Hoeffler, "Greed and Grievance in Civil War."

³² F. Renaud, *Control, Adapt or Flee: How to Face Environmental Migration?* (United Nations University; Institute for Human Security, 2007).

³³ R. Cincotta, R. Engleman, and D. Anastasion, "The Security Demographic: Population and Civil Conflict After the Cold War (Washington, DC: Population Action International, 2003); and Bloom, Canning, and Sevilla," in *The Demographic Dividend* (Population Action International, 2002), 48.

³⁴ H. Hegre et al., "Predicting Armed Conflict 2010–2050," in *50th Annual Convention of the International Studies Association* (New York, 2009), 15–18.

as the presence of a youth bulge means that the various sides to a conflict have a larger recruitment base (cannon fodder) to draw from. Most countries have experienced youth bulges as they undergo the demographic transition towards becoming developed, as life spans increase but birthrates remain high.³⁵ Ateem finds that countries undergoing this transition tend to be 2.5 times more likely to experience civil war than other countries as, most often, economic growth is unable to keep up with the demand for jobs.³⁶

The general conclusion by a number of analysts as regards demographic drivers of conflict seems to be that democratic characteristics, while important, tend to only become conflict drivers when certain economic and sociopolitical conditions are present; they build off of other structural drivers instead of being a source of conflict themselves³⁷.

Section 2.2.b: Economic Drivers

Economic drivers encompass the structure and dynamics of a country's economy, as well as the material wellbeing of its population. Economic drivers are widely seen as the most important drivers of conflict,³⁸ as they are thought to underlie most types of

³⁵ R. Picciotto, "State Fragility and Human Security in Africa," in *Conflict Prevention and Development Co-Operation in Africa: A Policy Workshop*, vol. 10, 2010, 1–25.

³⁶ E. S.M Ateem, "The Root Causes of Conflicts in Sudan and the Making of the Darfur Tragedy," in *Conflict Prevention and Development Co-Operation in Africa: A Policy Workshop*, Country Case Study (presented at the Presentation to Wilton Park Conference, Wilton Park, Sussex, 2007).

³⁷ C. Raleigh and H. Urdal, "Climate Change, Environmental Degradation and Armed Conflict," *Political Geography* 26, no. 6 (2007): 674–694; Smith, "Trends and Causes of Armed Conflict." Wimmer, Cederman, and Min, "Ethnic Politics and Armed Conflict." J. D Fearon and D. D Laitin, "Ethnicity, Insurgency, and Civil War," *American Political Science Review* 97, no. 1 (2003): 75–90.

³⁸ Smith, "Trends and Causes of Armed Conflict." Collier and Hoeffler, "Greed and Grievance in Civil War."

conflict, especially ethnic and secessionist conflicts, given their tendency to generate intergroup grievances and competition. The existing literature on the economic causes of conflict—perhaps the most extensive of any driver category—provides some of the most straightforward relationships between driver and conflict, and as we will see in section four, they may also provide the key to establishing a link between climate change and conflict.

GDP and GDP Per Capita: high-income countries are less likely to experience conflict, all other things being equal. This relationship is perhaps the most widely accepted of any relationship of driver to conflict in this section. Researchers from Collier (2004) to Piccitto (2010) and Dixon (2009) have all found a very robust correlation between a state's income level and the level of violence it is likely to experience within its borders.³⁹ Piccitto, for example, found that states with a per capita GDP of US\$1,000 or less were 3 times more likely to experience conflict than those with per capita GDPs of US\$4,000 or more.

Over Dependence on Natural Resources or Agriculture: States with economies largely based on a single or on a few select resources like timber, oil, ores, and agricultural produce, tend to be overly vulnerable to price and trade shocks, which can

³⁹ Paul Collier, "Economic Causes of Civil Conflict and their Implications for Policy," in *Leashing the Dogs of War: Conflict Management in a Divided World*, ed. Chester Crocker, Fen Hampson, and Pamela All (Washington DC: United States Institute of Peace Press, 2007); J. Dixon, "What Causes Civil Wars? Integrating Quantitative Research Findings," *International Studies Review* 11, no. 4 (2009): 707–735; Piccitto, "Conflict Prevention and Development Co-Operation in Africa."

generate group resentments as economic shocks are more likely to affect certain segments of society—those lacking a financial cushion or other options for earning a livelihood—than others. But group grievances can also arise from such economic dependence even during the good times whenever the wealth generated by natural resources or produce are unequally distributed between groups, or whenever the extractive process used to obtain the resources produces localized pollution or forces the relocation of local populations⁴⁰. Dependence on natural resources and or agricultural production is most often measured by the percent of a country's GDP coming from primary commodity exports. Collier found that countries where 26% or more of their GDP comes from primary commodity exports are 23% more likely to experience conflict all other factors being equal. He argues that a country's reliance on easily lootable goods opens it up to the possibility of predatory (greed-based) rebellions.⁴¹

Economic downturns/poor growth/under development A weakening economy can be a major driver of conflict as slowdowns narrow the peaceful (and lawful) options for an individual to earn a livelihood. A 'shrinking pie' can also lead to elite competition for control over dwindling economic resources. Both of these outcomes can lead to conflict and each can also serve to reinforce the other.⁴² Ethnic violence and anti-immigrant sentiments often accompany economic downturns when once well established groups

⁴⁰ Syed Mansoob Murshed and Mohammad Zulfan Tadjoeeddin, "Revisiting the greed and grievance explanations for violent internal conflict," *Journal of International Development* 21, no. 1 (January 2009): 92.

⁴¹ Collier, "Economic Causes of Civil Conflict and their Implications for Policy."

⁴² Smith, "Trends and Causes of Armed Conflict."

begin to see a decline in their livelihoods or prospects;⁴³ such a decline can be relative or absolute, but relative declines would seem to be the most conducive to creating the conditions for ethnic based violence (see horizontal inequality below). Piccitto (2010) points out that during the period from 1980-2000, one third of the least developed countries were embroiled in intrastate and or interstate conflicts, and that of the 20 countries in 2002 ranked lowest in terms of the Human Development Index, 16 were currently in or had just emerged from violent conflict. Countries experiencing positive economic growth were 50% less likely to experience conflict than countries undergoing an economic contraction, as rapid economic growth raises the opportunity costs for would be fighters to join a rebellion.⁴⁴

Section 2.2.c Security Drivers

Security drivers are those factors that can affect the ability of a state to maintain a sense of order within its boundaries. They also represent the opportunities, or lack there of, for rebel groups to challenge the existing system(s).

History of Violence: the single greatest security-based driver of conflict (and most cited) is whether the state or society in question has experienced violent conflict in the recent past. Stewart (2002) finds that countries with a history of prior conflict are 40 to 50% more likely to experience either a new conflict outbreak or a reoccurrence of the old

⁴³ D. Bloomfield, Y. Gai, and B. Reilly, *Analyzing Deep-Rooted Conflict* (Stockholm: International Institute for Democracy and Electoral Assistance, 1998).

⁴⁴ Piccitto, "Conflict Prevention and Development Co-Operation in Africa."

conflict⁴⁵. The most obvious consequence of a country having endured a recent conflict is conflict reoccurrence, when one or more parties to the conflict decide that the post-conflict situation is not to their liking. But a history of violence can also lead to new conflicts: if the *structural factors* that lead to the initial conflict remain unaddressed, the chances are greater that a new conflict may emerge. The recent conflict could also make mobilizing groups for new violence easier as the past conflict likely generated new grievances over its lifetime.⁴⁶ Finally, the prior conflict likely had an adverse impact on the country's national economy and personal income,⁴⁷ which, as we've seen, can pave the way for new conflicts.

Rebel Opportunities: Fearon and Laitin (2003) suggest that wars are driven by military opportunity rather than questions of political legitimacy.⁴⁸ If this is true, then the existence of such opportunities may be strong drivers or at least indicators of future conflict. Included in this section is a wide array of factors that can make it harder for a state to maintain control over its territory and therefore might make it easier for rebel groups to form. One such factor that appears in many studies is the presence of mountainous terrain, poor road networks and jungles. Some researchers like Fearon and Laitin (2003) find that mountainous countries are more likely to experience civil wars

⁴⁵ Stewart, Holdstock, and Jarquin, "Root Causes of Violent Conflict in Developing Countries Commentary."

⁴⁶ Ibid., 344.

⁴⁷ Hegre et al., "Predicting Armed Conflict 2010–2050."

⁴⁸ Fearon and Laitin, "Ethnicity, Insurgency, and Civil War."

because of the cover such terrain lends to rebel fighters.⁴⁹ But other studies find no evidence of mountainous terrain as an explanatory factor.⁵⁰ The geographic distribution of a country's population may be more important than the particular type of terrain as a more wide flung populace would naturally be harder to control.⁵¹ The level of small arms available in the country is another potential rebel opportunity as the presence easily available weapons not only weakens the state's monopoly of force but also can generally lower the cost of resistance. Other rebel opportunities include: the presence of valuable and easily lootable resources which can provide a rebel movement with all the funding they'd need to challenge the state⁵²—this is covered more under the economic drivers category, material and monetary support by foreign rebels or other states, and the presence of cross-border safe havens.⁵³

State Strength and Level of Militarization: The first priority of any (healthy) state is to provide security for its people, to protect them from potential enemies, both foreign and domestic, and to keep criminal activity in check. The level of criminal violence in a country can be a good indicator of the state's strength; the inability to enforce its own laws and protect its citizens can also lead to grievances against the state and prompt various groups to take up arms for their own protection. The level of militarization in a country has a similar impact as the greater the presence of the state security apparatus, the

⁴⁹ Ohlson, "Understanding Causes of War and Peace"; Fearon and Laitin, "Ethnicity, Insurgency, and Civil War."

⁵⁰ Dixon, "What Causes Civil Wars?"

⁵¹ Collier and Hoeffler, "Greed and Grievance in Civil War."

⁵² Ohlson, "Understanding Causes of War and Peace," 139.

⁵³ Ibid.

more likely some group will become aggrieved or feel insecure, again increasing the likelihood of conflict rather than suppressing it.⁵⁴ But this effect goes the other way as well: if the level of militarization is so low that the state is no longer able to deter non-actors from challenging it or each other, then there will be a similar push by various groups to provide their own security, again increasing the likelihood of conflict.⁵⁵

Section 2.2.d: Sociopolitical Drivers

Sociopolitical drivers of conflict encompass a country's political system and the nature of relations between the state and its people. Sociopolitical drivers include: government/regime structure, democratization, weak state capacity, loss of state legitimacy, and elite intransigence.

Government/regime structure: Current literature exploring the relationship between government structure and the risk of conflict suggests that there exists an inverted-U relationship between the nature of a state's political structure and the likelihood of conflict. The inverted-u pattern runs from strong democracy on one side to strong autocracy on the other. Strong democracies and strong autocracies tend to be quite stable due to their capacity to control their populations. For democracies, control and stability is maintained through the combination of a monopoly on the use force, and their ability to become more inclusive or responsive to the demands of its people. For autocracies, it is

⁵⁴ R. I Rotberg, "Failed States, Collapsed States, Weak States: Causes and Indicators," in *State Failure and State Weakness in a Time of Terror* (Washington DC: Brookings Institution Press, 2003), 1–25.

⁵⁵ Byman and Van Evera, "Why They Fight," 37.

the monopoly of force coupled with their ability to ignore or crush dissent. It is when political systems move towards the middle of the U, either through attempts at democratization (for autocracies) or repression (for democracies) that the chance of violent conflict becomes greatest. Anocracies make up the middle of the U.

Anocracies are a transitional state between autocracy and democracy and tend to be the least stable form of government as any attempt to move from the middle can trigger conflict. Marshall and Cole, for example, find anocracies to be highly unstable, with 50% of those studied experiencing a major regime change within 5 years and 70% within 10. Over time, anocracies tend to be 6 times more likely to experience conflict than democracies and at least 2.5 times more likely than autocracies. Anocracies are also 3 times more likely to revert or move to an autocracy than to become a democracy.⁵⁶

Democratization: Democracies do not fight other democracies. This finding has almost become a truism in international relations. And while it does appear to be true that an established, strong democracy is likely to remain at peace both with other democracies and itself, the process of democratization is not so peace inducing. Indeed, democratization can be a primary driver of conflict. Byman and van Evera describe three main ways the democratization process might act as a conflict driver: when the political elites currently in power undertake violent measures to crush democratic movements in the hopes of retaining their own power, when minority groups worry that a democratic system might sideline them, reducing what power or privileges they might currently

⁵⁶ Marshall and Cole, "*Global Report 2009*."

enjoy, and when the democratization process opens the door for secessionist movements as their regions gain greater autonomy from the political center.⁵⁷ The DFID study of conflict trends provides a list of African countries that have experienced violent conflict triggered by efforts at democratization: the Central African Republic, Comoros, Congo Brazzaville, Guinea-Bissau, Ivory Coast, Lesotho, Niger, and Sierra Leone--each of these countries undertook a program of rapid democratization. Three countries, Burkina Faso, Djibouti and Tanzania took a much slower approach and remained largely peaceful.⁵⁸

Loss of State Capacity: A state is considered strong when it has the capacity to both maintain security within its borders and to provide (at the least) basic services for its people; such states are unlikely to experience violent intrastate conflict. Stewart describes state capacity as a *social contract*: the well functioning state, with its provision of services and a monopoly on the use of force, creates a favorable environment for economic advance and social stability, and in turn makes violent options less attractive. But when a state grows weak, when it is no longer able to uphold its *contract* and services lapse, instability and violence become more likely.⁵⁹ The question, then, is what causes states to lose capacity? The most likely causes are sudden shocks to the system: economic downturns that require a large amount of government resources, a surge in food or energy prices that make subsidizing staple goods impossible, and expensive

⁵⁷ Byman and Van Evera, "Why They Fight."

⁵⁸ Goodhand, Vaux, and Walker, *Conducting Conflict Assessments Guidance Notes*.

⁵⁹ Stewart, Holdstock, and Jarquin, "Root Causes of Violent Conflict in Developing Countries Commentary."

disasters⁶⁰. In other words, events that strain state resources may result in a long term or even permanent loss of capacity.

Loss of State Legitimacy: Intrastate conflicts do not occur without reason, and much of the reason would seem to hinge on whether a state's citizenry views the apparatus of state as legitimate. A legitimate state is one that meets the economic, security, and sociopolitical needs of its people—so long as potentially restive groups feel that they have a voice in political decision making, have a fair shot at making a decent living and feel secure, it is unlikely that any rebel group (should one form) will be able to attract enough of the polity to prove a challenge to the state. Thus, state legitimacy, as Douma et al point out, is strongly linked to the state's institutional capacity; as it gains or losses capacity, it also gains or loses legitimacy.⁶¹ The potential for violent conflict comes when a state begins to lose its legitimacy (assuming it had any to begin with). The causes of conflict literature identify several ways this can happen: poor economic performance, a lack of regime accountability, the rise of a restive class, and according to Byrn and Van Evera, the discrediting of state ideology as with the collapse of the Soviet Union.⁶² Once states see their legitimacy begin to erode, it can be difficult to regain it. Should a state push toward increased democratization, entrenched elites may come to oppose the broadening of access to power and the possibility of a tyranny of the masses becomes

⁶⁰ We will revisit each of these shocks and their role in generating conflict in Section Four

⁶¹ Douma, Frerks, and Van de Goor, *Causes of Conflict in the Third World*.

⁶² Byman and Van Evera, "Why They Fight."

greater.⁶³ Should a state instead try to suppress dissent it will likely only strengthen current grievances through heavy-handed tactics and through continuing to fail at address the reasons why they lost legitimacy in the first place. A number of researchers have found the loss of state legitimacy to be one of the most important causes of intrastate conflict.⁶⁴

⁶³ Byman and Van Evera call this ‘one person one vote, once’

⁶⁴ Jonathan Goodhand, *Violent Conflict, Poverty and Chronic Poverty* (Chronic Poverty Research Centre, 2001); G. Brown and F. Stewart, “Fragile States,” in *UNU-WIDER Conference on Fragile States-Fragile Groups*, 2007; Byman and Van Evera, “Why They Fight.”

Section 3: Climate Change and Africa

Section 3.1 Vulnerability and adaptation

Nearly every study of climate change and its anticipated human impacts singles out Africa and Sub-Saharan Africa in particular, as being the most vulnerable region in the world. For this paper, it is important to understand both what it means to be vulnerable to climate change and the various factors that make one region more susceptible than another. The concept of climate vulnerability is best thought of in terms of a simple equation:

Level of Vulnerability to Climate Change = (exposure + sensitivity) – (resilience + adaptive capacity)

This equation applies to all levels of analysis, but here we will stick to the societal level. A society's level of vulnerability to climate change is equal to the extent to which the livelihoods of its people depend on natural ecosystems (exposure), plus how much these ecosystems change for every unit of change in the global system (sensitivity), minus the structural aspects of the society in question that can dampen (or worsen) climate vulnerability/effects (resilience) plus the resources the society can draw on to

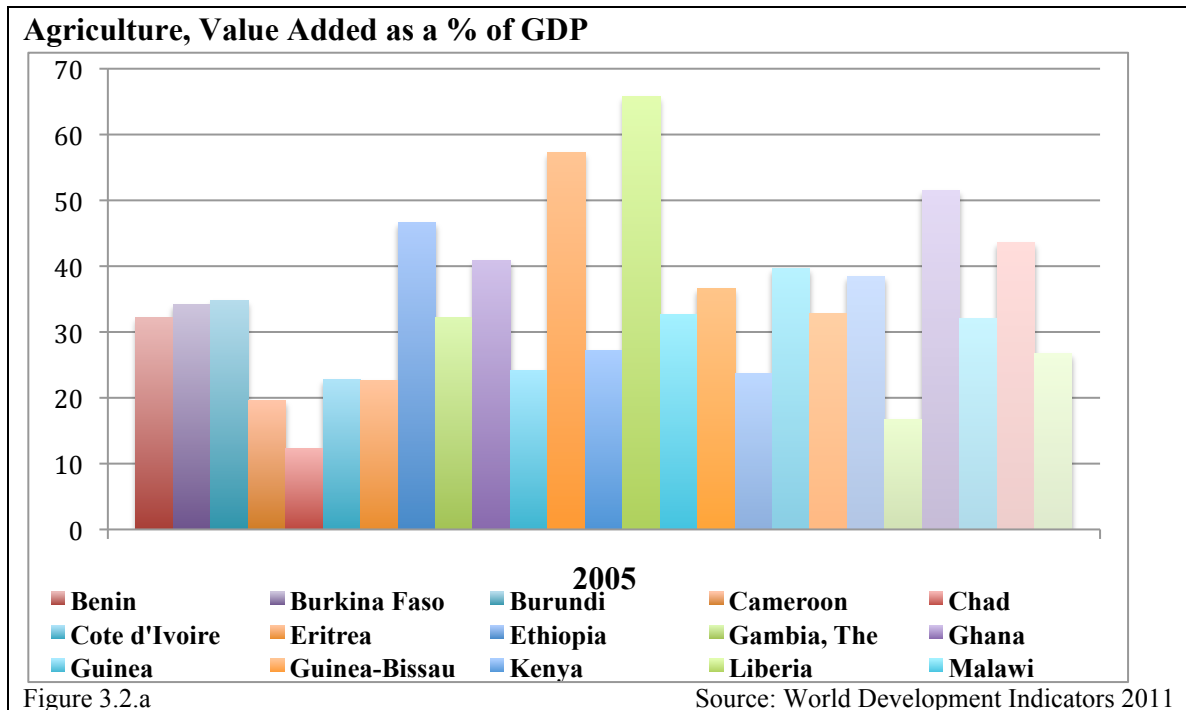
address climatic changes or to change its own behavior (adaptive capacity).⁶⁵

Section 3.2: A Vulnerable Continent

African societies, and developing countries more generally, tend to be more vulnerable to climactic changes than developed countries because of five widely shared, vulnerability-generating characteristics: a significant proportion of their economies are based on environmentally sensitive sectors like agriculture, forestry, fisheries, and tourism; their ability to adapt to change is limited due to poor institutional and physical infrastructure; many are already suffering from localized environmental degradation and water stress; they tend to be located in regions of the world most likely to see severe climate change; and their populations tend to be particularly clustered in ecologically fragile areas or areas vulnerable to sea level rise. Nearly every country in Africa has all five characteristics, making it the best model for studying the impact of climate change on society and for identifying the linkages between climate and conflict.

⁶⁵ Most existing studies provide some variation of this definition. The IPCC's definition of climate vulnerability is: 'the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes S. Solomon et al., *IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (New York: Cambridge University Press, 2007), 48. Brown and McLeman define it as a function of the sensitivity to change of the unit of study (the system, population, region, etc.); the climatic conditions and consequent biophysical changes to which that unit is and is likely to be exposed; and the capacity of the unit to adapt to or cope with the expected changes. O. Brown and R. McLeman, "A Recurring Anarchy? the Emergence of Climate Change as a Threat to International Peace and Security," *Conflict, Security & Development* 9, no. 3 (2009): 294.

Section 3.2.a: Africa's Agricultural Dependence



Agriculture dominates the African economy, both in terms of its overall size and in the sheer number of livelihoods dependent on it. Estimates are that the agricultural sector alone represents between 23 and 37% of the continent's total GDP and accounts for up to half of the value of the continent's total exports (40 to 55% of total export value).⁶⁶ The sector provides employment for some 65 to 75% of Africa's total labor force (in some countries it can be as high as 90%)--exports of fresh fruit and vegetables to the UK, alone provide some 1 million livelihoods.⁶⁷

⁶⁶ Percentages from African Futures J. Cilliers, B. Hughes, and J. Moyer, African Futures 2050-the next forty years (Pretoria, South Africa; Denver, Colorado: Institute for Security Studies, Fredrick Pardee Center for International Futures, 2011). O. Brown and A. Crawford, "Climate Change and Security in Africa," *Manitoba: IISD* (2009): 8. World Bank, *World Development Report 2010: Development and Climate Change.*, World Development Report (Washington DC: World Bank, 2010).

⁶⁷ Foresight, *The Future of Food and Farming*, Final Project Report (The Government Office for Science, London.: Foresight, 2011).

Despite the sector's great value, agriculture in Africa remains severely underdeveloped, with small-scale farmers accounting for more than 90% of all agricultural production on the continent⁶⁸. Some 80% of all African cropland is rain-fed, as opposed to irrigated, meaning that crops are dependent on receiving adequate and timely rainfall.⁶⁹ African farmers use the lowest levels of fertilizer of any region, averaging 9 kilograms of fertilizer per hectare of land as compared to a global average of 101 kg/ha,⁷⁰ and its farms continue to see high levels of post-harvest crop loss (averaging 10-20% loss for Maize, 25% for all cereals, and as much as 50% for fruits and vegetables)⁷¹ due to poor infrastructure. Overall agricultural production in Africa has indeed increased, tripling over the last 50 years, but at the same time (1969-2005), caloric consumption in SSA increased by only 3% and since 2005 has undergone major declines. East Asia, during the same period, saw caloric intake increase by 41%.⁷² Because of rapid population growth, per capita food production today is roughly equivalent to the 1960 level.⁷³

Agriculture in Africa is also severely dependent on favorable weather conditions. Along with being primarily rain-fed, many African crops are already grown at the edge of their heat tolerance, so that even a few unusually hot days can have a major impact on

⁶⁸ United Nations Environment Programme., *Global Environment Outlook 4: Environment for Development*. (Nairobi Kenya: United Nations Environment Programme, 2007), 17.

⁶⁹ World Bank, *World Development Report 2010: Development and Climate Change*.

⁷⁰ *The Environmental Food Crisis: The Environment's Role in Averting Future Food Crises*, A UNEP Rapid Response Assessment (Arendal Norway: UNEP, 2009), 82.

⁷¹ Ibid.

⁷² Foresight, *The Future of Food and Farming*, 51.

⁷³ Ibid., 81.

crop yields due to water-loss and decreased fertility.⁷⁴ Maize, sorghum, millet and groundnut—staple produce across much of Africa—yields are already subject to climactic fluctuations like El Nino. During strong El Nino periods, these crops can see a 20-50% drop in yields across southern Africa.⁷⁵ Recent climate change forecasts see southern Africa’s climate moving towards more El Nino-like conditions, on a permanent basis.⁷⁶ Making matters worse, maize, a water-hungry and drought susceptible crop, is the most widely grown of any staple crop across Africa; it is the main food source for some 300 million people.⁷⁷

Complicating factors is the fact that many of the people employed in the agricultural sector have few prospects outside the sector and are barely scraping by as it is. Some 3/4s of Africa’s malnourished children and the majority of people living in absolute poverty live on small farms.⁷⁸

Section 3.2.b: Environmental Degradation

Soil erosion, increasing soil salinity, and desertification are already having a massive impact on food and water security levels across Africa, making affected societies that much more vulnerable to future changes in climate. Estimates are that, as early as 1990, some 5 million square kilometers of were already considered degraded, including

⁷⁴ G. Conway, *The Science of Climate Change in Africa: Impacts and Adaptation*, Discussion Paper (London: Grantham Institute for Climate Change, 2009).

⁷⁵ Ibid.

⁷⁶ E. Aguilar and others, “Changes in precipitation and temperature extremes in Central America and northern South America, 1961–2003,” *J. Geophys. Res* 110 (2005): D23107.

⁷⁷ Foresight, *The Future of Food and Farming*, 89.

⁷⁸ Ibid., 120.

65% of all cropland and 40% of pastureland currently in use (a 1993 measurement), as well as 70% of the continent's drylands⁷⁹ as a result of over-cultivation, overgrazing, deforestation, and mismanagement of irrigated cropland.⁸⁰ A further 950,000 square kilometers is threatened with irreversible degradation if current rates of nutrient loss continue.⁸¹ Most of this degradation comes as the result of soil erosion due to deforestation (13%), poor agricultural practices (37%), and overgrazing (49%).⁸² Sub-Saharan Africa has the highest rate of deforestation of any region in the world, losing 40,000 square kilometers or .6% of its forest cover every year (the global average rate is .18%)—with eastern and southern Africa having the fastest rates of loss.⁸³

Coastal erosion is also proving a major problem as increasing beachfront development and sand mining has led to erosion rates as high as 30 meters/year in Western Africa (with Togo and Benin seeing the largest losses).⁸⁴ Salinization and desertification are the other main types of land degradation. Current estimates are that 2.7% of Africa's total land area, about 647,000 square kilometers is affected by salinization; that's 26% of all salinized land worldwide. Africa's drylands, which cover

⁷⁹United Nations Environment Programme., *Global Environment Outlook 4: Environment for Development.*, 204.

⁸⁰Brown and Crawford, "Climate Change and Security in Africa," 12.

⁸¹*The Environmental Food Crisis: The Environment's Role in Averting Future Food Crises*, 40.

⁸²M. Medany et al., "Background Paper on Impacts, Vulnerability and Adaptation to Climate Change in Africa" (presented at the African Workshop on Adaptation Implementation of Decision 1/CP.10 of the UNFCCC Convention, Accra, Ghana: African Workshop on Adaptation Implementation of Decision 1/CP.10 of the UNFCCC Convention, 2006), 6.

⁸³United Nations Environment Programme., *Global Environment Outlook 4: Environment for Development.*, 204.

⁸⁴*Ibid.*, 209.

43% of its land area are very susceptible to desertification, and in recent decades have seen an accelerating rate of desertification. Each year, some 3500 square kilometers of Nigerian land turns to desert.⁸⁵

Degraded agricultural lands lead without question to reduced crop yields, and while the exact level of loss depends on very localized conditions, estimates are that crop loss from soil erosion alone amounts to between 2 and 40% of potential productivity, a much wider range than the global average of 1 to 8%.⁸⁶ Such reductions in productivity have a direct impact on economic growth as crop loss due to land degradation is thought to amount to 3% of agriculture's total contribution to GDP in Sub-Saharan Africa. In Ethiopia, alone, land degradation amounts to a loss of US\$130 million each year.⁸⁷ But degraded land not only leads to reduced crop yields, it limits the possibility of further agricultural expansion—something greatly needed in the face of expected population growth—and negatively impacts water sources as increased runoff and silt loads reduce water quality, harm wetlands and can even change the course of rivers.

Section 3.2.c: Africa's Population

Africa's population is very unevenly distributed and is, more often than not, concentrated in places particularly vulnerable to the effects of climate change. The majority of Africa's population and its greatest densities can be found along the

⁸⁵ Brown and Crawford, "Climate Change and Security in Africa," 12.

⁸⁶ United Nations Environment Programme., *Global Environment Outlook 4: Environment for Development.*, 210.

⁸⁷ *The Environmental Food Crisis: The Environment's Role in Averting Future Food Crises*, 210.

continent's coastlines and major river deltas like the Niger and Nile; this is especially true in West Africa. There, 40% of the total population lives within one-kilometer of the coast⁸⁸. Twelve African cities (including eight out of the twenty most populous cities on the continent) are considered to be at risk from sea level rise, storms, and coastal erosion, even as their populations continue to soar.⁸⁹ By 2015, Africa is projected to have three coastal cities of at least 8 million people⁹⁰ as much of the continent's future population growth is expected to occur in West and East Africa where coastal concentrations are already great⁹¹. But exposure to coastal impacts is not the only vulnerability. Roughly 1/3 of Africa's population lives in drought prone regions.⁹² Ethiopia, for example, is the third largest country in Africa, and the majority of its population lives in the western half of the country that is already prone to drought and crop failure⁹³—and is not expected to improve in the future. African countries also host a large number of forcibly displaced persons, some 15 million in 2004. The majority of these people are internally displaced within their country of origin while 3.5 million now live in other countries.⁹⁴ Displaced persons often lack the resources and social support networks of established people, even the very poor. This renders them particularly vulnerable to the effects of climate change.

⁸⁸ Kurt Campbell, *Climatic Cataclysm: The Foreign Policy and National Security Implications of Climate Change* (Washington D.C.: Brookings Institution Press, 2008).

⁸⁹ Ibid

⁹⁰ Conway, *The Science of Climate Change in Africa*, 15.

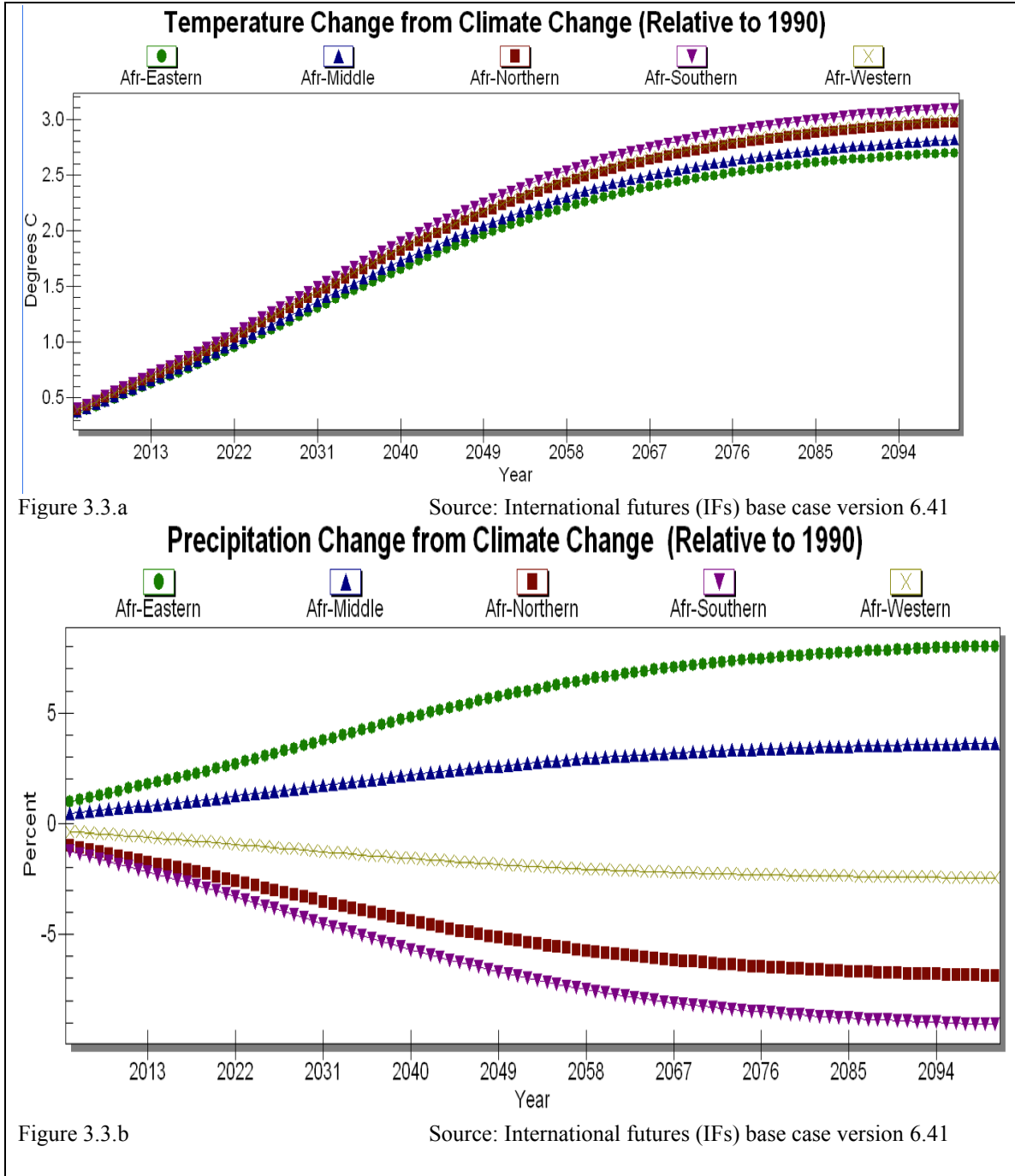
⁹¹ Cilliers, Hughes, and Moyer, *African Futures 2050-the next forty years*.

⁹² Brown and Crawford, "Climate Change and Security in Africa," 12.

⁹³ Busby et al., *Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa?*, *Climate Change and African Political Stability* (The University of Texas at Austin: Robert S. Strauss Center for International Security and Law, 2010).

⁹⁴ M. G Marshall, *Conflict Trends in Africa, 1946-2004: A Macro-Comparative Perspective* (Arlington, VA: Center for Systemic Peace, 2006).

Section 3.3: A Climate Change Forecast for Africa



The most recent climate change forecasts for Africa paint a rather grim future in terms of increasing food and water security as temperatures and sea levels continue to rise, and as precipitation patterns and intensities continue to shift. Much of the fine-grain

detail of these changes remain uncertain—the exact amount of change and the exact distribution of future climatic changes—today’s crop of general circulation models allow for a ‘broad brush’ forecast of climatic change for the continent and its regions over the rest of this century.

Africa on the whole, going forward, is likely to see current warming trends continue and grow even more pronounced over all seasons and across all regions of the continent, though the extent of this warming will likely not be uniform.⁹⁵ The subtropical regions of Africa’s north and south will likely warm the most, by as much as 4°C under standard emissions scenarios, some 1.5 times greater warming than forecast for the global average,⁹⁶ while the continent’s tropical regions, eastern Africa, and most coastal regions may ‘only’ warm by 2-3°C by the end of the century.⁹⁷ Most of the continent will also see a decrease in overall precipitation, with northern Africa, from the Mediterranean coast to the northern Sahara, and southern Africa beyond the Sahel both seeing a substantial decrease in precipitation by as much as 15-20%.⁹⁸ East Africa, on the other hand, may actually see a substantial increase in overall rainfall. The extent of temperature and precipitation changes in the Sahel region remains the most uncertain, with some models showing major decreases in precipitation and others major increases. The region will grow warmer, but by how much is also uncertain. Sea levels will rise around the

⁹⁵ Africa’s tropical forests have warmed at a rate of .29°C per decade, and the highlands of East Africa have warmed at .5°C per decade. Africa as a whole is seeing warming at a rate above the global average

⁹⁶ The IPCC’s A1B emissions scenario

⁹⁷ Solomon et al., *IPCC, 2007*.

⁹⁸ *Ibid*

continent's coasts by at least one-half meter⁹⁹ inundating low-lying areas and sending saltwater intruding into groundwater. Floods and droughts will become more common and more severe across much of Africa. Such broad-brush changes are interesting, but mean little without a more detailed look at their impact on Africa's people and environments.

Rising temperatures, besides posing a direct threat to human health and security from heat exhaustion, are likely to worsen food security across the continent. Most crops currently grown in Africa are already close to the limit of their heat tolerance, and the livestock, especially cattle, many Africans depend on are also very sensitive to temperature rises. In many regions, even a few days of extreme heat could result in reduced crop yields, as well as milk and meat production.¹⁰⁰ Warming can also negatively impact fish catches—a key source of protein for many African communities. Already, Lake Tanganyika is suffering from a decline in ecological productivity due to warming.¹⁰¹

Estimates for crop yield loss due to increasing heat range greatly, especially when the effects of CO₂ fertilization are factored in: the IPCC estimates that northern Africa could see an 18% reduction in total crop yields, and southern Africa 22%, this even after

⁹⁹ Sea level forecasts vary widely as most models do not account for polar ice melt, instead focusing on thermal expansion

¹⁰⁰ Busby et al., "Of Climate Change and Crystal Balls: The Future Consequences of Climate Change in Africa" (presented at the Paper presented at the annual meeting of the Theory vs. Policy? Connecting Scholars and Practitioners, New Orleans Hilton Riverside Hotel, 2010).

¹⁰¹ Ibid

C02 fertilization is taken into account.¹⁰² Other projections suggest some African countries could suffer crop losses as high as 50% by 2020.¹⁰³ The wheat fields of northern Africa and the maize fields of southern Africa are at greatest risk of crop loss, with some analysts suggesting that in these regions such crops may become impossible to grow.¹⁰⁴ The World Bank estimates that a 2°C rise in global average temperature could reduce the GDP per capita of most African countries by 4 to 5%, primarily due to agricultural losses.¹⁰⁵

Increasing heat in the climatic system is also altering precipitation patterns and rainfall intensities across the continent, yielding more frequent extremes of both dry and wet and a worsening of water security for many. By 2020, forecasted changes in rainfall may expose some 75 to 250 million Africans to increased long-term water stress, as northern, southern and parts of western Africa will all likely see moderate to severe decreases in overall rainfall and surface water flow.¹⁰⁶ Rainfall in these regions is likely to become more erratic, with more intense rainfalls and flooding punctuated by more intense and extensive droughts. In southern Africa alone, the area prone to water shortages could increase from 9% today to 29% by 2050.¹⁰⁷ For the Sahel and central regions of Africa, the picture is more uncertain, with most models pointing to a slight increase in overall rainfall. Eastern Africa, on the other hand, will likely see a moderate

¹⁰² Solomon et al., *IPCC, 2007*.

¹⁰³ Conway, *The Science of Climate Change in Africa*, 15.

¹⁰⁴ Ibid

¹⁰⁵ World Bank, *World Development Report 2010: Development and Climate Change*.

¹⁰⁶ Solomon et al., *IPCC, 2007*.

¹⁰⁷ Busby et al., "Of Climate Change and Crystal Balls: The Future Consequences of Climate Change in Africa."

to extreme increase in rainfall and surface water flow—though as much of this increase will be concentrated in the wet season, it may lead to significant flooding monsoons that do little to enhance dry season availability.¹⁰⁸ Increasing temperatures will also worsen the water situation for the 2 million people in Tanzania dependent on melt water from the mountain glaciers of Mount Kilimanjaro and Mount Kenya during the dry season, as the glaciers are melting rapidly and are forecast to disappear by 2030-2050,¹⁰⁹ though some studies place the date as early as 2020.¹¹⁰ Either way, the glaciers had already lost 33% of their ice as of 2000.¹¹¹

More frequent and intense droughts will cause both increased crop and livestock loss. Past droughts (1980-2000) in Africa have killed an average of 40% of all livestock in the affected regions (losses ranged from 22-90% of herd).¹¹² Semiarid and arid lands, already accounting for much of the continent's surface area, will likely expand 5-8% by 2080 as rain-patterns shift, the African monsoon weakens, and increasing temperatures drive greater rates of evaporation.¹¹³

Insects and disease-causing microbes represent two populations likely to benefit from climate change as rising temperatures and changing rainfall patterns make new areas more hospitable. The increasing range of insects like the desert locust is likely to

¹⁰⁸ Ibid

¹⁰⁹ Busby et al., "Of Climate Change and Crystal Balls: The Future Consequences of Climate Change in Africa"; Catherine McMullen and United Nations Environment Programme., *Climate change science compendium 2009* (Nairobi Kenya: UNEP, 2009).

¹¹⁰ Lester Brown and Earth Policy Institute, *Plan B 3.0: Mobilizing to Save Civilization*, 1st ed. (New York: W. W. Norton, 2008).

¹¹¹ Ibid

¹¹² *The Environmental Food Crisis: The Environment's Role in Averting Future Food Crises*, 53.

¹¹³ Conway, *The Science of Climate Change in Africa*.

further decrease crop yields in a region where annual crop losses from insect pests is already in the billions of dollars. Malaria and dengue carrying mosquitoes are moving into new areas in East Africa like the Kenyan highlands as temperatures and humidity increase. East and Central Africa are both likely to see increased incidence of both diseases along with other diarrheal-causing diseases like cholera. By 2030, some 1.15 billion people on the continent will be at risk from malaria, up from 630 million in 2005.¹¹⁴ The incidence of diarrheal diseases could increase by as much as 10% also by 2030.¹¹⁵ In 2000, WHO found such climate-sensitive diseases to be the leading cause of climate induced death on the continent, and this is likely to remain the case going forward.¹¹⁶

With much of Africa's population and agriculture concentrated along the continent's coastal regions, rising sea levels will impact both food security and direct human security as populations are forced to relocate. Saltwater intrusion into currently fertile river deltas and more intense coastal storms with greater storm surges could severely damage crop production. By 2050, 17 to 30 percent of Guinea's rice fields could be lost to sea level rise—assuming no adaptation. And in Nigeria, some 6,000 square kilometers of agricultural land and hundreds of oil fields would be inundated by a one-meter rise in sea level.¹¹⁷

¹¹⁴ Ibid.

¹¹⁵ Busby et al., "Of Climate Change and Crystal Balls: The Future Consequences of Climate Change in Africa."

¹¹⁶ Ibid.

¹¹⁷ Ibid.

The consequences of the climatic and environmental changes described above will certainly have a severe impact on Africa's human societies (see below), but there remain a number of key uncertainties that, depending on how they resolve, could severely worsen or help ameliorate this seemingly dire situation: whether the Sahel gets drier or wetter;¹¹⁸ whether the flow of Africa's Zambezi and Limpopo decrease by a lot or a little; whether the Nile's flow increases or decreases;¹¹⁹ whether the effect of carbon fertilization is greater than or less than expected; whether the effect on Africa's monsoons are greater or less than expected.

¹¹⁸ C. P. McMullen and J. Jabbour, *Climate Change Science Compendium 2009* (Nairobi, Kenya: United Nations Environment Program, 2009).—some models suggest that the Sahel may be on the verge of becoming much wetter, a return to conditions from 9000-5000 years ago, when the Sahara was green. Such a result would be a great boon for Africa.

¹¹⁹ Conway, *The Science of Climate Change in Africa*.

Section 4: From Climate Change to Conflict? Mapping the Potential Pathways

Section 4.1: The Environment-Conflict Connection: does one exist?

Mainstream discourse often depicts the debate over whether changes in the natural environment can induce conflict in human societies as a largely black-and-white argument between two diametrically opposed camps: the neo-Malthusians, who argue for a direct and robust linkage between environmental degradation and conflict, and the Cornucopians, who argue against any linkage as they believe human ingenuity, adaptability and market mechanisms will ensure environmental issues are resolved peacefully—the conflicts that do occur being due to non-environmental factors. While this depiction of a confrontational argument allows for some drama, it actually presents a false dichotomy, as the debate is far from black-and-white. Indeed, *even* a cursory reading of the recent literature in the field suggests that the two sides are much closer than is commonly believed;¹²⁰ and a middle ground between the two is readily apparent. This section first looks at some of the main arguments for and against an environment-conflict connection and then provides a synthesis of the two camps, which will give us our rationale for pursuing the identification of some possible causal pathways from climate change to conflict (see below).

¹²⁰ And yet, most papers on the subject begin with the statement that ‘there’s little consensus’ on the relationship between climate or environment and conflict. See Bernauer et al, for example.

Section 4.1.a: The ‘For’ Camp

Homer-Dixon’s *Toronto Project on Environmental Change and Acute Conflict* research group (TPECAC), was one of the primary ‘pro’ environment-conflict research groups. They assumed a tight linkage between environmental change (especially those that resulted in natural resource shortages) and conflict and conducted a number of qualitative studies to determine if their reasoning was correct. They also examined the standard Malthusian drivers of population growth and resource distribution issues. TPECAC identified two potential pathways from environmental change to conflict. In the first, the over-exploitation/degradation of natural resources force large-scale migrations, which in turn triggers ethnic strife between the new arrivals and established groups. In the second, resource scarcity causes economic hardship and undermines state capacity and legitimacy, which in turn open the way for grievance-based rebellion. Despite their efforts, the TOECAC group was unable to identify a direct linkage between the environment and conflict. Instead, they argued that when taken in combination with political and socioeconomic factors, environmental change and natural resource scarcity could indeed contribute to the outbreak of violent intrastate conflict.¹²¹

Homer-Dixon himself has been placed squarely in the neo-Malthusian camp since the publication of *On the Threshold: Environmental Changes as Causes of Acute Conflict* in 1991. But his work, both in 1991 and since, seems more to bridge the two camps rather than to fully subscribe to either. While he does identify causal paths from environmental change to conflict, Homer-Dixon is quick to point out that the links he describes are

¹²¹ Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (Germany), *Climate change as a security risk* (London: Earthscan, 2008).

neither necessarily tight nor deterministic; there are numerous intervening factors that influence whether a society is vulnerable or resilient to the effects of environmental change. He describes environmental change as playing different causal roles depending on the political, socioeconomic, and technological intervening factors present.

Historically, the case for the neo-Malthusian viewpoint seems quite strong. Four factors largely determine the resources available to a given society: the environment in which the society exists,¹²² the organization and size of the society,¹²³ the efficiency of the extractive and processing technologies available to the society,¹²⁴ and the society's interactions with other societies.¹²⁵ It is clear from archeological records that ancient societies were very dependent on their environment and were very sensitive to any changes in it. Indeed, the development of the other three factors stem from this dependence as societies struggled, first to adapt to environmental change and later to support a growing population while furthering environmental adaptation. The first sedentary agricultural systems developed as environmental conditions in some areas made hunting and gathering impractical while rewarding the growing of crops. The first major civilizations arose in areas where seasonal flooding and droughts required organized responses to build waterworks and establish calendars and long term planning. The records also contain many instances where societies were either unable or unwilling to adapt to natural changes and or to curtail their own impact on their environments: the

¹²² Encompassing the type of resources available and the fragility or robustness of the ecosystems involved

¹²³ Along social, political, economic, and demographic lines

¹²⁴ How much waste and pollution is generated

¹²⁵ Trade, war, etc.

Mayans at the end of their Classical period, Easter Island and other Polynesian island societies, Sumer, the Anasazi, and so on all seemed to go through violent collapses which saw the breakup of empires and even the rise of cannibalism. The question is whether today's environmental issues, from general environmental degradation to climate change, pose a similar threat to modern societies. For those in the 'for' camp, the answer to this question is clearly yes.

Section 4.1.b: The 'Against' Camp

The International Peace Research Institute Oslo (PRIO), headed by Gleditsch, has been one of the primary 'anti' environment-conflict groups in that they provided many critiques of Homer-Dixon's group and neo-Malthusian thought in general. The PRIO group also belonged to the Collier school of resource-based conflicts, arguing that resource abundance and not scarcity was a primary cause of conflict. They conducted quantitative studies designed to look cases where conflicts did occur and where in similar circumstances they did not. The PRIO, like the TPECAC found no evidence of a direct connection and that while environmental issues may indeed increase the risk of conflict, they are a minor part of the constellation of factors that go into generating conflict.¹²⁶

Buharg et al identify an interesting paradox: how can there be a strong linkage between climate change and conflict when most of the environmental processes associated with climate change have truly only begun to appear over the last few decades,

¹²⁶ Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (Germany), *Climate Change as a Security Risk*.

a period coinciding with a dramatic decline in the frequency and severity of conflicts.¹²⁷ They also chastise the majority of researchers who they feel ignore this paradox. This paradox can potentially be explained in two ways. First, most of the climate processes currently underway are still in their ‘infancy’ so to speak, with most of the changes still to come, and, with the possibility for accelerating or non-linear change in the future, it seems a mistake to conclude that there is no correlation just because it hasn’t been apparent over these last two decades. Any correlation could easily be masked by the massive geopolitical shifts that accompanied the end of the Cold War (which saw peak in the number of conflicts before falling steadily over the next decade). The other explanation for Buharg’s paradox is that it may not be looking at the right conflicts. While the total number of all conflicts around the world has decreased, the number of non-state conflicts in Africa, for example remained steady after the end of the Cold War, then hit its highest levels in 1998-2000 and peaked again in 2007. And since the latest climate change studies show Africa to be warming faster than any other non-polar region, the two trends do seem to coincide—this doesn’t prove causation by any measure, but it does suggest the possibility.

Brown and McLeman warn against the sort of neo-Malthusian logic that often creeps in when environment-conflict researchers analyze conflicts in Africa. As they rightly point out, the region of the Sahel containing Darfur has been subject to a number

¹²⁷ H. Buhaug, N. Gleditsch, and O. Theisen, “Implications of Climate Change for Armed Conflict,” in *World Bank Workshop on the Social Dimensions of Climate Change* (Washington DC: World Bank, 2008), 5–6.

of intense droughts while the outbreak of conflict remains rare.¹²⁸ They argue that the Sudanese government and its support of the Janjaweed militia is to blame for the current Darfur conflict and not desertification. They also suggest that the environment-conflict connection is overly deterministic, as, in many parts of Africa, traditional, local institutions exist to settle any resource scarcity disputes before they become violent—though as we will see in Section 5, such institutions are not always successful.

Salehyan doesn't reject the notion that environmental degradation or climate change poses a threat to human societies, rather he too questions the 'for' camp about its over-reliance on environmental determinism. He argues that the effects of climate change 'boil down' to competition over scarce resources and potential loss of livelihoods, and that there are many ways for societies to manage these problems without resulting to violence.¹²⁹ The structural approach to climate conflict linkages often discounts or ignores the factors of human agency, technological innovation, and the role government plays in redistributing and managing resources, and in providing conflict mediation. Thus, any conflict that results is due to failure of the political process and not resource scarcity. The core of this argument is the theory of the rational actor: the assumption is that violence is a poor response to resource scarcity since it will 'often do nothing to correct the ecological issue and may damage the environment further;' other adaptive measures whether migrating or adopting new farming techniques are less costly and less hazardous to one's health. This leads to Salehyan's conclusion that 'environmental

¹²⁸ Brown and McLeman, "A Recurring Anarchy?"

¹²⁹ I. Salehyan, "From Climate Change to Conflict? No Consensus Yet," *Journal of Peace Research* 45, no. 3 (2008): 315-326.

processes, by themselves cannot explain why, where, and when fighting will occur;’ instead, you need the same ‘intervening variables’ that Homer-Dixon suggested were necessary. To Salehyan, state capacity is the single most important of these variables, and is the one likely to forestall the outbreak of widespread conflict. He tends to dismiss the claims that climate change might overwhelm a state’s capacity to cope with the changes as speculative since ‘such effects either have not materialized or have not been adequately researched.’ Corruption and cronyism and predatory state behavior are the greater problems facing developing countries.¹³⁰

Section 4.1.c: Empirical Findings

Raleigh and Urdal constructed a statistical model designed to test whether environmental and or demographic stressors can increase the likelihood of a conflict occurring in a given country. To build their model, they gathered data on conflicts around the world that occurred during the 1990-2003 period. The authors then selected a set of four independent variables of conflict to test in their model: water scarcity, land degradation, population growth, and population density. The results of running the model showed that while the four variables do increase the likelihood of conflict occurring, the increase is negligible unless other important exogenous factors are present, namely, state weakness, low GDP per capita, poor or negative economic growth, and an over dependence on export commodities, i.e. the standard drivers of conflict. The presence of environmental or demographic stressors therefore serves to aggravate a situation where

¹³⁰ Ibid.

conflict may already be likely. Of the four identified stressors, land degradation and population density were found to have the strongest correlation, with land degradation enhancing the probability of territorial conflicts, like peasant uprisings or ethnic strife, and with population density increasing the prospect for civil war. And when coupled with water scarcity, population density was found to increase the risk of all forms of conflict. The rate of population growth, on its own, seemed to have effect. Raleigh and Urdal's main conclusion is that the extent of environmental and demographic stress depends largely on the actions, or lack of actions, a state takes to address the problems it faces; those states that lack the capacity to address these factors will therefore face a greater risk of domestic upheaval.¹³¹

Others, like Zhang et al had similar findings: changes in a region's average annual temperatures tend to correlate with both declines in agricultural productivity and the frequency of conflict. And in a study of 41 African countries from 1981-1999, Migel et al. found evidence that declines in annual rainfall 'substantially reduces national income growth and thereby indirectly increases the probability of intrastate conflict.

But Buharg et al, Barnett, and Theisen all found the opposite: their own quantitative studies all failed to show any correlation between environmentally driven resource scarcities and conflict, and no evidence that climate change (to date) has had a detrimental economic impact on any country.

¹³¹ C. Raleigh and H. Urdal, "Climate Change, Environmental Degradation and Armed Conflict," *Political Geography* 26, no. 6 (2007): 674-694

*There is common agreement that there are links, if vague, between environmental change and violent conflict, however it has not been shown that environmental factors are the only or even important factors leading to conflict.*¹³²

*Despite many claims by high-ranking policy-makers and some scientists—the existing empirical literature has so far not been able to identify systematic, causal relationships of this kind.*¹³³

*Rather I argue that the concept of environmentally induced conflict is itself fundamentally flawed, as it neither allows for convincing empirical substantiation nor for sound theory building. A critical review of the literature reveals the shakiness of the concept's core assumption: the idea that “environmental concerns are indeed associated with greater conflict.”*¹³⁴

Section 4.1.d: Bringing the Two Camps Together

There are several problems with many of these studies and their conclusions. First, they concentrate on certain types of conflicts, favoring civil wars--where an organized and armed rebel group challenges a national government—and other large-scale conflicts, while ignoring the possibility for low-level conflicts fought between non-state actors; even as Section 5's case studies suggest such low-level conflicts represent the majority of environment-related conflicts. Indeed, Theisin, writing for the International Peace Research Institute (which tends to belong to the 'anti' camp) remarks on the need for researchers to focus more on local, less intense conflicts. Another problem, especially for quantitative studies, is that most studies do not address the possibility of tipping points, thresholds and other sudden environmental shocks or

¹³² J Barnett and W Adger, “Climate Change, Human Security and Violent Conflict,” *Political Geography* 26, no. 6 (2007): 4.

¹³³ T. Bernauer, A. Kalbhenn, V. Koubi, and G. Ruoff, “Climate Change, Economic Growth, and Conflict,” *Climate Change and Security* (2010): 1.

¹³⁴ T. Hagmann, “Confronting the Concept of Environmentally Induced Conflict,” *Peace, Conflict and Development* 6, no. 6 (2005): 4.

ecosystem collapse; they instead favor an environment that undergoes gradual change. Admittedly, such *black swans* are inherently difficult to model or predict, but the possibility ought to be included—you see this in some studies where researchers compare the different effects of gradual and rapid changes, using changes in annual rainfall as a measure of rapid change and temperature increase as a gradual change.

Establishing clear, firm, and direct relationships between environmental change (or climate change for that matter) and violent conflict has proved notoriously difficult. Study after study—well beyond those described above--have either found tantalizing evidence but no smoking gun, no evidence at all for a direct connection, or contradictory evidence. What are we to make of this? Because of this inability to establish a direct linkage, many researchers have begun to look at more indirect mechanisms by which environmental change might drive conflict. And it is here where the two sides of the debate come together, and where certain ‘reasonable’ causal pathways begin to be elicited.

Section 2 of this paper looked at the existing literature on what are considered to be the ‘standard’ drivers of conflict. The rest of this section seeks to map out how the effects of climate change might interact with the conflict drivers of section 2 in ways as to increase the likelihood of conflict. This section makes the case for four possible pathways from environmental change to conflict: the resource scarcity pathway, the economic pathway, the weak state pathway, and the migration pathway. Of course, like the standard drivers of conflicts before, these pathways are interconnected and

overlapping. Thus the final part of this section attempts to synthesize these pathways into a more comprehensive picture of climate change's potential impact on societal stability.

Section 4.2: Climate Change: The Threat Multiplier?

Most quantitative and or empirical studies of climate change and conflict have yielded either inconclusive or contradictory results (with some forms of environmental degradation and change driving conflict and others dampening it). This has led many researchers to conclude that, should any links exist, those links are most likely indirect and minor, playing second fiddle to more established conflict factors (economics, sociopolitical factors, etc). Instead, the 'standard' characteristics of societies and systems that generate favorable conditions for intrastate conflict remain most important, determining whether or not environmental change becomes a factor. This has resulted in two common viewpoints: the first sees the inclusion of climate change in causes of conflict analysis as unnecessary as the same conditions that make a society vulnerable to climate change also make it vulnerable to conflict. The second viewpoint sees climate change acting as a threat multiplier rather than an outright source of conflict. As a threat multiplier, climate change is seen to play on a society's existing weaknesses, pushing the state closer to conflict and or collapse; thus, climate change is an important part of the conflict equation and must be included in conflict models in order to better understand future conflict occurrences. A threat multiplier increases the severity of existing threats—but by what mechanism(s)? Are certain threats to stability more likely to be multiplied

than others? The climate-conflict pathways proposed in this section are an attempt to answer these two questions.

Section 4.3: Climate-Conflict Pathways

Section 4.3.a: The Resource Scarcity Pathway

Scarcity based conflicts—whether over dwindling food stores, disappearing water sources, or a dearth of arable land—are the sort of Malthusian-based climate change scenarios that have come to occupy popular imagination: the hungry huddled masses streaming out of drought-stricken areas in search of food and water and willing to fight and even kill to secure them, and ready to overrun the Developed world. But how realistic is such a scenario? Can resource scarcities be a source of conflict? As mentioned in the introduction to this chapter, there is little consensus on the answer, with some scholars finding that resource scarcity has been and will continue to be an important driver of conflict, while others question whether environmental factors of any kind can play a role at all.

Recent history (2007-2011) provides a number of examples of, if not outright scarcity driven conflict, scarcity driven political instability. From late 2007 to mid 2008, a surge in food prices touched off a series of riots in a number of developing countries and even one developed country. A combination of environmental and human factors—droughts and floods hitting several major crop-growing regions, the diverting of large amounts of corn for use in ethanol production in the US, the climbing price of oil, and shrinking stores of grain in many countries—all drove food prices to record highs. In less

than a year, the price of rice on the world market increased by 75% and wheat by 120%. In Haiti, the high food prices led to a week of violent protests and riots that brought down the Haitian government as protestors clashed with Haitian police and even UN Peacekeepers. The unrest resulted in five deaths, the torching of cars, and the looting of businesses. Similar protests occurred in Egypt, Bangladesh, Burkina Faso, Cameroon, Cote d'Ivoire, Guinea, India, Indonesia, Italy, Mauritania, Mexico, Morocco, Mozambique, Tunisia, and Yemen.¹³⁵

More recently, in September 2010, rioting broke out in Mozambique (again) after high wheat prices forced the government to raise the price of bread by 30%. The rioting lasted for days and left 10 people dead and at least 300 wounded.¹³⁶ Also in 2010, Niger experienced the worst food crisis in its history (according to the UN). Then, in late 2010 to early 2011, droughts in China, Russia, and Argentina, and massive flooding in Australia caused world food prices to reach new record highs (the price of wheat rose from US\$4 a bushel in July 2010 to US\$9 in February 2011).¹³⁷ The high food prices also appear to have played a part in the series of revolts now dubbed the Arab Spring that took place in the Middle East and North Africa during the period—with several still active—that led to the deposing of leaders (Tunisia and Egypt), and civil war (Libya and Yemen),

¹³⁵ "Riots, Instability Spread as Food Prices Soar." CNN's Planet In Peril. 14 April, 2008, "Food Prices Threaten Global Security." The Guardian. 9 April, 2008

¹³⁶ J. Berazneva and D. R Lee, "Explaining the African Food Riots of 2007-2008: An Empirical Analysis," in *Economic Development in Africa* (presented at the CSAE Conference: 2011 Annual Conference, Oxford, UK, 2011).

¹³⁷ Sarah Johnstone and Jeffrey Mazo, "Global Warming and the Arab Spring," *Survival* 53, no. 2 (April 2011): 11-17.

with Egypt, Tunisia and Yemen all seeing food riots before the larger scale antigovernment movements.¹³⁸

Of course, it is important to note that these food shortages and high food prices were not due solely to environmental factors. Political, economic, and social factors all played major roles in food shortages and in resource scarcities more generally. Homer-Dixon, in his seminal work on resource scarcity and conflict, describes three types of resource scarcity: environmental *or supply based scarcity*, *demand-based scarcity* (due to both population growth and increasing incomes driving up demand for resources), and *structural-based scarcity* (the unequal distribution of resources due to existing political, social, and economic systems). Homer-Dixon also suggests that resource scarcity, to a certain degree, can be subjective; once you get beyond the bare minimum amount of food or water required to survive, resource scarcity can be determined by beliefs, preferences, and norms as well as absolute scarcities.¹³⁹ And food scarcity does not appear to be enough to cause conflict in and of itself. In most cases, the riots are settled by government action without turning into full-blown conflicts, usually by increasing food subsidies, garnering more food imports, etc. But states that lack the capacity to correct such shortages may see food riots turn into anti-government conflicts. By failing to address the high price of food in a timely manner or by seeking to end food riots by force, states can endanger their legitimacy, increasing the likelihood of conflict. The Egyptian

¹³⁸ *ibid*

¹³⁹ T. F Homer-Dixon, "On the Threshold: Environmental Changes as Causes of Acute Conflict," *International security* 16, no. 2 (1991): 76–116.

government's response to the 2008 food riots has been cited as one of the main grievances that touched off the 2010-2011 revolution.¹⁴⁰

The role of water scarcity in conflict, in general, has been a controversial one, with many analysts noting that there have been very few water based wars in history, and that, more likely than not, water issues between countries are settled through peaceful agreement. But the same cannot be said for intrastate conflict; as Africa provides a number of instances where water scarcity and issues over water access have indeed driven some conflicts, though these have remained mostly small scale. There are two main forms of 'water conflict' in Africa: violent confrontations between nomadic herders and sedentary farmers of different tribal affiliations over access to watering holes, and competition between rural and urban populations for access to the same water source. Environmental degradation and resource scarcity has been a major driving factor in the genocide in Darfur. Increasing desertification in the region (primarily due to over grazing) and water scarcity due to drought forced pastoralists and farmers to coexist on smaller areas of land. In the past, the farmers allowed the pastoralists to move their herds through their lands and even allowed the herders use of their wells. As the water scarcity worsened, the pastoralists used the migration adaptive strategy and moved onto lands occupied by the farmers, and the farmers in turn began fencing off their lands. Thus land and water shortages and changes in climate helped to exacerbate already existing religious and ethnic tensions and led to the outbreak of violence in the region.¹⁴¹

¹⁴⁰ Ray Bush, "Food Riots: Poverty, Power and Protest," *Journal of Agrarian Change* 10, no. 1 (January 2010): 119-129.

¹⁴¹ Gwynne Dyer, *Climate Wars* (Carlton North Vic.: Scribe Publications, 2008).

Given that much hinges on the standard drivers of conflict (section 2), and demand and structural based scarcities, what role does this leave for environmental factors like scarcity and degradation? Hauge and Ellingsen find that the states affected by environmental degradation (especially deforestation, land degradation and water scarcity) are more likely to experience intrastate conflict overall, with land degradation being the single most aggravating factor. Interestingly, the type of environmental degradation seems to have an effect on the type of conflict, with deforestation being a significant driver for small-scale conflicts but not larger conflicts like civil war. Land degradation and water scarcity are both significant when it comes to general armed conflict but again are not significant when it comes to civil war. Despite this, Hauge and Ellingsen still find the standard drivers more important than environmental drivers. However, they do find the risk of conflict to be the highest when the state is suffering from all three scarcities at once.¹⁴²

One of the main arguments against *environmental scarcity* driven conflict is that issues like land degradation and deforestation are slow moving changes and thus allow plenty of time for people to adapt.¹⁴³ We will look at this issue in more detail in Section 4.3.c on the different effects of rapid and gradual change, but it is important to keep in mind here.

¹⁴² Wenche Hauge and Tanja Ellingsen, “Beyond Environmental Scarcity: Causal Pathways to Conflict,” *Journal of Peace Research* 35, no. 3 (May 1, 1998): 299 -317.

¹⁴³ Hendrix and Glaser find this to be the case when comparing the impact on conflict occurrence of changes in rainfall as compared to slow moving land degradation

Section 4.3.b: The Economic Pathway

Just as economic drivers are considered the most important and most straightforward of conflict drivers, so too is the economic pathway from climate change to conflict. In Section 2.2.b we saw how negative factors like poor growth, recessions and general economic underdevelopment can lead to conflict by decreasing both national and personal income, by restricting peaceful options for making a living, and by undercutting the state's ability to maintain expected public services as state revenues decline. We also saw that economies overly dependent on agricultural production tend to be more vulnerable to fluctuations in the global economy, with political instability often accompanying price extremes, both declines in price and surges in price (the former affecting farmers and rural workers, the latter affecting urban populations). All this highlights the importance of economic stability and growth in maintaining a peaceful society—it also highlights the fact that anything that disrupts such stability could trigger political instability in those societies unable to absorb or quickly correct the economic damage. The question is whether the effects of climate change can cause the sort of economic havoc that might then lead to instability.

The Stern Review is one of the most comprehensive reports on climate change's potential economic impacts (and well regarded, though it is not without some controversy). And while its focus is primarily on developed countries, it seems reasonable to expect that any economic toll for such countries would be even greater for developing countries given their lower capacity for adaptive measures. Stern estimates that extreme weather events alone could cost as much as .5 to 1% of world GDP by 2050,

with subsequent increases as temperatures continue to climb.¹⁴⁴ Watkis estimates that for Africa, the cost may be as high as 1.5 to 3% of the continent's total GDP by 2030.¹⁴⁵ The main consequences of climate change, changing temperature and precipitation patterns and extreme weather events and sea level rise will all likely inflict heavy economic tolls on affected countries, Developing and Developed, and are already doing so in many areas of the world.

Recent storm and flood related damage have cost developed countries billions of dollars in infrastructure damage as well as lives lost. Hurricane Katrina in 2005 cost the US US\$125 billion dollars or 1.2% of its GDP and killed 1300 people.¹⁴⁶ The 2003 heat wave in Europe cost the region's agricultural sector some US\$15 billion dollars and killed upwards of 35,000 people¹⁴⁷. If developed countries can be so affected, what about developing countries? The record 2010 flood in Pakistan submerged 1/5th of the entire country and likely cost the country from 25 to 40 billion dollars, including a loss of 2.8 billion from the agricultural sector alone.¹⁴⁸ And these costs are only from infrastructure damage and crop loss, and do not yet account for the displacement of an estimated 18 million people.¹⁴⁹ Overall, such disasters are estimated to cost the developing world

¹⁴⁴ N Stern, *The Economics of Climate Change: The Stern Review* (Cambridge UK; New York: Cambridge University Press, 2007), chap. 5, page 1.

¹⁴⁵ Paul Watkis, "Economics of Climate Change: Key Messages" (presented at the Financing for Development, Conference on Climate Change, Kigali, 2009).

¹⁴⁶ Stern, *The Economics of Climate Change*.

¹⁴⁷ Ibid.

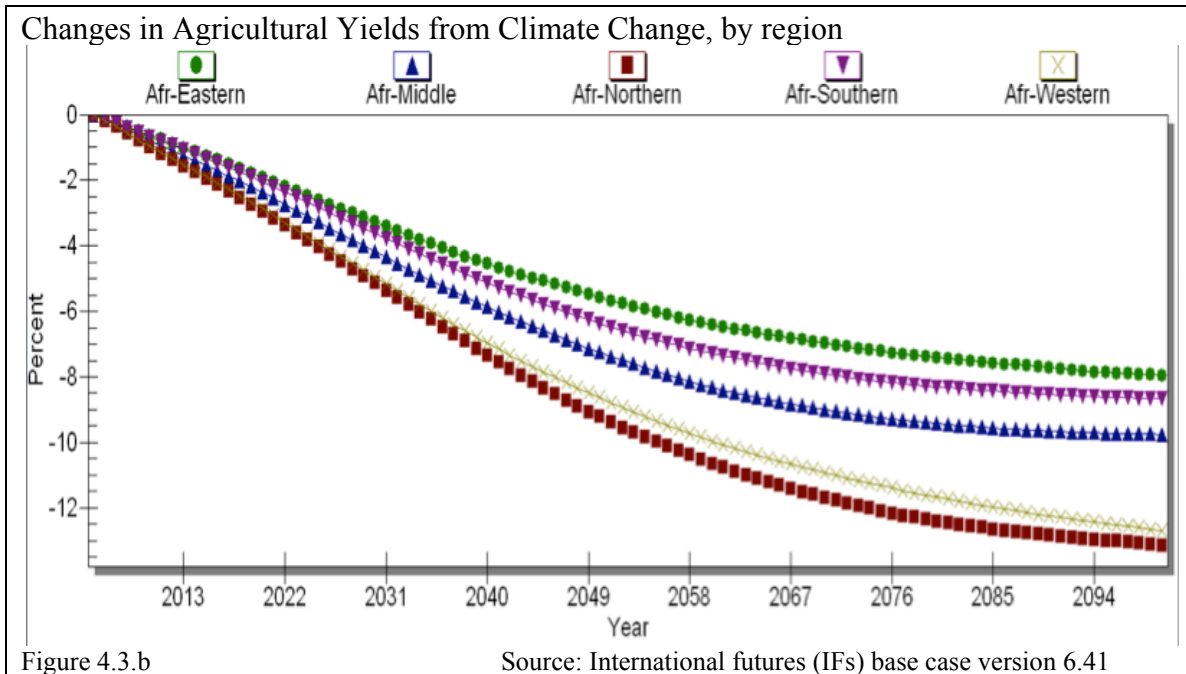
¹⁴⁸ BBC, Pakistan Floods: damage and challenges. 26 August 2010.

¹⁴⁹ BBC, Pakistan Floods Still Claiming Lives Six Months on. 28 January 2011.

US\$100 billion dollars a year (annual average from 1980 to 2004), and 95% of all deaths due to weather related disasters from 1980 to 2004 occurred in the developing world.¹⁵⁰

Climatic changes like changing precipitation patterns and rising temperatures will also have a major impact on crop yields, above and beyond direct destruction by extreme events. In some parts of the world, like the Developed North (especially Canada and Russia), climate change might actually boost crop yields as heretofore non-arable land thaws. Carbon dioxide fertilization may also help increase yields in such countries, though the amount of benefit remains uncertain. But for most of the world, and especially for Africa, climate change is expected to have a major negative impact on crop yields (see Section 3.xxx), and the increase in already warm temperatures will likely counteract any gains from carbon fertilization. For countries that are largely dependent on their agricultural sector for food, employment, and economic growth, any decline in crop yields could quickly translate into a decline in state GDP and an increase in unemployment, poverty, and ultimately hunger—all of which, according to many scholars of the standard causes of conflict can become conflict drivers through the creation of grievances, horizontal inequalities, and loss of state legitimacy. It is possible that any shortfall in food crops due to climate change may be made up via international trade, but for those countries already struggling to both produce enough food and to distribute it equitably, and for those countries whose main source of income is precisely what is affected, trade will likely not make up for declining yields.

¹⁵⁰ IIASA, *Climate Change and Extreme Events: What Role For Insurance?* Policy Brief (Laxenburg, Austria: International Institute for Applied Systems Analysis, 2009), www.iiasa.ac.at.



Thus, climate change, through a reduction in crop yields and through damage caused by extreme weather events and through damage and relocation efforts from rising sea levels do seem to have a real economic impact, and will likely have an increasingly grave impact on states around the world as this century progresses. Increasing economic damage will sap a state's ability to deal with the current crisis at hand and leave it less able to undertake further adaptive measures in the future as conditions worsen. And as the section on resource scarcity (above) suggests, when a state is unable or unwilling to correct the scarcity, or in this case to provide adequate recovery measures, to subsidize food after a massive crop loss and retraining and or relocation for those who've lost their livelihoods and homes, it risks losing legitimacy in the eyes of its people. Pakistan's 2010 flood provides a clear example of this as the prime minister continued his tour of Western countries as the disaster unfolded and as militant groups proved more effective than the

government in delivering aid, increasing public anger towards the government and enhancing the public's view of the militant groups.¹⁵¹

The mitigative and adaptive measures undertaken by a state can themselves be a source of economic hardship, straining a state's resources, perhaps opening the way to conflict as potential rebel groups see the state 'in over its head'. Coastal countries, for example, may have to construct mega-defenses or mega-relocations of fast growing cities and highly populated and agriculturally productive river deltas as sea levels rise.¹⁵² This would be enormously expensive. Of course, already fragile states may not have the required resources to undertake adaptive actions in the first place, leave

4.3.c: The Weak State Pathway

When it comes to climate change and conflict, state capacity, or strength, is an important intervening variable. A strong state with effective institutions can dampen the blow from resource scarcity and other environmental damage by providing relief and correcting structural scarcities. A strong state can also better bring in outside aid and take up adaptive and mitigative efforts prior to disaster striking. These are some of the primary reasons why [developed countries tend to be more resilient to extreme weather events and the like than developing countries. In weak or fragile states, weak institutions and or corrupt practices result in an unfair distribution of resources and are unable to adequately compensate their people for lost resources; such failures can lead to growing grievances

¹⁵¹ Guardian.Uk.co Pakistan floods: army steps into breach as anger grows. 8 August 2010. ForeignPolicy.com Militants on the move in Pakistan? 27 August 2010.

¹⁵² See Appendix B1 for a list of vulnerable African cities and river deltas

against the state and those elites seen to be hoarding resources for their own benefit.¹⁵³

Such grievances can combine with already existing ones and tip the balance toward conflict.

Environmental degradation can increase resource scarcity as traditional resource sources like fish stocks, forests, and fertile soil, decline. The impacts of climate change, in particular, can further stress an already fragile state by worsening environmental degradation, increasing pressure on all levels of society and could worsen socio-economic and political tensions particularly in societies dependent on natural resources. Barnett argues that environmental change can undermine a state's legitimacy in the eyes of its people when it is unable to correct or prevent damage done to economic livelihoods, human health, food and water security. And whether or not a state is able to prevent such impacts, the state's own resources, capacity and even military strength may be lessened, providing an opportunity for insurgents. An extra drain on resources also means less money going to other needy areas.¹⁵⁴

Bernauer, meanwhile suggests that whether climate change leads to conflict hinges on the ability of the state to settle or moderate grievances before they lead to outright conflict, and that democracy in particular is an important intervening variable, as democratic systems are better able to avoid violence during economic downturns. He posits that climate change, by reducing a country's rate of economic growth, can reduce the amount of resources available to the government both to correct climate-related

¹⁵³ Surendrini Wljeyaratne, *Fragile Environment, Fragile State: What Role for Conflict-Sensitivity and Peace-Building?* Discussion Paper (Canadian Council for International Cooperation, 2009)

¹⁵⁴ Barnett and Adger, "Climate Change, Human Security and Violent Conflict."

damages and to maintain general stability, thus weakening its capacity to provide for its people. Loss of legitimacy would follow quickly.¹⁵⁵

4.3.d: The Migration Pathway

As we saw in Section 2.2.a, migration can be a source of conflict when it disrupts an established ‘balance of power’ between ethnic and religious groups within sending and receiving populations. We also saw that people migrate based on a wide variety of push-pull factors. The question is whether climate change will lead to an increase in the number of migrants, and or generate large numbers of internally displaced peoples. Thus, the migration pathway from climate change to conflict would work through migratory patterns and the demographic dynamics of sending and receiving states.

The International Organization for Migration (IOM) organizes the effects of climate change into two sets of migration drivers: climate processes, where long-term changes in a region’s environment changes people’s incentives (through income loss, loss of housing, increased scarcity, etc) to remain in a particular location.¹⁵⁶ Climate events on the other hand, are sudden cataclysmic events like floods, glacial lake outbursts, and hurricanes that can displace large numbers of people in a hurry. Clearly, if people’s homes are destroyed and fields washed away, they may seek new livelihoods elsewhere. A person’s ability to migrate depends on his level of mobility, which is a function of his

¹⁵⁵ T. Bernauer, A. Kalbhenn, V. Koubi, and G. Ruoff, “Climate Change, Economic Growth, and Conflict,” *Climate Change and Security* (2010): 21–24.

¹⁵⁶ O Brown, *Climate Change and Migration*, IOM Migration Research Series (Geneva, Switzerland: International Organization For Migration, 2008).

or her resources on hand, along with other forms of social and financial capital.¹⁵⁷ Of course, this only applies to migration and not forced displacement.

Whether people choose to leave their homes or are driven from them, they tend to follow one of the four main types of migratory movement: international migration, internal displacement, rural to urban migration and temporary migration. International migration is what most people think of when it comes to migration. In terms of environmental and climate migration, the crossing of international borders is rather rare, despite the common conception of hordes of poor people moving to developed countries.¹⁵⁸ Those that do cross international borders tend to follow preexisting routes, especially to those places where they have familial and social ties.

A vast majority of those uprooted by environmental and climactic changes move within their country of origin. Instead of going abroad, they become internally displaced and either end up in the country's central cities or in refugee camps. When long-term changes like droughts set in, rural to urban movement becomes a commonplace response. When those who subsist on local agriculture for their livelihood can no longer make a living, they tend to head to the nearest urban center, looking for jobs. The IOM outlines four major consequences of such forced migration. First, rural to urban population movements due to increasing food and water security will put increased pressure on existing urban infrastructures and services which in many cities of the developing world are already severely strained. The second major consequence is that economic and brain

¹⁵⁷ Ibid

¹⁵⁸ V Kolmannskog, *Future Floods of Refugees: A comment on climate change, conflict and forced migration* (Oslo, Norway: Norwegian Refugee Council, 2008).

drains will occur in the countries of origin further weakening the potential for future economic growth across the developing world. Third, the influx of large numbers of environmental refugees to new areas will result in increased ethnic tensions as different groups once separate mix and as the newcomers begin to compete with those already established for limited and in many cases decreasing resources. The fourth major consequence has to do with human health and welfare. In general, as populations move, disease goes with them. But massive numbers of environmental refugees displaced in camps or crammed into urban slums represent a particular threat of increased disease activity as poor sanitary conditions combine with the difficulty of providing vaccinations and medical treatment to the displaced.

4.3.e: Rapid versus Gradual Change

Adaption takes time. With slow moving climatic changes, a society has time to adapt to the changing climate without becoming unduly stressed; it can build elaborate waterworks and levees, relocate cities, develop new crops and farming methods designed for a warmer/drier climate. Successful adaptation to climate change would limit or even negate the potential of climate change to drive conflict, as peaceful options would still be readily available to those groups who might otherwise turn to violence. This is one of the central arguments of climate-conflict skeptics (and Cornucopians), that humans are creative and flexible creatures, and that climate-conflict supporters tend to adopt a stance

of environmental determinism.¹⁵⁹ And for the most part, the climate conflict skeptics would seem to be correct, as, barring non-linear or abrupt climate change scenarios, the increasing temperatures, rising sea levels, shifting precipitation patterns, and desertification that are the hallmarks of climate change are all slow moving phenomena giving people time to undertake adoptive measures. But climate change also includes rapid phenomena: more extreme storms and floods, and short-term extreme heat waves and droughts. A fast moving natural disaster like a hurricane allows for quick evacuations and sandbagging but not long term adaptive measures. Thus, it would stand to reason that a natural disaster would be more likely to drive conflict than a 1°C increase in average temperatures over a decade or more. And what we can see is that the impact of natural disasters fit quite nicely into the four pathways to conflict described above.

Natural disasters like hurricanes and floods can inflict major economic damage to a state, as infrastructure is destroyed, lives are lost, productivity in the region grinds to a halt, and money is redirected to support rebuilding efforts. Depending on the size of the disaster, a state can see an overall decline in GDP—which fits with the economic pathway from climate change to conflict. Brancatti makes a similar economic causal argument in his study on the effect of earthquakes on intra and interstate conflict. He found that because of their rapid onset and lack of warning, earthquakes were more likely to lead to conflict by causing affected groups to undergo a direct and dramatic increase in

¹⁵⁹ Homer-Dixon does warn of not falling into the trap of environmental determinism, but he also stresses that we should not invest too much faith in the potential of human ingenuity to respond to multiple, interacting, and rapidly changing environmental problems (Homer-Dixon Threshold). He argues that as climate change undermines state and society, there can develop an ingenuity gap—as people are unable to overcome recent changes even if they may once have had the means to adapt.

relative deprivation (thus stoking anger and resentment). He suggests that other similarly rapid natural disasters might have the same effect.¹⁶⁰ Hendrix and Glassier also argue that because short term or rapid onset climatic changes will likely lead to immediate reductions in income, people will be less able to take adaptive measures.¹⁶¹

Natural disasters can also undermine a state's ability to maintain security in the affected region, as was seen in Haiti after the 2010 earthquake, and in Pakistan after the 2010 floods. The destruction of infrastructure and redirection of government funds and attention is one reason for this, but as Buhaug argues, the humanitarian aid that often pours into the affected region can provide an easily lootable resource, a la the greed theory of conflict causes, and the inevitable orphans left in the disaster's wake can become ready recruits for militias. Disasters therefore decrease the opportunity cost for group conflict by weakening the state and providing new resources—the weak state pathway.

Increased resource scarcity tends to be a standard outcome of most disasters as crops are destroyed, water sources are polluted and the normal means of goods and electricity transport and distribution are disrupted. Following a sufficiently large disaster, the government and international community may be hard-pressed to provide needed food and water before secondary human tragedies occur. Poor aid response and slow/uneven aid distribution has often been a source of public grievance against the state

¹⁶⁰ D. Brancati, "Political Aftershocks: The Impact of Earthquakes on Intrastate Conflict," *Journal of Conflict Resolution* 51, no. 5 (2007): 715.

¹⁶¹ C Hendrix and S Glaser, "Trends and Triggers: Climate, Climate Change and Civil Conflict in Sub-Saharan Africa," *Political Geography* 26, no. 6 (2007): 695-715.

and or the international community—with unequal distribution being worse than slow but even distribution. This fits well with the resource scarcity pathway.¹⁶²

Finally, immediate displacement, resource shortages, economic damages and a decline in personal security, may result in large-scale population movements over short periods of time, with people often moving to urban areas already straining to support fast growing populations. As with climate change itself, the pace of migration can be more important than absolute numbers, as a flood of post-disaster refugees can quickly overwhelm the receiving area's resources, driving new intergroup tensions as established and displaced groups struggle for resources—the migration pathway.

Thus, while not a pathway to conflict itself, the pace of climate change and the impact of rapid extreme events may prove a deciding factor between a society or state being able to cope with and employ adaptive measures to changes in its environment, thereby staving off conflict, and being overwhelmed to the point where conflict becomes possible or more likely.

¹⁶² S. Schell-Faucon, “Disaster Management in Conflict Situations: International Experience Before and After the Asian Tsunami,” in *A New Dynamic for Peace* (Bonn, Germany: Friedrich-Ebert-Stiftung, 2005), 8–18.

Section 5: Case Studies, the Climate-Conflict Pathways in Action?

Section 5.1: Farmer-Herder Conflicts

Perhaps the best evidence for a climate-conflict connection comes from the African Sahel where farmer-herder conflicts have become more frequent and more widespread over the last century, and especially the last fifty years. According to Davidheiser and Ofouku, a combination of historical, social, and environmental factors have come together to disrupt established patterns of interactions and promote the outbreak of violent conflict. During the colonial period, changes in land tenure systems brought about the rise of resource intensive cash cropping. The resulting environmental degradation, coupled with increasing human and livestock populations in the region, the advent of longer, more severe droughts, and increasing north-south migration have all increased competition over land and water between the nomadic herders and sedentary farmers that inhabit the region.¹⁶³

The changing climate has been particularly important in driving the most recent conflicts as increasingly arid conditions across the Western Sahel have driven thousands

¹⁶³ Mark Davidheiser and Aniuska Luna, "From Complementarity to Conflict: A Historical Analysis of Farmer-Fulbe Relations in West Africa," *African Journal on Conflict Resolution* 8, no. 1 (2008): 77-104; A. U. Ofuoku, "The Role of Community Development Committees in Farmer-Herder Conflicts in Central Agricultural Zone of Delta State, Nigeria," *Studies (IJRS)* 16, no. 1 (2009).

of Fulbe and Fulani-Hausa herders out of their traditional lands south into farming lands. The influx of herders and their flocks have resulted in disputes over watering holes, migratory routes, dry-season farming, crop destruction, etc, that often become violent and drag in whole tribal units. Where herders and farmers have traditionally coexisted, such conflicts are rare, as local institutions exist to curb such conflicts. But areas where the two populations have just begun to interact do not have such institutions. Farmer-herder conflicts have now occurred in Nigeria, Cote de'Ivoire, Cameroon, Senegal, Mali, northern Kenya, and Somalia.

Nigeria is the poster child for the standard drivers of conflict. Its borders enclose a massive, rapidly growing population riven by ever more entrenched ethnic, religious, and political divisions, all while being governed by a government unable to moderate or mediate the ever-increasing number of conflicts spreading across its territory. But for the purposes of this paper, we shall concentrate on just one of the country's many conflicts: the ongoing conflict between nomadic pastoralists and sedentary farmers. Small-scale, localized violence between herders and farmers have been a common feature of life in Nigeria's northeastern states for decades. But in recent years the violence has grown more pronounced and widespread.¹⁶⁴ Since 1999, the northeastern states of Bornu, Yobe, Taraba, Gombe, Bauchi, Benue, and Nasarawa have all seen violent clashes between the numerous ethnic groups inhabiting the region, with the herder farmer conflict being the most common but not the only form of conflict. The conflict between herders and farmers boils down to disputes over land and access to water resources aggravated by ethnic

¹⁶⁴ R. Blench and Dendo Mallam, *Natural Resource Conflicts in North-Central Nigeria: A Handbook and Case Studies* (London: Mandarax Publishing, 2004).

differences; the nomadic herders tend to be of the majority Fulani-Hausa Muslim group while the sedentary farmers tend to be Christian Tivs along with other minority groups. Central to the conflict are the enclosure of grazing lands by farmers, blocked access to watering holes, trespassing, and cattle-damaged crops¹⁶⁵. Most clashes go unreported, except when they reach a significant level; in 2001, the Nigerian military went in to Benue state to stop fighting between Jukuns and Tivs (two sedentary groups) over access to traditional homeland territory, that led to 200 civilians being killed.¹⁶⁶ In 2003, nomadic herdsman from Chad attacked a rural village in response to violent grazing land disputes the year before between farmers and herdsman in the area leading to dozens of deaths.¹⁶⁷

According to Obioha, conflicts over land account for more than 50% of all communal clashes experienced in Nigeria from 1991 to 2005. Land-rights, access and ownership lie at the heart of the pastoralist-farmer conflict. Obioha found that many tribal clashes are due to the scramble for arable land and water sources by ‘peasant populations’ as the growing economic divide between wealthy and poor rural dwellers have led to a shortage of good land. Accelerating desertification in the Sahel region of northern Nigeria has been a primary push-factor in the movement of Fulani-Hausa herds southwards into established farmlands, upsetting long-standing customs of fair land use. Climate change can thus be seen as a direct source of the confrontation between ethnic

¹⁶⁵ A. D. Olabode and L. T. Ajibade, “Environment Induced Conflict and Sustainable Development a Case of Fulani-Farmers’ Conflict in Oke-Ero Lgas, Kwara State, Nigeria,” *Journal of Sustainable Development in Africa* 12, no. 5 (2010).

¹⁶⁶ L. Roma, “Climate Change, Population Drift and Violent Conflict Over Land Resources in Northeastern Nigeria,” *J. Hum. Ecol* 23, no. 4 (2008): 311–324.

¹⁶⁷ Ibid.

groups in the region.¹⁶⁸ Climate change has also helped foster conflict between sedentary farming communities of different ethnic backgrounds as agriculturally productive land becomes scarcer. With Nigeria, we can see the Resource Scarcity, and Migration pathways as being especially prominent, but the Weak State pathway is also present.

In northern Kenya, low-level conflicts between farmers and herders and between different herding clans have become commonplace over the last fifteen years. As with other such conflicts, the primary conflict flashpoints are contested watering holes, grazing land and trampled crops. As drought conditions became the norm ten years ago, nomadic herders in the north began pushing south, triggering conflicts with the farmers already inhabiting the south.¹⁶⁹

Even though all of these conflicts are considered low-level and would likely pass under the radar of most quantitative studies of environment-conflict linkages, they are of major importance to the countries affected, especially economically. Livestock production in northern Kenya provided some 10% of the country's GDP in 2001 and accounts for 90% of all employment in the northern provinces. Overall, Kenya's agricultural sector provided 27% of the country's GDP in 2005. When herders and farmers fight, livestock and crop yields fall, and so do people's livelihoods.¹⁷⁰

Somalia, of course, has seen high-level conflict for more than a decade now. But here too, there are herder-farmer conflicts and tribal clashes over land and water, made

¹⁶⁸ Ofuoku, "The Role of Community Development Committees in Farmer-Herder Conflicts in Central Agricultural Zone of Delta State, Nigeria."

¹⁶⁹ Wljejyartne, *Fragile Environment, Fragile State: What Role for Conflict-Sensitivity and Peace-Building?*.

¹⁷⁰ Ibid

worse by high numbers of internally displaced peoples. Somalia is currently undergoing the worst drought the region has seen in over 60 years. It is currently sending two thousand people a day across the border into Northern Kenya. Even without the current drought, relatively peaceful Puntland has seen frequent clashes between herding and farming groups over access to crop/grazing land and water sources.¹⁷¹ As in Kenya, livestock and farmland are incredibly important and worth fighting for, especially when threatened by drought and population movement.

Section 5.2: More Controversial Conflicts

Rwanda: Pre-genocide Rwanda was very much an agrarian country, despite its densely populated nature. 95% of the country's population lived in the countryside and 90% of all workers in the country were employed in the agricultural sector. The result of such concentrations in rural areas and agriculture meant that most of the country's population relied heavily on renewable resources like arable land and forest for sustenance and livelihoods.¹⁷² Rwanda suffered from declining of soil fertility, watershed degradation, and deforestation, all of which increased food, water, and land scarcity even as demand for these resources continued to grow (rising incomes and population growth). Erosion of farmland in the country was especially bad due to the country's hilly nature and poor agricultural practices. Half of all farmlands in Rwanda are located on hillsides, making them prone to erosion. According to Percival and Homer-Dixon, heavy rainfall events

¹⁷¹ Per Wam, *Conflict in Somalia: Drivers and Dynamics* (Washington DC: World Bank, 2005).

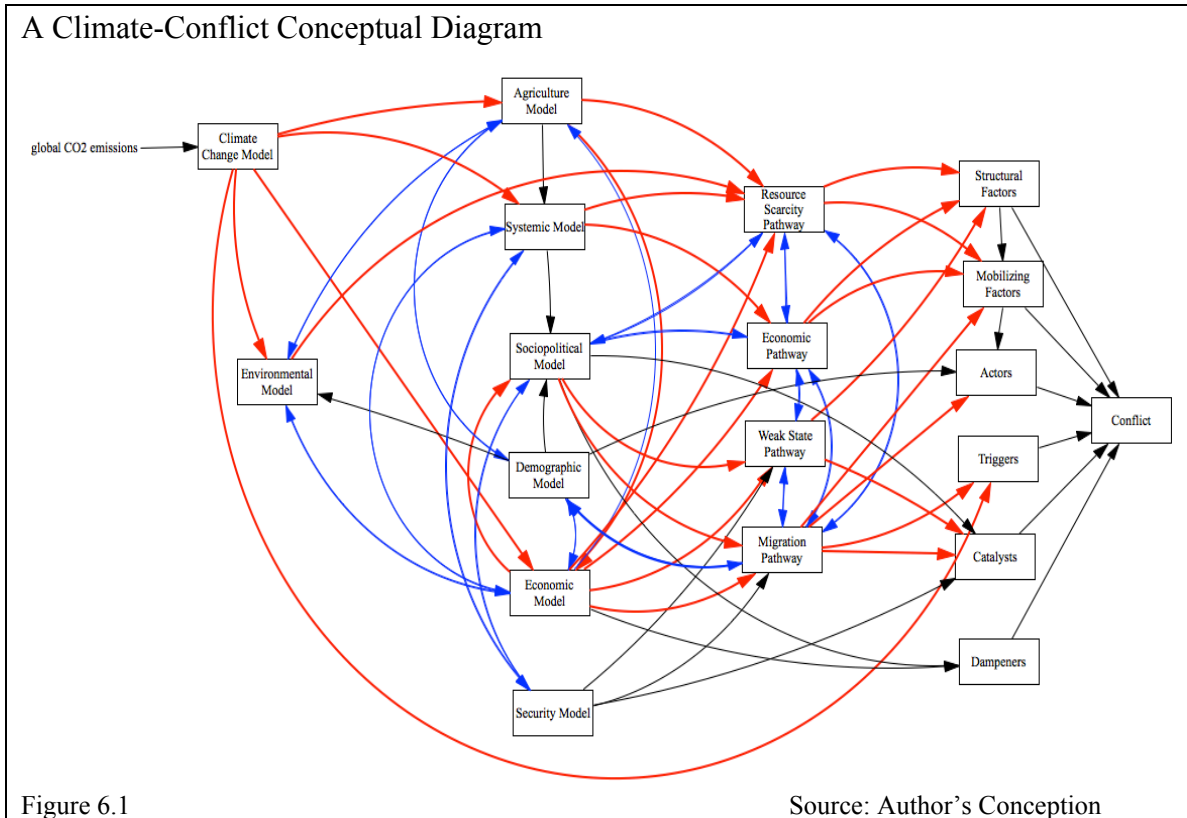
¹⁷² Hendrix and Glaser, "Trends and Triggers: Climate, Climate Change and Civil Conflict in Sub-Saharan Africa."

would wash away more than eleven tons of soil per hectare per year, sending some 12 million tons of soil into the country's rivers every year. Outside of the hills, over-cultivation was the primary reason for loss of soil fertility.

To make matters worse, several droughts in the 1980s and early 1990s further reduced water availability in areas already suffering from water scarcity due to the draining of wetlands and damaging of watersheds.¹⁷³ The result of these environmental woes was that agricultural production in Rwanda fell sharply and could no longer keep pace with the country's rapid population growth. As crop yields fell, people began to migrate to cities and as yet undamaged farmland. And as time went on, the Rwandan state began to lose legitimacy. But the Rwandan Genocide was clearly not entirely due to environmental stress and resource scarcity. As Percival and Homer-Dixon warn, such an explanation is too simplistic and ignores the many political, economic, and social factors that led to the other grievances that would eventually explode into the genocide. Still, it seems reasonable to argue that environmental scarcities, especially of arable land, worsened the situation, giving rise to new or strengthening existing grievances among the affected population.

¹⁷³ Ibid.

Section 6: Building a Climate-Conflict Forecasting Model



There are a number of different approaches to building a forecasting model of conflict: the quantitative econometric approach that relies on the collection of large data sets and tests for statistical significance of potential conflict drivers; the qualitative approach that uses expert knowledge and analysis of specific countries and or regions; and the comparative or structural analysis approach that looks at identifying common elements and conditions between past conflicts cases or between states currently seen to

be unstable.¹⁷⁴ Each of these approaches has drawbacks and limitations. On the quantitative end, there is the need for high quality data sets for significant periods of time along with the problem of having to be overly focused on specific drivers that may miss necessary nuance and having to rely on statistical significance when correlation may not mean causation. The qualitative approach suffers from the problem of subjectivity, and the comparative or structural approach again runs into correlation versus causation problems as well as being prone to painting with overly broad strokes in the sense that focusing on commonalities may leave out important differences between cases. As Goldstone argues, the best solution, it would seem, would be to combine, as much as possible, the three approaches into a single comprehensive framework. That is the approach taken here.

In the prior section of this paper, we identified four potential pathways from climate change to conflict: the resource scarcity pathway, economic pathway, weak state pathway, and the migration pathway. Each suggests a way in which the impacts of climate change on human societies might, if not lead directly to, at the least increase the possibility of violent intrastate conflict occurring. In Section 2, we outlined a number of widely regarded ‘standard drivers’ of conflict, each of which may play some role in driving intrastate conflict. Finally, in Section 3, we explored the factors that make Africa in particular more vulnerable than most regions both to conflict and to climate change. We also looked at what climate change may hold for Africa in the future. Having now assembled each piece, we can put together a comprehensive (as comprehensive as

¹⁷⁴ J. A Goldstone, *Using Quantitative and Qualitative Models to Forecast Instability*, Special Report (Washington DC: United States Institute of Peace (USIP), 2008).

practical anyways) model of the interconnections of all these pieces, which will in turn allow us to construct a conceptual framework for forecasting future climate conflicts.

Basic Components: The modular approach to building a conflict forecasting model is in response to the inevitable complexity that arises when one tries to map out all the reciprocal connections between the various elements that make up such a model. The best way to think about the modular approach is to think of each component (a component covers a category of drivers like demographics, economics, etc) as a module that contains a number of subcomponents within it. The model is then organized in such a way as to provide two levels of analysis: components that link to each other and subcomponents that link to each other. The interconnected modules are then ‘plugged into’ the four climate-conflict pathways and the conflict framework developed in section 2.xxx.

Section 6.2: The Component Modules

Climate Change Module: the climate change component module includes the factors that determine its severity, namely the level of global carbon dioxide and other greenhouse gas emissions, the stock of CO₂ currently in the atmosphere, the loss of carbon-sequestering natural habitats, and carbon uptake and human attempts at mitigation; it also includes the forward linkages to other modules. It is possible to get quite detailed here, given all that the level of CO₂ emissions depends on, the world’s energy sector, agriculture, etc. So, for the sake of simplicity, we assume a single carbon emissions input based on existing emissions scenarios like the IPCC’s A1B1 scenario, or

the IFs emissions forecasts. The climate change module contains five main subcomponents that have forward linkages to the rest of the model: the probability of extreme weather events, changes in precipitation patterns, changes in temperature, sea level rise, and CO₂ fertilization. Also, because African countries generate comparatively small amounts of CO₂, we have left out the feedback mechanism from the economic and agriculture modules that would lead back to climate change, though this may be added in the future.

The Climate module is directly connected to the Agricultural, Economic, and Environmental Modules, due to climate change's impact on crop yields, agriculturally based livelihoods, storm related economic damage, and land degradation due to desertification and increased erosion, respectively. The module is also directly connected to the triggers factor of the conflict model, as extreme weather events may act as sparks, touching off an already building conflict, and to the Demographic module due to an increasing burden of communicable disease. The climate module is also indirectly linked, primarily through its economic and agricultural impacts, to the sociopolitical and systemic modules, because its effects, prevention and or adaptive measures can drain state resources, and because it can influence whether a country will seek outside aid money and or increased food imports respectively.

The Environment Module: the environmental module includes within it the stocks of arable land, water resources, forestry, and fisheries in each country. The module is directly linked with climate change, due to the impact a changing climate will have on

natural ecosystems, as well as the Agricultural, Demographic, and Economic modules, which represent patterns of land use, the demand for natural resources, as well as a population's environmental footprint. It is also directly connected to the resource scarcity pathway as the health of the environment is one of the major factors determining the level of natural resources available. The environmental module is also indirectly connected to state capacity and state legitimacy (of the Sociopolitical Module) as an environment in decline may not only drain state resources, it may also cost a state legitimacy either by letting environmental decline continue or by being seen as a direct contributor to the decline.

The Agricultural Module: this module includes several subcomponents: the amount of arable land and water used, crop yields, livestock production levels, and irrigation levels. The Agricultural module is directly linked to the Demographic module, as population size is a major determinant of food and water demand, as well as the Systemic module, as the level of a country's food production is a determinant in how much food the country imports. It is also directly linked with the Economic module, due to income generation, and the level of its dependency on agricultural production.

The Demographic Module: includes total population, population density and growth rate, the rate of urbanization, the population's age and sex structure, its ethnic and religious factionalization, and the burden of communicable disease within the population. The Demographic module is directly connected to the sociopolitical module, as

population pressures and specifically ethnic competition for state resources may shape the nature of the state. It is also directly connected to the economic module, as the size of a country's working-age population and the ratio of dependents to workers are both important for determining a country's economic growth. The Demographic module is also linked directly to the environmental module, in order to model carrying capacity. Finally, the module is indirectly connected to the actors factor of the conflict model as the ethnic and religious make up of the country may reveal which groups are more likely to take up arms.

The Economic Module: includes a country's GDP, its GDP per capita, the growth rate of each, the level of a country's economic dependence on agricultural production, the presence of economic discrimination, and the country's foreign debt level. The Economic module is a central component of the model, being directly connected to every other module except for Security—though should a measure of the black market be included, this would also prompt a direct connection. The linkages between the Economic module and climate change and environmental degradation will most likely be negative, weakening a country's economy depending on the severity of impacts. Demographics, of course, play an important role in terms of both current consumption levels and the possibility for future GDP growth. The economic module is also closely linked to the Agricultural.

The Systemic Module: includes a country's openness to trade, whether any of its neighbors are currently involved in conflict (inter or intra), how involved the country is in international organizations and treaties, and the amount of food the country imports. The Systemic module is directly connected to the Sociopolitical module, as a country's political system both can determine and be shaped by its involvement on the international state—with democratic or democratization states tending to be more open than others. It is also directly connected to the economic pathway as high levels of trade may help dampen economic losses from local declines in production and can provide an alternate, peaceful source of income, unless of course, the goods the country trades in are specifically affected by climate change.

The Sociopolitical Module: includes a country's regime type, whether the country is in the process of democratizing and or how far it is in that process, state capacity and state legitimacy. The module is directly connected to all of the main modules except for climate change and environment (there are, however, indirect connections which we will describe in a moment). Sociopolitical factors tend to mediate the impacts and interactions of all the other societal modules, as the political system and the political society tends to shape how the society behaves, from setting reproductive policy, or not, to negotiating international treaties and maintaining security within the country's borders. The Sociopolitical module is also indirectly connected to the Environmental and Climate Change modules as the state may see its legitimacy decline should it be unable to correct the environmental issues plaguing its people or should it be seen as having a hand in the

degradation in the first place. The module is also directly connected to dampeners and catalyst conflict factors, as the state is a primary player in most conflicts, and can either act as a dampener by suppressing possible conflict or as a catalyst by making a conflict worse whether by its own actions or a lack of action.

The Security Development Module: includes the prevalence of small arms in the country, the country's level of militarization, its geography, and whether it has a history of conflict. The module is directly connected to the Sociopolitical and Systemic modules. The Systemic because many small arms are likely to come from outside the country, and because whether neighboring states are currently or have recently experienced conflict will likely affect the country's level of militarization. The Sociopolitical module because state capacity and legitimacy both reflect and influence the country's level of security, and because the country's regime type and political structure may affect its ability to maintain control over its entire territory when conflict promoting terrain like mountains and jungles are present.

Adding the Pathways: as well as connecting with each other, the modules described above also fit directly and indirectly into the four climate-conflict pathways. The resource scarcity pathway is made up from the interactions between the Agricultural Module, Demographic Module, Economic Module, Environmental Module, Sociopolitical Module, and Systemic Module. Together, these modules encompass the three types of scarcities described by Homer-Dixon: environmental/supply based scarcities, demand

based scarcities, and structural scarcities. The economic pathway is made up from the interactions of the Economic Module, Sociopolitical Module and Systemic Module. The migration pathway is made up from the Demographic Module, Economic Module, Security Module, Security Module and Sociopolitical Module. Together these factors represent the push-pull factors that drive people to migrate, from population pressure to physical insecurity. Finally, the weak state pathway consists of Economic, Security and Sociopolitical factors. The Climate Change and Environmental modules are indirectly present in each pathway, as their effects are already felt in each individual module.

Tying it all to the Conflict Framework: the four climate-conflict pathways provide the primary connections between the modules and conflict factors. The resource scarcity, economic and weak state pathways all act as structural factors, creating the underlying conditions for conflict. But resource scarcity and economics can also provide motivation and opportunities for conflict (mobilizing factors). The migration pathway can act as a number of conflict factors: it can be a mobilizing factor by upsetting current political and demographic systems, a sudden influx of people into a region can act as a trigger, igniting existing but latent hostilities between ethnic/religious groups, and it can act as a catalyst, as refugee camps created by a conflict may give provide recruiting groups for various groups to continue fighting. Each of the four pathways, of course, can also feed off of and reinforce each other.

By using this modular structure, we can see how the impacts of climate change and environmental degradation ripple through the system, creating conditions more conducive to conflict occurrence.

Section 7: Conclusions

Whether environmental change, generally, or climate change, in particular, can cause conflict remains controversial and unproven. But this paper, by raising and answering five important questions, has been able to show that for vulnerable societies, environmental factors can indeed increase the potential for violent conflict within states, but by acting through or in accordance with other conflict promoting factors. In this conception, climate change becomes a threat multiplier, aggravating existing conflict drivers and weakening conflict dampeners, making intrastate conflicts more likely.

This paper began by asking five important questions: why do conflicts occur when and where they do? How might climate change effect vulnerable societies in Africa? Could these effects lead directly to violent conflict? Or might they instead drive conflict indirectly? And, finally, once we have established a connection between climate change and conflict, can we construct a climate-conflict model to serve as a basis for identifying future conflict hotspots? To answer these questions, we first developed our own conflict framework containing the various elements that ‘work together’ to generate conflict and which, through interaction, can cause a conflict to evolve once it is underway. We then looked at a number of structural drivers, from demographics to

domestic and international security, that the existing literature has found to influence the probability of conflict occurrence.

Once we had an understanding of the general factors that go into generating conflict, it became possible for us to qualitatively identify possible causal pathways by which the effects of climate change on vulnerable societies might increase the probability of conflict within those societies. We located these pathways by comparing the ‘standard’ drivers of conflict and the expected impacts of climate change, the pathways occurring where the drivers and impacts matched. We found four main climate-conflict pathways: the economic, resource scarcity, weak state, and migration pathway; where the economic pathway leads from climate change-related damage to agricultural production and infrastructure to economic downturn/loss of livelihoods, to conflict-causing grievances; the resource scarcity pathway leads from heightened environmental food and water scarcity to intergroup competition for resources to conflict; the weak state pathway from resource drains, direct damages and failure to protect to grievances; and the migration pathway, which leads from increased hardship and loss of livelihood, to rural to urban migration, to increased interethnic rivalry. We also found that the exact nature of the climatic changes, whether they occur gradually or rapidly, can have a great impact on the causal pathways, with rapid climatic events strengthening the pathway from climate to conflict and with gradual changes weakening the pathway, as such changes allow time for societies to adopt nonviolent coping measures instead of turning to conflict.

Finally, we turned to mapping these four pathways by building a conceptual model highlighting the linkages between climatic changes, the elements of our conflict

framework, from structural factors and motivating factors to conflict dynamics like catalysts and dampeners. The conceptual model nicely illustrates climate change's role as threat multiplier, but it is, of course, overly simplistic. The challenge, then, is to figure out the exact nature and relative strength of each interaction in the model—to quantify those relationships. The quantification of this paper's findings represents the next step in our goal of developing a forecasting model that has the potential to act as an early warning system, identifying potential conflicts before they occur. This, however, must be saved for a later paper.

Bibliography

- Aguilar, E., T. C. Peterson, P. Obando, R. Frutos, J. A. Retana, M. Solera, J. Soley, et al. "Changes in Precipitation and Temperature Extremes in Central America and Northern South America, 1961–2003." *J. Geophys. Res* 110 (2005).
- Ateem, E. S.M. "The Root Causes of Conflicts in Sudan and the Making of the Darfur Tragedy." In *Conflict Prevention and Development Co-Operation in Africa: A Policy Workshop*. Country Case Study. Wilton Park, Sussex, 2007.
- Barnett, J., and W Adger. "Climate Change, Human Security and Violent Conflict." *Political Geography* 26, no. 6 (2007): 639-655.
- Berazneva, J., and D. R Lee. "Explaining the African Food Riots of 2007-2008: An Empirical Analysis." In *Economic Development in Africa*. Oxford, UK, 2011.
- Bernauer, T., A. Kalbhenn, V. Koubi, and G. Ruoff. "Climate Change, Economic Growth, and Conflict." *Climate Change and Security* (2010): 21–24.
- . "Climate Change, Economic Growth, and Conflict." *Climate Change and Security* (2010): 21–24.
- Blench, R., and Dendo Mallam. *Natural Resource Conflicts in North-Central Nigeria: A Handbook and Case Studies*. London: Mandarins Publishing, 2004.
- Bloomfield, D., Y. Gai, and B. Reilly. *Analyzing Deep-Rooted Conflict*. Stockholm: International Institute for Democracy and Electoral Assistance, 1998.
- Brancati, D. "Political Aftershocks: The Impact of Earthquakes on Intrastate Conflict." *Journal of Conflict Resolution* 51, no. 5 (2007): 715.
- Brown, G., and F. Stewart. "Fragile States." In *UNU-WIDER Conference on Fragile States-Fragile Groups*, 2007.
- Brown, Lester, and Earth Policy Institute. *Plan B 3.0: Mobilizing to Save Civilization*. 1st ed. New York: W. W. Norton, 2008.
- Brown, O. *Climate Change and Migration*. IOM Migration Research Series. Geneva, Switzerland: International Organization For Migration, 2008.
- Brown, O., and A. Crawford. "Climate Change and Security in Africa." *Manitoba: IISD* (2009): 8.
- Brown, O., and R. McLeman. "A Recurring Anarchy? the Emergence of Climate Change as a Threat to International Peace and Security." *Conflict, Security & Development* 9, no. 3 (2009): 289–305.
- Brown, S., A. S Kebede, and R. J Nicholls. "Sea-Level Rise and Impacts in Africa, 2000 to 2100." *Unpublished report to Stockholm Environment Institute* (2009): 215.
- Buhaug, H., N. Gleditsch, and O. Theisen. "Implications of Climate Change for Armed Conflict." In *World Bank Workshop on the Social Dimensions of Climate Change*, 5–6. Washington DC: World Bank, 2008.
- Busby, Smith, White, and Gulledge. "Of Climate Change and Crystal Balls: The Future Consequences of Climate Change in Africa". New Orleans Hilton Riverside Hotel, 2010.

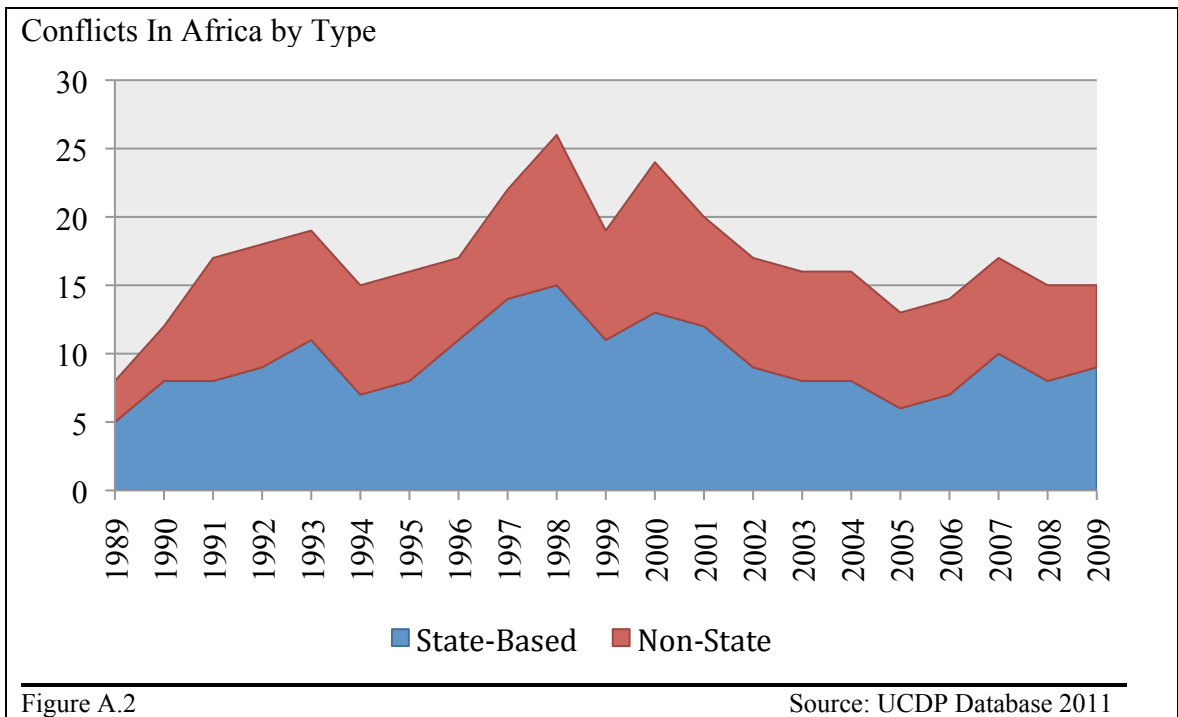
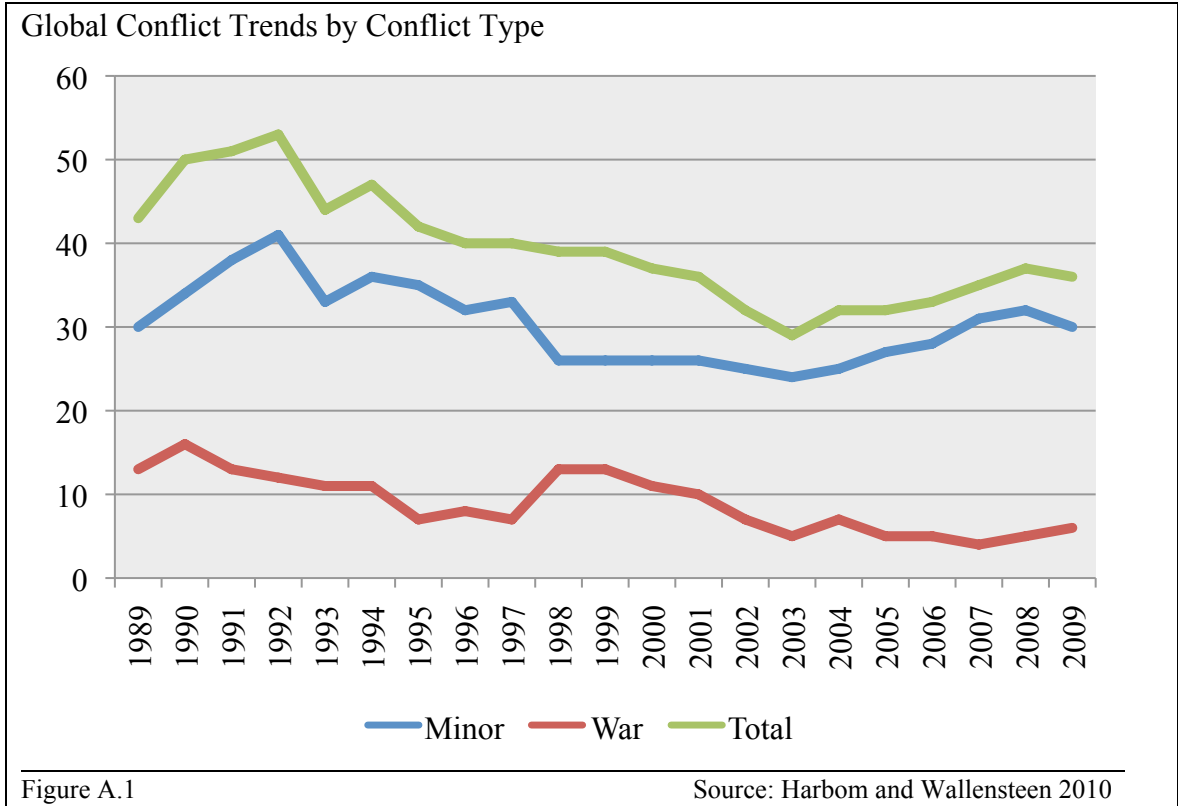
- Busby, Smith, White, and Strange. *Locating Climate Insecurity: Where Are the Most Vulnerable Places in Africa?* Climate Change and African Political Stability. The University of Texas at Austin: Robert S. Strauss Center for International Security and Law, 2010.
- Bush, Ray. "Food Riots: Poverty, Power and Protest." *Journal of Agrarian Change* 10, no. 1 (January 2010): 119-129.
- Byman, D., and S. Van Evera. "Why They Fight: Hypotheses on the Causes of Contemporary Deadly Conflict." *Security Studies* 7, no. 3 (1998): 1-50.
- Campbell, Kurt. *Climatic Cataclysm: The Foreign Policy and National Security Implications of Climate Change*. Washington D.C.: Brookings Institution Press, 2008.
- Cilliers, J., B. Hughes, and J. Moyer. *African Futures 2050-the next forty years*. Pretoria, South Africa; Denver, Colorado: Institute for Security Studies, Fredrick Pardee Center for International Futures, 2011.
- Cincotta, R., R. Engleman, and D. Anastasion. "The Security Demographic: Population and Civil Conflict After the Cold War (Washington, DC: Population Action International, 2003); and Bloom, Canning, and Sevilla." In *The Demographic Dividend*. Population Action International, 2002.
- Collier, P., and A. Hoeffler. "Greed and Grievance in Civil War." *Oxford Economic Papers* 56, no. 4 (2004): 563.
- Collier, Paul. "Economic Causes of Civil Conflict and their Implications for Policy." In *Leashing the Dogs of War: Conflict Management in a Divided World*, edited by Chester Crocker, Fen Hampson, and Pamela All. Washington DC: United States Institute of Peace Press, 2007.
- Conway, G. *The Science of Climate Change in Africa: Impacts and Adaptation*. Discussion Paper. London: Grantham Institute for Climate Change, 2009.
- Davidheiser, Mark, and Aniuska Luna. "From Complementarity to Conflict: A Historical Analysis of Farmer-Fulbe Relations in West Africa." *African Journal on Conflict Resolution* 8, no. 1 (2008): 77-104.
- Dixon, J. "What Causes Civil Wars? Integrating Quantitative Research Findings." *International Studies Review* 11, no. 4 (2009): 707-735.
- . "What Causes Civil Wars? Integrating Quantitative Research Findings." *International Studies Review* 11, no. 4 (2009): 707-735.
- Douma, P., G. Frerks, and L. Van de Goor. *Causes of Conflict in the Third World: Synthesis Report*. The Hauge, 1998.
- Dyer, Gwynne. *Climate Wars*. Carlton North Vic.: Scribe Publications, 2008.
- Elbadawi, I., and N. Sambanis. "How Much War Will We See? Estimating the Prevalence of Civil War in 161 Countries, 1960-1999." *Journal of Conflict Resolution* 46, no. 3 (2002): 307-334.
- Fearon, J. D, and D. D Laitin. "Ethnicity, Insurgency, and Civil War." *American Political Science Review* 97, no. 01 (2003): 75-90.
- Foresight. *The Future of Food and Farming*. Final Project Report. The Government Office for Science, London.: Foresight, 2011.

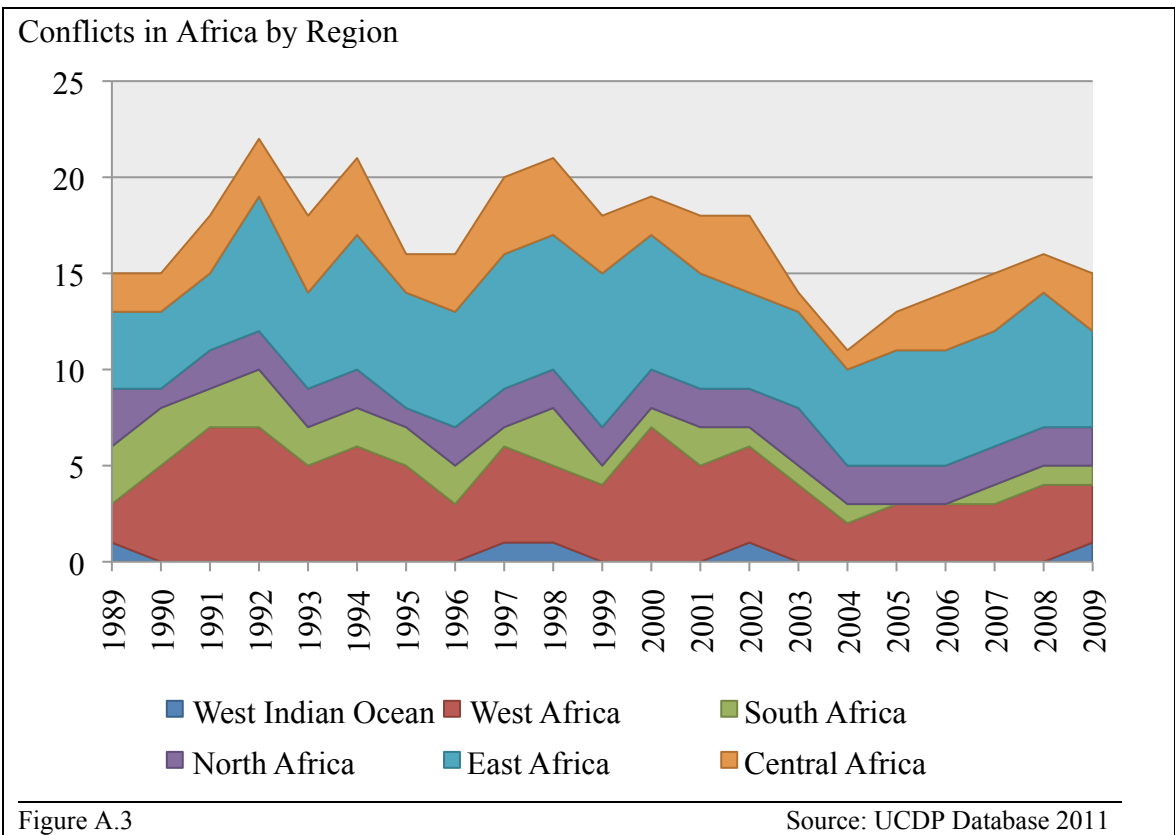
- Fukuda-Parr, S., M. Ashwill, E. Chiappa, and C. Messineo. "The Conflict-Development Nexus: A Survey of Armed Conflicts in Sub-Saharan Africa 1980-2005." *Journal of Peacebuilding and Development* 4, no. 1 (2008): 1–16.
- Goldstone, J. A. *Using Quantitative and Qualitative Models to Forecast Instability*. Special Report. Washington DC: United States Institute of Peace (USIP), 2008.
- Goodhand, J., T. Vaux, and R. Walker. *Conducting Conflict Assessments Guidance Notes*. Department for International Development, 2002.
- Goodhand, Jonathan. *Violent Conflict, Poverty and Chronic Poverty*. Chronic Poverty Research Centre, 2001.
- Gurr, T. R., M. Woodward, and M. G Marshall. "Forecasting Instability: Are Ethnic Wars and Muslim Countries Different?" In *Annual Meeting of the American Political Science Association, September*, 1–4, 2005.
- Hagmann, T. "Confronting the Concept of Environmentally Induced Conflict." *Peace, Conflict and Development* 6, no. 6 (2005): 1–22.
- Harbom, L., and P. Wallensteen. "Armed Conflicts, 1946-2009." *Journal of Peace Research* 47, no. 4 (2010): 501-509.
- Hauge, Wenche, and Tanja Ellingsen. "Beyond Environmental Scarcity: Causal Pathways to Conflict." *Journal of Peace Research* 35, no. 3 (May 1, 1998): 299 -317.
- Hegre, H., J. Karlsen, H. M Nygaard, H. Strand, and H. Urdal. "Predicting Armed Conflict 2010–2050." In *50th Annual Convention of the International Studies Association*, 15–18. New York, 2009.
- Hendrix, C, and S Glaser. "Trends and Triggers: Climate, Climate Change and Civil Conflict in Sub-Saharan Africa." *Political Geography* 26, no. 6 (2007): 695-715.
- Hewitt, J, Ted Gurr, and Jonathan Wilkenfeld. *Peace and Conflict 2010: Executive Summary*. University of Maryland: Paradigm Publishing, 2010.
- IIICR. *Conflict Barometer 2009*. Annual Flagship Report. Conflict Barometer. University of Heidelberg: Heidelberg Institute for International Conflict Research, 2009.
- Homer-Dixon, T. F. "On the Threshold: Environmental Changes as Causes of Acute Conflict." *International security* 16, no. 2 (1991): 76–116.
- Human Security Center. *Human Security Brief 2006*. Annual Flagship Report. Human Security Brief. University of British Columbia: Human Security Center, 2006.
- IIASA. *Climate Change and Extreme Events: What Role For Insurance?* Policy Brief. Laxenburg, Austria: International Institute for Applied Systems Analysis, 2009. www.iiasa.ac.at.
- Johnstone, Sarah, and Jeffrey Mazo. "Global Warming and the Arab Spring." *Survival* 53, no. 2 (April 2011): 11-17.
- Kolmannskog, V. *Future Floods of Refugees: A comment on climate change, conflict and forced migration*. Oslo, Norway: Norwegian Refugee Council, 2008.
- Marshall, M. G. *Conflict Trends in Africa, 1946-2004: A Macro-Comparative Perspective*. Arlington, VA: Center for Systemic Peace, 2006.
- Marshall, M. G, and B. R Cole. *Global Report 2009: Conflict, Governance, and State Fragility*. George Mason University: Center for Systemic Peace and Center for Global Policy, 2009.

- Marshall, Monty. *Conflict Trends in Africa, 1946-2004 a Macro-Comparative Analysis*. Report prep. for Africa Conflict Prevention Pool (ACPP). Arlington, VA; London: Center for Systemic Peace; Department for International Development, 2006.
- McMullen, C. P., and J. Jabbour. *Climate Change Science Compendium 2009*. Nairobi, Kenya: United Nations Environment Program, 2009.
- McMullen, Catherine, and United Nations Environment Programme. *Climate change science compendium 2009*. Nairobi Kenya: UNEP, 2009.
- Medany, M., I. Niang-Diop, T. Nyong, and R. Tabo. "Background Paper on Impacts, Vulnerability and Adaptation to Climate Change in Africa". Accra, Ghana: African Workshop on Adaptation Implementation of Decision 1/CP.10 of the UNFCCC Convention, 2006.
- Murshed, Syed Mansoob, and Mohammad Zulfan Tadjoeeddin. "Revisiting the greed and grievance explanations for violent internal conflict." *Journal of International Development* 21, no. 1 (January 2009): 87-111.
- Ofuoku, A. U. "The Role of Community Development Committees in Farmer-Herder Conflicts in Central Agricultural Zone of Delta State, Nigeria." *Studies (IJRS)* 16, no. 1 (2009).
- Ohlson, T. "Understanding Causes of War and Peace." *European Journal of International Relations* 14, no. 1 (March 2008): 133-160.
- Olabode, A. D., and L. T. Ajibade. "Environment Induced Conflict and Sustainable Development a Case of Fulani-Farmers' Conflict in Oke-Ero Lgas, Kwara State, Nigeria." *Journal of Sustainable Development in Africa* 12, no. 5 (2010).
- Picciotto, R. "State Fragility and Human Security in Africa." In *Conflict Prevention and Development Co-Operation in Africa: A Policy Workshop*, 10:1-25, 2010.
- Raleigh, C., and H. Urdal. "Climate Change, Environmental Degradation and Armed Conflict." *Political Geography* 26, no. 6 (2007): 674-694.
- Renaud, F. *Control, Adapt or Flee: How to Face Environmental Migration?* United Nations University; Institute for Human Security, 2007.
- Roma, L. "Climate Change, Population Drift and Violent Conflict Over Land Resources in Northeastern Nigeria." *J. Hum. Ecol* 23, no. 4 (2008): 311-324.
- Rotberg, R. I. "Failed States, Collapsed States, Weak States: Causes and Indicators." In *State Failure and State Weakness in a Time of Terror*, 1-25. Washington DC: Brookings Institution Press, 2003.
- Salehyan, I. "From Climate Change to Conflict? No Consensus Yet." *Journal of Peace Research* 45, no. 3 (2008): 315-326.
- Schell-Faucon, S. "Disaster Management in Conflict Situations: International Experience Before and After the Asian Tsunami." In *A New Dynamic for Peace*, 8-18. Bonn, Germany: Friedrich-Ebert-Stiftung, 2005.
- Smith, D. "Trends and Causes of Armed Conflict." In *The Berghof Handbook for Conflict Transformation*. Berlin: Berghof Research Center for Constructive Conflict Management, 2003.
- Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Averyt, M. Tignor, and H. L. Miller. *IPCC, 2007: Climate Change 2007: The Physical Science Basis*.

- Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. New York: Cambridge University Press, 2007.
- Stern, N. *The Economics of Climate Change: The Stern Review*. Cambridge UK; New York: Cambridge University Press, 2007.
- Stewart, F., D. Holdstock, and A. Jarquin. "Root Causes of Violent Conflict in Developing Countries Commentary: Conflict—from Causes to Prevention?" *British Medical Journal* 324, no. 7333 (2002): 342.
- The Environmental Food Crisis: The Environment's Role in Averting Future Food Crises*. A UNEP Rapid Response Assessment. Arendal Norway: UNEP, 2009.
- United Nations Environment Programme. *Global Environment Outlook 4: Environment for Development*. Nairobi Kenya: United Nations Environment Programme, 2007.
- Uppsala Conflict Data Program. "Definition of Armed Conflict - Uppsala University." *Department of Peace and Conflict Research*, n.d. http://www.pcr.uu.se/research/ucdp/definitions/definition_of_armed_conflict/ (accessed July 24, 2011).
- USAID. *Conducting a Conflict Assessment: A Framework for Strategy and Program Development*. Conflict Management and Mitigation. Washington, DC: USAID, 2005.
- Wallensteen, Peter, and Margareta Sollenberg. "Armed Conflict, 1989-2000." *Journal of Peace Research* 38, no. 5 (2001): 629 -644.
- Wam, Per. *Conflict in Somalia: Drivers and Dynamics*. Washington DC: World Bank, 2005.
- Watkis, Paul. "Economics of Climate Change: Key Messages". Kigali, 2009.
- Wimmer, A., L.-E. Cederman, and B. Min. "Ethnic Politics and Armed Conflict: A Configurational Analysis of a New Global Data Set." *American Sociological Review* 74, no. 2 (April 2009): 316-337.
- Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen (Germany). *Climate change as a security risk*. London: Earthscan, 2008.
- Wljeyaratne, Surendrini. *Fragile Environment, Fragile State: What Role for Conflict-Sensitivity and Peace-Building?* Discussion Paper. Canadian Council for International Cooperation, 2009. http://www.ccic.ca/_files/en/what_we_do/002_environmental_justice_2009-01-14_brief_3_adaptation_peacebldg.pdf.
- World Bank. *World Development Report 2010: Development and Climate Change*. World Development Report. Washington DC: World Bank, 2010.

Appendix A.1





Appendix B.1

African Cities Vulnerable to Sea Level Rise

Rank	Population Ranking		Asset Ranking	
	African Port City	Exposed Population (Thousands)	African Port City	Exposed Assets (US\$ Billions)
1	Alexandria, EGYPT	4103	Alexandria, EGYPT	528.2
2	Lagos, NIGERIA	3229	Abidjan, COTE D'IVOIRE	142.0
3	Abidjan, CÔTE D'IVOIRE	3110	Lagos, NIGERIA	117.3
4	Lomé, TOGO	858	Banghazi, LIBYAN ARAB JAMAHIRIYA	48.8
5	Conakry, GUINEA	496	Lome, TOGO	42.0
6	Maputo, MOZAMBIQUE	384	Conakry, GUINEA	30.1
7	Dare-es-Salaam, TANZANIA UNI REP	351	Algiers, ALGERIA	14.4
8	Banghazi, LIBYAN ARAB JAMAHIRIYA	143	Casablanca, MOROCCO	12.1
9	Dakar, SENEGAL	131	Durban, SOUTH AFRICA	11.6
10	Mogadishu, SOMALIA	115	Maputo, MOZAMBIQUE	10.7
11	Casablanca, MOROCCO	88	Dakar, SENEGAL	7.7
12	Douala, CAMEROON	78	Cape Town, SOUTH AFRICA	6.8
13	Algiers, ALGERIA	67	Douala, CAMEROON	5.4
14	Accra, GHANA	51	Dare-es-Salaam, TANZANIA, UNI REP	5.3
15	Durban, SOUTH AFRICA	42	Rabat, MOROCCO	4.9
16	Rabat, MOROCCO	35	Accra, GHANA	4.0
17	Cape Town, SOUTH AFRICA	25	Tripoli, LIBYAN ARAB JAMAHIRIYA	3.3
18	Luanda, ANGOLA	18	Mogadishu, SOMALIA	2.1
19	Tripoli, LIBYAN ARAB JAMAHIRIYA	10	Luanda, ANGOLA	1.1
TOTAL		13332		997.73

Figure B.1

Source: S. Brown, A. S Kebede, and R. J Nicholls, "Sea-Level Rise and Impacts in Africa, 2000 to 2100," *Unpublished report to Stockholm Environment Institute* (2009): 215.

Appendix B.2

Map of Vulnerable Cities and Populations

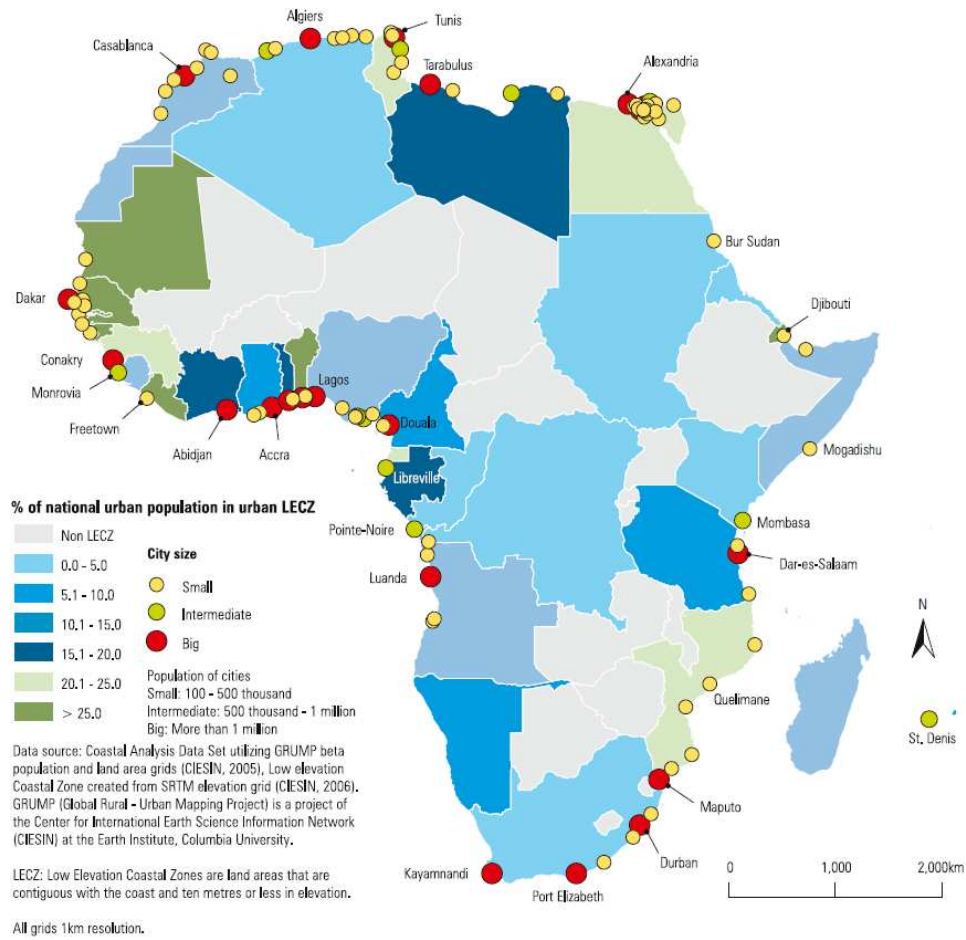


Figure 2: African cities at risk due to sea-level rise (including St. Denis in Reunion) (Taken from UN-HABITAT, 2008).

Figure B.2

Source: Ibid.

Appendix C.1

Climate-Conflict Pathway Model with Drivers

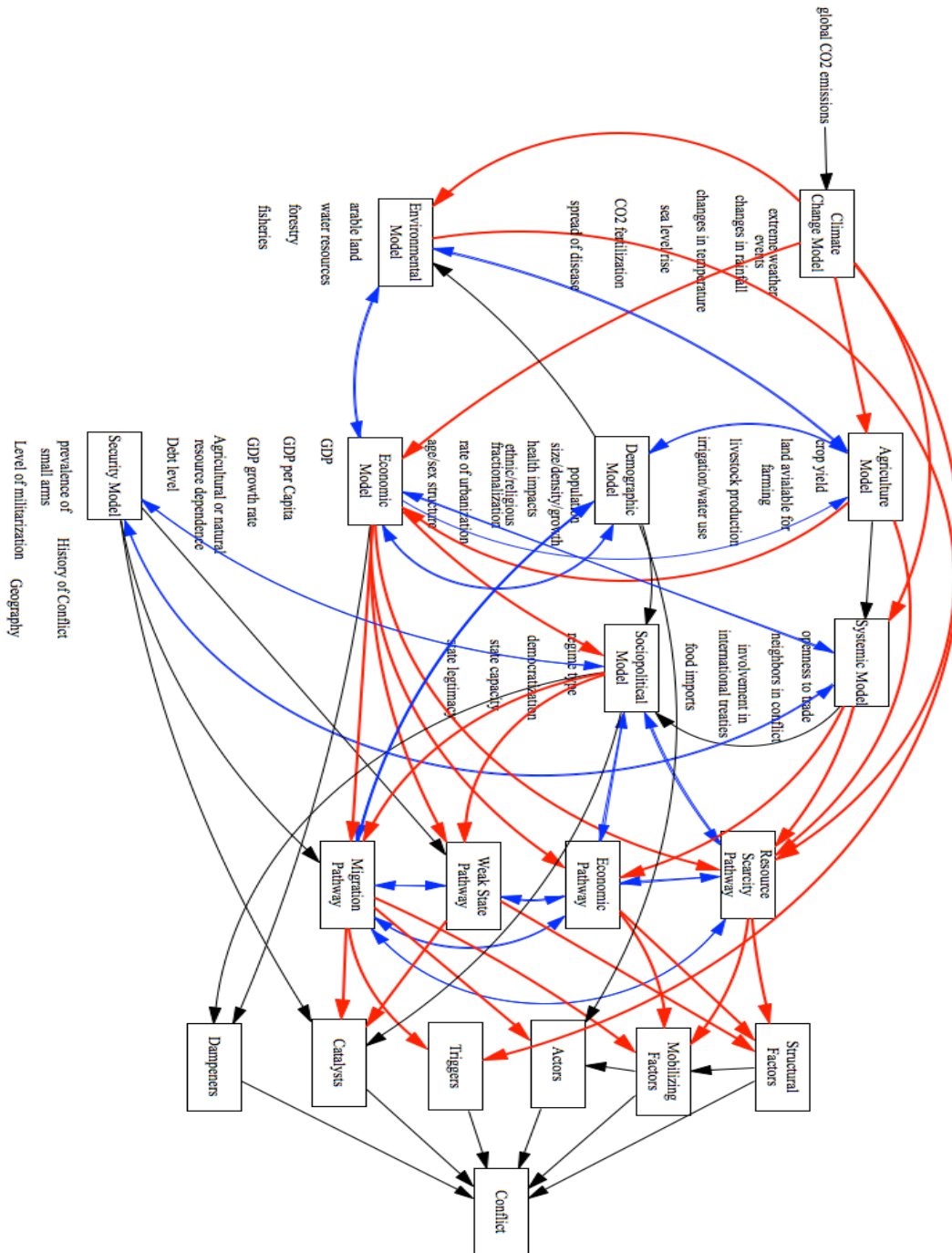


Figure C.1

Source: Author's Conception