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The Drier the Land, The Higher the Chance?: An Examination of the Relationship Between Water Availability and Civil Conflict and Its U.S. National Security Implications

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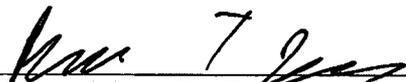
THE DRIER THE LAND, THE HIGHER THE CHANCE?: AN EXAMINATION OF
THE RELATIONSHIP BETWEEN WATER AVAILABILITY AND CIVIL
CONFLICT AND ITS U.S. NATIONAL SECURITY IMPLICATIONS

By
Sailer E. Perkins

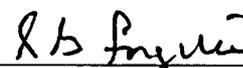
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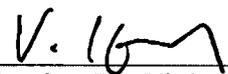
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It is to my parents Phillip and Angela Perkins that I dedicate this work, for their unending support and loving advice throughout my college career. Thank you for always encouraging my curiosity and drive to learn. I hope this makes you proud, and I am so grateful that you have always pushed me to pursue my dreams. Love always, your tiny dancer. Finally, I would like to thank two people very close to my heart: Beau Brawner for telling me all year to "keep my chin up" through the stressful times, and Kalee Jones for sitting in the study boat with me.

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ABSTRACT

SAILER E. PERKINS: The Drier the Land, the Higher the Chance?: An Examination of
The Relationship Between Water Availability and Civil Conflict Onset and Its Us
National Security Implications
(Under the direction of Dr. Benjamin Jones)

This thesis uses quantitative and qualitative methods to examine the relationship between water availability and civil conflict through an ethnic conflict lens. It further applies the trends observed in this relationship to United States National Security concerns to provide real-world applications of the knowledge gained. Consisting of quantitative and qualitative parts, this thesis uses logit analysis of data to test for significance in the water-conflict relationship then conducts a case study on Israel and Palestine, Darfur, and ISIS in Iraq to examine how water impacts conflict in true situations.

This thesis posits that increased measures of ethnic divisiveness, monopolization of power, autocratic rule, and shorter period of peace will inform the relationship that greater supply, demand, or structurally induced water scarcity will increase the likelihood of violent or nonviolent conflict onset. Although no reliable significant relationships were found, this result indicates that water is more likely an indirect contributor to conflict through the social processes it initiates than a consistently measurable cause of conflict. Through the case studies, this thesis finds that hydrological factors, lack of adaptation ability to environmental changes, information problems, and social processes triggered by water issues are indications that water may be contributing to conflict potential in real cases.

Therefore, this thesis concludes that although statistical relationships between water scarcity and conflict outcomes eluded the analysis, there are observable instances in which water issues contributed indirectly to creating conditions favorable for conflict. In terms of United States national security interests, this conclusion necessitates that in order to predict and prevent water-related insecurity and instability, it is essential that the United States take initiative to promote knowledge of future environmental changes, their impacts on water and social stability, and effective adaptations for unclear future conditions.

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CHAPTER 1: INTRODUCTION

A day without easy access to useable water, much less a week or month, is an experience nearly inconceivable in developed areas and yet altogether common outside of them. However, in the face of ongoing water resource degradation, population growth, and the looming threat of the effects of climate change on already scarce resources, water stands to be an increasingly prevalent source of concern for communities around the world (Gunasekara et. al., 2013). In fact, the per capita freshwater availability is set to continue on a downward trend worldwide, with a number of nations seeing expected decreases putting them far below the recommended minimum of 1000 cubic meters per capita per year by 2025 (Homer-Dixon, 1999). How do states decide to allocate water resources when there is so little to go around? Even today, one does not have to look very far to see the effects of water scarcity in such cases. For example, access to water has been and will continue to be a core sticking point of the Israeli-Palestinian conflict and has only prolonged and exacerbated violence, animosity, and political conflict between the groups. In conflicts such as this, where existing societal divides meet water scarcity and preferential allocation, interests in control over water resources are likely to incentivize competing groups to act to secure what they can for the present and the future. Considering the high probability that in many areas water insecurity will only worsen in the coming decades, the dire need to secure this resource will also increase accordingly and likely exacerbate tensions among competing groups as allocation and access vary between them. This area of study attempts to find relationships between water and

conflict with the intent of being better able to identify potential trouble areas and mitigate the effects of the relevant factors. The capture of the popular imagination with concerns of water wars and violence in recent years, compounded by fears of climate change-induced shortages of water in the near future and the presence of clear water elements in the prolongation of the Israeli-Palestinian peace process, reflects the timeliness of this study in attempting to find meaningful relationships between water resources and political and violent conflict. This thesis, therefore, attempts to examine the issue with a more societal focus in looking at how divisions interact with water scarcity to produce conflict.

Water scarcity issues have gained attention due to concerns over interstate “water wars,” though the conversation has tended to focus less on the relationship between water scarcity and civil conflict (Gunasekara et. al., 2013). Many studies have examined and demonstrated a relationship between water stress and violence in general, and one specifically (Ashton 2002) looked at the unequal geographic distribution of water as it increases the risk of violence, though few analyses have probed the intersection of societal divides and water scarcity as it engenders conflict (Gunasekara, et. al. 2013). Homer-Dixon (1999) posited that as opposed to interstate or international conflict, environmental scarcity leads to social effect that are most likely to lead to violence on an ethnic level. However, previous studies have failed to give much attention to the presence of civil divides that may in fact be the moderating factor determining this violent outcome. Therefore, this thesis aims to assess the following question: **How does the existence of salient social or ethnic divides inform the relationship between water scarcity and conflict within a nation?**

The use of existing divides as a moderating factor differs from previous studies in that in this question, they play an integral role in the path from water scarcity to conflict rather than simply being exacerbated as a social effect of environmental stress (Homer-Dixon, 1999). Though there are, of course, other instances that may lead to violence over water, this investigation into the relationship between these factors seeks to determine whether this is in general a volatile reaction of societal elements.

In order to examine this question further, it is necessary to both define water scarcity and conflict in the context of this study. Water scarcity, easily enough quantified by current and predictive estimations of resource availability, must also be considered in terms of quality and usability. There is plenty of scientific data available to demonstrate the changes in physical availability of water, though the presence of water does not always make it useable. Access or lack thereof to useable water sources is also a form of stress, as is relative deprivation of water resources between members of the same society. Therefore, this paper utilizes measures for total resources per capita, total withdrawal per capita, as well as population with access to safe drinking water to represent different measures of water availability stemming from various causes of scarcity.

Secondly, it is important to define the types of conflict that are likely to be significant as related to water conflict. Is water security only of concern when it leads to violence? Clearly, violent conflict – events of organized violence in which at least one casualty was reported - over water is a generally undesirable outcome. That is not to say that in some instances, particularly where historical marginalization is present, that violence cannot be an intended consequence of induced scarcity. Whether intentional or simply as a result of environmental factors and competition between groups, the element

of interest is the social factors that constitute the relationship between water disputes and violence.

On the other hand, it may be useful to lower the threshold of conflict from only violent events to include data from riots, protests, and other forms of resistance that indicate high tensions as a result of water and a heightened risk of escalation to violence. This is also useful for answering the question of how and what types of conflict does water stress contribute to, and what factors cause variations in cases. By looking at instances of water stress, civil tensions, and conflict together as part of the same question, we can begin to create a more specific concept of water conflict.

Experts generally attribute the relationship between environmental scarcity and conflict to a general increase in the stress levels of societies (Homer-Dixon, 1999), and this argument holds weight in considering the relationship between social divides and conflict induced by water. In order to connect water scarcity to violence or protest, there must be an intermediate step that informs the relationship and shifts it in the direction of conflict. As presented above, this study examines whether the presence of existing societal divides is indeed such an intermediate factor. However, this process alone is not enough to tell us how or why this interaction is volatile.

For that, it is necessary to examine some of the societal effects engendered by this intersection. Water is generally an indirect cause of conflict (Homer-Dixon, 1999), which is why this study looks not simply at correlations of scarcity and conflict, but attempts to examine the relationship of scarcity with another commonly cited source of conflict – civil divides. In the coming years, with environmental degradation and therefore supply-induced scarcity of useable water on the rise, many communities could see their local

resources diminished. Particularly in areas where water is accessed via aquifers or surface water sources used more heavily by outside actors, urban communities may fall victim to scarcity at no fault of their own and with little clout to solve the problem. Lands traditionally occupied by one ethnic groups could see challenges and encroachment from others whose resources have diminished. Others may be incentivized by increasing scarcity to seek territorial expansion for the acquisition of resources for the future. Migration, another commonly mentioned result of environmental scarcity (Homer-Dixon, 1999), could bring ambivalent groups closer together and increase petty tensions to the point of violence. These effects of scarcity, and this list is not exhaustive, are important alone but even more so when existing tensions between groups are high.

To examine these mechanisms and the overall question of the relationship between water availability, conflict onset, and the intervening variable of social divisions, this study presents a quantitative analysis of data from the FAO Aquastat, Ethnic Power Relations, and NAVCO datasets. Through logit testing of six hypothetical models representing various measures for water availability and social divisiveness, the study finds little support for the theory that these divides are the intervening variable that determines whether a water-scarce society will experience conflict outbreaks or not. The outcome of this analysis indicates that neither the measures of water alone nor their interactions with the intervening variables show that an increase in per capita availability of water resources decrease the likelihood of conflict. Though these findings are likely affected by the missingness of data from the Aquastat dataset for many countries, they are useful for indicating that the effect of water availability on conflict is likely highly individualized. Thus, despite the existence of cases in which water scarcity is a visible

catalyst for violence, these results demonstrate the difficulty and perhaps futility of attempting to make concrete generalizations of this relationship.

However, having found that there exists little significant relationship between issues of water scarcity, ethnic divisiveness, and incidences of conflict, it is important to recognize the limits of broad theoretical models of conflict for explaining the way in which specific intrastate conflicts occur on the ground. Furthermore, an important conclusion can be drawn from the lack of significant findings: that water may not affect conflict in the ways measured by this quantitative analysis, but may indeed still contribute in more subtle ways to the destabilization of societies and peace. Although quantitative models may contribute to the predictability of conflict events, they tell us little about the underlying mechanisms. In addition to providing a more in-depth understanding of how state and non-state actors are affected by water uncertainties and the mechanisms through which water becomes a tool and facilitator of conflict or impediment to peace, an examination of case studies provides real-world examples that analysts can use to determine trends in similar situations. Therefore, the second part of this thesis seeks to discover what practical trends emerge from current case studies of water in conflict, and examine their relevance and application to potential future conflicts. The cases of Israel and Palestine, the Darfur conflict in Sudan, and ISIS in Iraq will provide real-world examples of the ways in which state and non-state actors negotiate their water access and political positioning through the lens of water. In all these cases, water can be seen as a destabilizing factor, tool or facilitator of conflict, or impediment to peace that affects the security of nations and regions in tangible ways. Therefore, despite a lack of quantitative support for the initial hypotheses presented, it is

clear that water may serve a minor but critical role in the transition from peace to conflict or the prolongation of conflict.

Therefore, the cases studies serve to answer a different set of questions. For one, what processes result from water shortages that consistently contribute to increased conflict vulnerability, such as migration or economic damage? How do different hydrologies and geographical distributions of water contribute to political or physical conflict scenarios? In what ways do opponents use water realities or perceptions as political tools to alter the course of conflict? Are there visible instances in which water helps mitigate, rather than exacerbate, political issues? In examining these themes and others through the three cases of Israel, Sudan, and Iraq, this paper aims to contribute to a more integrated understanding of water's role in civil conflict. The first section of the paper will focus on these cases individually and what they can contribute in addressing these questions.

Secondly, this section aims to use the answers found through this analysis to determine how such understandings affect the United States' role in maintaining global security and the potential impacts of water-related conflict on US national security. The second section of this paper will focus more exclusively on the intelligence value of this information and how it can contribute to informing the strategies of US foreign policy and intelligence communities. Through examinations of the United States' interests and abilities in working to mitigate the role of water in conflict, this section seeks to provide viable strategy options for these communities to practice in order to mitigate the challenges posed by water issues around the world.

The importance of this issue to the United States rests on two overarching observations. One, that the availability of useable natural water resources in many areas of the world is declining due to persistent overuse and climate change effects. Secondly, that the areas most dramatically affected by this change in physical availability also tend to lie in historically more conflict-prone areas, particularly in the Middle East and Africa. In the context of growing uncertainty around global water and environmental resources and a growing, developing population, the relationship between environmental changes and societal and security effects is more pressing than ever. Furthermore, it is likely that water problems around the world will worsen at an unprecedented pace for which the global community has little meaningful preparation. As the global leader in security and foreign policy, the United States has major interests in pursuing courses of action to prevent the destabilization of nations or regions due to the factors discussed in the paper. Should environmental changes, particularly acute ones, contribute to the types of social, economic, and demographic disruptions that this thesis anticipates, the results are likely to compound in negative and destabilizing ways. In order to prevent this, it is essential that research and understanding of issues be prioritized so that appropriate adaptations can be anticipated and prepared.

Therefore, with the intention of exploring these points, this thesis proceeds with an analysis of the existing relevant literature on environmental scarcity and civil conflict, then delves into an explanation of the theory developed to explain this relationship. Following the theory is an explanation of the quantitative methodology used to test the theory, and finally a discussion of results. This is followed by the qualitative analysis of case studies from Israel and Palestine, Darfur in Sudan, and Iraq and the Islamic State

(ISIS), and finally concludes with an interpretation of trends from the analysis holistically as they relate to US foreign policy options.

CHAPTER 2: LITERATURE REVIEW

As an emerging field of concentrated study, the literature on water-related conflict suffers from expected growing pains. Pioneered as a subset of environmental questions on conflict by the likes of Homer-Dixon (1994, 1999) and Hauge and Ellingsen (1998), discussion of the potential effects of water resource availability on conflict still draws heavily from more general environmental literature. Nevertheless, with water conflict spotlighted as an area of growing concern among world leaders and in the popular imagination (Katz 2011), it is increasingly essential that the conversation is driven by research rather than conjecture.

In contrast, the literature on ethnic conflict is more robust. Study of ethnic conflict is certainly not without its conflicting arguments, though this study aims to let analysis drive interpretation of the causal mechanisms through whichever lens is most appropriate. In general, the economic value of water suggests a very real, material significance to competing claimants over scarce resources. In addition, the necessity of water for economic activities and the increasingly prevalent treatment of water resources as a non-military matter of national (or group) security (Gleick 1993) suggests a security-driven, rational choice perspective on the causes of domestic conflict or at least the possible role of water in violence.

Environmental Scarcity and Water Scarcity

As water scarcity falls under the larger category of environmental scarcity in existing literature and derives many attributes from this general discussion, it is helpful to begin there. In terms of defining scarcity, a market-like view has categorized it into three origins: supply-induced, where a dwindling supply causes shortages; demand-induced, when a demand significantly increases, usually due to population change, while a supply remains constant or shrinks; and structural scarcity, when unequal distribution of a resource causes scarcity to vary (Homer-Dixon 1999, Hauge and Ellingsen 1998, Gizelis 2010).

A number of researchers have tried to pare down the relationship of environmental resources in general, and water in particular, with the likelihood of conflict. To begin with one of the more seminal works on the subject, Homer-Dixon's "Environmental Scarcities and Violent Conflict: Evidence from Cases" (1994) finds that environmental scarcities contribute to persistent, diffuse, intrastate conflicts through a post-mortem examination of various cases. Homer-Dixon defines his notion of scarcity as arising from depletion, degradation, and unequal distribution of renewable resources, as well as increased demand on limited capacity as a function of increasing population and stable or decreasing supply (1994, 1999). This conceptualization has been repeated in many studies.

Homer-Dixon's main argument for why some societies are more likely to successfully adapt to scarcity than others is a political one that hinges on an "ingenuity gap" (1999). The concept of the ingenuity gap treats ideas and social capacity as factors similar to capital or labor, and are critical to the ability of a society to effectively manage

its grievances and develop. This gap, generated by the singular, complex situation of a particular case, such as weak or incompetent political institutions, natural disasters, struggling markets, or resource shortages, exists between the ingenuity that exists in a society and the amount required to overcome a resource shortage (1999). Homer-Dixon argues that this gap can turn into a cyclical erosion of government authority and accordingly increase the likelihood of violence while decreasing state capacity to manage scarcity and crises in general (1999).

Therefore, Homer-Dixon's mitigating factors of ingenuity and adaptability are tempered by his "social friction" concept, which explains that scarcities sometimes incentivize elites to impede innovation to protect narrow interests. These concepts attempt to find a middle ground between neo-Malthusian arguments, which suggest that growing populations will induce poverty as resources become scarcer, and economic optimist arguments, which depend on technological innovation to overcome scarcity. Furthermore, Homer-Dixon's explanation of the link between scarcity and conflict suggests that effects on economic productivity, migration, social segmentation, and disrupted institutions contribute to the ingenuity breakdown that hinders adaptation (1999). Perhaps the most important aspect of Homer-Dixon's work, however, is that given structural factors that encourage or inhibit ingenuity, he places a very high emphasis on the role of environmental scarcity as the sole driver that tips the scales into conflict.

Others have meditated on similar mechanisms through empirical analysis. Examining this "ecoviolence" perspective that environmental scarcity leads to violence by hindering effective development and societal capacity, De Soysa (2002) interestingly

finds that the highest likelihoods of conflict related to resources were when moderate abundances or scarcities existed. De Soysa (2002), like Hauge and Ellingsen (1998), test for a variety of resources including water, but did so against proxies for ingenuity such as trade openness and development indices. These studies diverge where De Soysa (2002) finds little causal link and Hauge and Ellingsen (1998) do for aspects of their analysis. One of the first large-N studies for looking at environmental degradation and domestic armed conflict, Hauge and Ellingsen analyze the relationship between supply-induced scarcity (in terms of freshwater availability per capita, annual change in forest cover, and land degradation), demand-induced scarcity (as population density and change in density), structural scarcity (measured as income inequality) and the dependent variable of domestic armed conflict occurrence (1998). Also, taking into account a nation's economic development (GNP per capita) and the type and stability of political regimes, Hauge and Ellingsen find that scarcity and degradation conditions compound the likelihood of domestic armed conflict in concert with factors such as high population density and income inequality (1998). Though the combination of supply, demand, and structurally-induced factors indicate the conflict-generating potential of scarcity, the authors find that environmental scarcities are secondary to explaining conflict behind economic and political factors (1998).

Hauge and Ellingsen (1998) make an important observation regarding relative importance of factors that contribute to the emergence of domestic armed conflict. They criticize Homer-Dixon's lack of dependent variable variation in the cases of his study (1994) for ignoring the potential for political and economic factors, such maldistribution of resources and income inequality, politicize resources and create structural scarcity

(1998). This concept of disaggregating the political and economic factors that might interplay with scarcity to cause conflict from the strict causal capacity of scarcity alone has been expanded on by studies like Gizelis (2010), which attempts to correct the failure of previous studies on water resources to consider the effectiveness of governance as a major mediating factor. Gizelis (2010) highlights the mediating role of domestic institutions, dependent on the institutional capacity of states to adapt to environmental scarcity and ensure satisfactory distribution of resources to their people, to assert that intrastate water resource conflicts are more institutionally rather than environmentally driven. Theisen (2008) also makes this critique of the literature as a whole, suggesting that the widely diverging opinions on the causality of environmental scarcity, and the fact that his study was unable to replicate Hauge and Ellingsen (1998), indicate that scarcity alone has little explanatory power but would do better when examined in more specific contexts of poverty, dysfunctional institutions, and rational choice arguments. Gleditsch similarly comments that research tends to neglect impactful political and economic factors that have more predictive power than scarcity, but rather interact with it to product conflict outcomes (1998).

Despite the causality debate, a strong consensus remains that scarcity can contribute to detrimental social effects. Of the socioeconomic and political effects of scarcity that can alter the risk of conflict, and in Homer Dixon's (1999) framework act to reduce ingenuity and adaptability, the expected population displacement caused by climate change is a major concern to some (Warner et al 2010). Scarcity acts to increase the general stress level of societies and may exacerbate existing tensions (Homer-Dixon 1999), particularly via migration (Brenauer et al 2012 and Warner et al 2010).

In this ongoing discussion of the role of scarcity in conflict, some studies have taken water up as a separate case (Gizelis 2010). Though general literature on environmental scarcity is useful for understanding the impact of scarcity on conflict and society, water brings unique challenges that are overlooked by this wide scope. A large body of literature has been devoted to examining the potential of dramatic interstate water wars (Cook and Bakker 2012, Katz 2011, Gunasekara et al. 2014). However, these give important insights into how competing parties, national or subnational, view water in their conflict of interests. Gleick (1993) emphasizes that freshwater is increasingly a matter of national security, and that access to shared water sources has in the past been denied as means of exerting political or military pressure. This “real politik” perspective sees water resource vulnerability as a function of political-economic conditions, water availability, and the extent to which a resource is shared, and although Gleick suggests that political confrontation between states is more likely than violence, a growing willingness to use water supply systems as tools of war may widen disparities and increase the prevalence of water as a factor in conflict (1993).

Other studies have looked specifically at water within a national context, generally examining scarcity as it intersects with the social, political, and economic factors that larger-scope studies are criticized for overlooking. Though the existence of water scarcity in a nation, whether supply, demand, or structurally induced, is likely to only contribute to conflict in concert with political and social factors, it is nevertheless an important area of study on its own. A resource that is not easily bound by territorial borders and that is often of ambiguous quality and quantity, water carries an inherent element of uncertainty that may play into a different rational calculus than more easily

quantified or divisible resources such as land. This uncertainty also makes the resource more susceptible to exploitation as a tool in conflict or politics. Though these intricacies are difficult to capture in large-N studies, the existing literature of water scarcities in conflict-prone political or economic conditions helps establish a general understanding of how water interacts with other national conditions to either produce or not produce conflict.

Ashton (2002) found a significant link between unequal geographic distribution of water and an increased likelihood of violence in cases in Africa. Gizelis (2010) examined the role of institutions in ameliorating the potential consequences of water scarcity by having the capacity to improve storage, quality, and equality and efficiency of distribution. A proponent of the relative importance of institutions over environmental scarcity, Gizelis finds that domestic institutions mediate different types of scarcity because of the institutional capacity of states to adapt to scarcity and public dissatisfaction, while less democratic institutions are more likely to induce structural scarcity (unequal distribution and mismanagement) that increases the risk of water-related conflict (2010). Looking again at societal inequality, Gunasekara analyzed this against water scarcity to find that “institutional and infrastructural arrangements that provide better access to and more equal distribution of water resources will significantly lower the risk of water conflict incidence in countries with low economic capacity” (2014).

It is clear that consensus on the causal effects of environmental scarcities is significantly lacking as a whole (Gleditsch 1998, Theisen 2008, Bernauer et al. 2012). Though some (Homer-Dixon 1999, Hauge and Ellingsen 1998) assess a fairly causal link

to conflict via social effects, there is little agreement on the relative significance of environmental scarcity in terms of other major contributing factors to violence such as social, economic, and institutional variables (De Soysa 2002). Furthermore, Homer-Dixon's backwards process-tracing method, which selects cases to examine based on the presence of the expected outcome, has been widely criticized as unsound (De Soysa 2002). In general, the literature suggests that while environmental scarcity, water scarcity included, can lead to social effects that increase the likelihood of violence, there is little direct link between the presence of a scarcity and violence that may emerge that is not heavily tempered by other factors (Gleditsch 1998).

At the heart of this debate is the relative importance of scarcity among other factors. Whereas Homer-Dixon (1999) and the ecoviolence approach suggest that scarcity causes social consequences that reduce adaptability and increase risk of conflict, others (Bernauer 2010, Gizelis 2010, De Soysa 2002, Gunasekara 2014) suggest that the preexisting social, political, and economic conditions of a nation determine whether scarcity will be of importance to conflict. Bernauer et al. (2012) explains well that scarcity might, under certain circumstances increase risk, but not necessarily systematically because this result is contingent on national adaptability and prevention of dangerous effects such as on economic performance and migration. Nevertheless, when the context of a scarcity has been examined in tandem with the context of another specific domestic issue, such as institutional weakness (Gizelis 2010), more consistent patterns may emerge.

Intrastate Conflict

In examining this intersection between water scarcity and civil conflict, it is useful to return to some contemporary understandings of intrastate conflict in particular. Theories for how intrastate conflict begins, which often focus on the greed versus grievance argument and the role of ethnic tensions, seek to uncover the motivations and circumstances that transform a peaceful society into a violent one. Therefore, by understanding the basic arguments for civil conflict onset, one can examine ways in which water scarcity might fit into such constructions and contribute to violence by engendering grievances, competition, and opportunities to gain from conflict.

Lake and Rothchild's "Containing Fear: The Origins and Management of Ethnic Conflict" (1996) does an excellent job of giving consideration to the classic ethnic conflict explanations of group differences, ancient hatreds, feuds, or difficulties coping with modern life as possible emotional motivators, though not as causes themselves. Similar to the environmental scarcity discussion, Lake and Rothchild find that though these factors do contribute, they are minor compared to more systematic problems stemming from collective fears for the future. Lake and Rothchild suggest that information problems, credible commitment problems, and a security dilemma over protecting group identity can exacerbate groups fears and cause conflict in instances where state weakness allows it (1996). According to this research, strategic interaction between groups in ethnically divided societies results in group competition over resources along ethnic lines, with each looking towards alternative futures to calculate strategies (1996). Again, these problems are alone not enough to initiate conflict without the impetus of information problems, commitment problems, or a security dilemma that

incites one actor to assess that a preemptive strike is the only way to secure an advantage (Lake and Rothchild 1996).

Focusing on the onset of civil conflict in terms of systematic factors, Sambanis (2001) identifies that ethnic-based civil conflict and non-ethnic civil conflict tend to have unique causes and attributes that are often overlooked. Contrary to studies that do not separate civil wars by type, Sambanis (2001) finds that the level of ethnic heterogeneity is positively associated with ethnic conflict but not non-ethnic conflict. The differences between identity and nonidentity wars continue in the factors related to their onsets, as identity conflicts are generally caused by political grievances and unlikely to occur in democratic societies. Political institutions were found to be more related to ethnic conflict than economic variables (Sambanis 2001). However, the research suggests that the likelihood of civil conflict is not only a function of internal factors, but also impacted by regional and national-level characteristics as well. For instance, a democratic neighborhood tends to moderate ethnic conflict while encouraging ideological rebellion, while the effect of a long regional peace or neighborhood war tended to have a more robust effect on ethnic conflict than non-ethnic conflict (Sambanis 2001).

Fearon and Laitin (2003) and Collier and Hoeffler (2004) add significantly to the discussion on the onset of civil conflict, particularly focusing on the role of political institutions in creating the conditions for a feasible rebellion. Fearon and Laitin (2003) suggest that civil conflict since the 1950s-1960s, including ethnic conflict, are best examined through a lens of insurgency, wherein “small, lightly armed bands [practice] guerilla warfare from rural base areas” (75). Their analysis suggests that ethnic heterogeneity, economic and political grievances, and even ethnic discrimination

(represented by nations with a minority greater than 7percent of the population and a majority greater than 49percent), were generally insignificant to the onset of conflict (Fearon and Laitin 2003). However, they find a much better predictor of conflict to be the existence of factors that facilitate insurgency, including weak regimes, political instability and recent statehood, larger populations, dependence on oil wealth, and the existence of mountainous territory that is difficult for a regime to govern effectively (Fearon and Laitin 2003). Collier and Hoeffler (2004) take a greed-versus-grievance approach to the conflict-predicting properties of ethnic grievances versus political and economic factors. They suggest that the political conditions that allow or incentivize conflict, in their terms “greed” and “opportunity,” have a stronger effect on the likelihood of conflict by predicting when grievances are most likely to be translated into action (Collier and Hoeffler 2004). Using proxies for possible resource extortion, diaspora support, or support from hostile governments as representations of opportunity, Collier and Hoeffler find opportunity to be a better determinant than grievances as represented by measures for polarization, political rights, regime openness, majority percentage, and income inequality (2004). The authors conclude that the significance of the “opportunity” measures, particularly financial opportunities for rebellion, are more consistent with the greed explanation than the grievance view in general (Collier and Hoeffler 2004). These two studies suggest that the existence of grievances of ethnic or economic are too ubiquitous to be strong predictors of conflict, with a much better indicator for the likelihood of conflict being the opportunity to engage in a viable insurgency.

This literature not only give a lens through which to view the group interactions and competition over water that may or may not contribute to conflict, but also provide

an understanding of the types of disturbances and national conditions that are more likely than others to lead to conflict.

Intersection – Conflict and Scarcity

Discussion of the role of water scarcity in civil conflict highlights a number of existing overlaps in the literature of general environmental scarcity and civil conflict. In particular, the role of institutions and their capacity to, or intention to, prevent maldistribution or structural scarcity of water resources comes to the forefront (Hauge and Ellingsen 1998). Though not all of the literature agrees on the mechanisms that relate scarcity and conflict, a number of important insights can be gleaned from all sides.

For one, Homer-Dixon (1999) touches on the concept of resource capture, wherein groups see increasing scarcity as a potential future disadvantaged and are incentivized to move early to secure resources. In this context, Homer-Dixon also discusses rent-seeking behavior with the tradeoff of opportunity costs for actors attempting to capture a resource with greed as a motivator (1999). Ecological marginalization, when population pressure on and unequal distribution of a resource induced movement of people to marginalized areas such as urban slums, is another concept with relevancy to the civil conflict discussion (Homer-Dixon 1999). According to Homer-Dixon's view that scarcity leads to institutional social weaknesses and subsequently violence, group fears and relative deprivation motivations are most likely to lead to insurgency and group-identity conflicts (1999). Furthermore, the implication that scarcity, especially adequate water, can lead to population displacement and increased

social tensions (Brenauer et al 2012 and Warner et al 2010, Homer-Dixon 1999), bodes unwell for areas that already have an increased risk of ethnic conflict.

Hague and Ellingsen suggest that countries with high income inequality are more likely to experience domestic armed conflict than those with greater income inequality (1999). This idea of structural scarcity deserves more mediation in the context that we are examining, for in their own words Hague and Ellingsen describe this type not necessarily as occurring through income inequality, but more generally as “when [resources] are concentrated in the hands of a few people while the remaining population suffers from resource shortages” (1999, 301).

With an issue as pressing as water access, which underlies productivity of a society, it is not a far leap to see how groups competing over water resources within a state could fall into a security dilemma as described by Lake and Rothchild (1996). Particularly when resources are dwindling at unknown rates and the preferences or power of an adversary may shift unexpectedly in the future, groups are incentivized to move quickly to secure and cement control over resources sooner rather than later. Those that have power may be incentivized to capture resources and increasingly concentrate them among elites or preferred groups. Increasing inequalities increases the likelihood of water conflicts, which suggests that enhancing access to water can help to lower the likelihood of water conflicts (Gunasekara 2014). While this may be true, the literature on ethnic conflict suggests that interested groups, especially those with power, will avoid a more equal distribution because of self-interest (Lake and Rothchild 1996).

Similarly, Sondershaus and Moss’ (2014) examination of a local water dispute in Germany found that different perceptions of vulnerability, rather than realities, were

shaped by institutions and social constructions and determined how groups viewed power relations. This echoes the alternative futures Lake and Rothchild (1996) describe, and demonstrates how water resources scarcity and perceptions of vulnerability may appear in competing groups' calculations of fear and strategy. This example also represents an avenue through which ethnic activists and political entrepreneurs may play on collective fears of urgent scarcity to galvanize support. Gleick's finding that nations will view and use freshwater resources as a matter of security and a tool of war translates easily into this context, particularly when state weakness allows conflicting groups to act effectively as autonomous bodies (1993).

Gizelis' (2010) study on the intersection of institutional considerations and water resources touches on a factor ignored in many other studies on environmental scarcity though very relevant to the outbreak of internal armed conflict (Sambanis 2001). His finding that effectiveness of governance and democracy reduces the likelihood of structural scarcity, mirroring Sambanis' (2001) find that democracy and effective governance reduces the likelihood of ethnic conflict. These parallel findings suggest that in this context of civil conflict and water scarcity, similar moderating factors work to prevent conflict.

Moving Forward

In studying the effects of water scarcity on civil conflict, it is necessary to examine a nexus of both domestic factors, like social cleavages and national freshwater availability, with factors and processes associated more with interstate conflict over water, with an in-depth understanding of how institutions and group dynamics affect the

onset of conflict. The result is a more comprehensive picture of how salient social cleavages act, particularly in areas of low government sovereignty and power, as pseudo-states to negotiate access to water resources via either diplomacy or conflict. Therefore, this study necessarily combines literature on both the effects of national environmental scarcity, which often focuses generally on more marketable resources, on conflict and violence with literature on the processes of water negotiation and conflict between actors in a fairly anarchical situation like states in the international arena.

As the scope of analysis narrows to a more specific question on water scarcity and ethnic conflict, a number of holes emerge in the literature and current understanding. The debate over the relative importance of scarcity among other factors, and more specifically different types of scarcity, lacks consensus as a whole but may benefit greatly from more targeted analysis into specific interactions of political-economic and scarcity factors. Exploration into causal mechanism demands further attention so as to not over or underestimate the real impact of scarcity in various contexts (Hauge and Ellingsen 1998). The literature also suffers from a lack of variety in terms of scale of conflict, as most examine fairly significant thresholds that might conceal lower, though significant, levels of conflict such as riots and protests (Hauge and Ellingsen 1998). In addition, the literature largely overlooks the potential interaction of different drivers of scarcity and the political, social, and economic context that may affect outcomes, such as the more sinister link between institutions, structural scarcity, and ethnic marginalization (Gizelis 2010). Though a large-scale analysis of such interactions may be tedious, examination of patterns in though cases may reveal salient political aspects of the discussion.

Furthermore, there are obvious challenges that have plagued the analysis of previous studies and will likely limit the thoroughness of this one as well. Namely, appropriate and sufficient data is lacking for large-scale examinations of unequal distribution of water resources *within* nations, as most data is collected on the state level (Hauge and Ellingsen 1998). Many previous studies, such as Gizelis and Wooden (2010), recognize the difficulty in examining sub-national variations in water scarcity and maintain it outside of the scope of analysis for the sake of simplicity. Sambanis (2001) laments that in order to more fully understand the causes of ethnic conflict as a subset of civil war, more group-specific “measures of inequality, political representation, and wealth distribution as well as territorial concentration of ethnic groups” should be collected. Nevertheless, the potential significance of this distributional inequity within a state as a determining factor of water scarcity’s role in domestic conflict likely necessitates that any attempt at thorough examination takes each nation’s unique distribution and causes of scarcity into account.

CHAPTER 3: THEORY

In order to examine the effect of water scarcity on the prevalence of domestic conflict, it is necessary to identify the role that water plays in the decision-making of relevant actors in this domestic situation. Though water is an inescapable necessity for the physical and economic health of all actors, it holds different meanings and purposes to each. These interests may conflict subtly or significantly, exacerbating the existing divides between competing groups. The incentives to capture resources for self-protection are high when resources are both necessary and of scarce or uncertain useable amounts, and the effects of such scarcity can also have social effects triggering the increase of perceived and authentic grievances. It is useful to examine these incentives in terms of a government-centric or non-state actors-centric view.

Government Logic

The state, which by default should have ultimate control of its territorial water resources, is generally expected to oversee the usage and distribution of water. States can be assumed to want these resources to ensure industry and agricultural economic growth, public health, and possibly political favors through increased private allocations. In any water-scare nations, grievances are likely to exist because of the low growth and quality of life that inadequate water supplies often mean. This is a common phenomenon that does not adequately explain the impact of water on conflict. However, when a state is also characterized by significant social divides, the incentive of the state to create a

structural scarcity, by preferentially allocating more water to certain groups than others, increases in order to secure dominance and disenfranchise groups with competing political goals. In a water-scarce situation, this treatment may include improved infrastructure in areas dominated by this group and lacking infrastructure in areas mostly composed of members of out-groups. Collier and Hoeffler (2004) find that the only ethnic grievance measure somewhat significant to their analysis of conflict emergence was the existence of a strong ethnic dominance, which in this context may indicate a strong political incentive to prioritize resources among the dominant ethnic group. As opposed to in water abundant societies, the scarcity of the water increases its values to the receivers and represents a relative deprivation to those without access.

Should individuals or groups manage their concerns over water with the government via lobbying and appropriate political processes, there is little need to resort to conflict. However, when the state cannot or will not adequately provide the resources the non-state actors demand, or when initiating a conflict under the banner of water-related grievances is in the interests of a group, groups may challenge the state or other non-state actors for control of the resource. For the purposes of this research, this designation includes existing ethnic groups, organized political opposition, as well as entrepreneurs representing an asymmetric insurgency against the state or another group. These actors, defined by elements of their structure, methods, and goals, are similarly distinguishable by their unique sets of interests.

The interests of the state may be principally concerned with the maintenance of power and the prevention of internal or external threats to its authority. Domestically, the state's response to threats differs greatly according to the regime's type and the extent to

which it is responsive to the needs or pressures of the population at large. Democracies generally handle opposition through political processes and representation. Autocracies, on the other hand, generally enact hard line policies against dissent (Hegre, et al. 2001). Autocracies face much lower fears of political overturn so long as they maintain sufficient favor, and are therefore less responsive to public concerns than private interests and pursuit of state goals. For this reason, they have greater latitude in their policies, particularly of the discriminatory variety. However, the fact that autocracies are often slow to change without conflict incentivizes both the state and opposition to more quickly resort to violence to either prevent or incite change, respectively.

States of both types are also beholden to the threat of outside forces, from the threat of meaningful - though generally unenforceable - international resolutions, to sanctions, to interventions in domestic affairs (Evans and Sanhoun, 2002). Therefore, it is in the interest of the state to abstain from, or at least conceal, the committing of acts that would draw negative attention or reprimand from the international community. In the event that violence occurs, the state is motivated to not only protect its power and authority but to use the opportunity of mutual conflict to secure a decisive victory, if possible, and discourage dissent with harsher methods than are allowable during relative peace. Though their incentives and methods differ, both democratic and autocratic state leaders are ultimately concerned with the maintenance of power, a motivation which often implies currying favor with certain groups at others' expense (Haggard and Hendrix 2015). Due to the popularly-enforced limitations on democratic governments versus the limited receptiveness of autocratic governments, a hypothesis of the relationship between regime type and the likelihood of conflict in this context emerges:

H1. Autocratic governments facing water scarcities and social divisions are more likely to experience conflict than democratic regimes.

Non-State Actor Logic

On the other hand, non-state actors, typically with significantly less power than the state itself, are generally governed by much weaker restraints on their latitude of policy and actions. Their goals differ significantly, which complicates generalizations of their actions, though the existing literature has indicated a number of noteworthy understandings and it is necessary to make a number of assumptions on how they may respond in similar ways. Organized oppositions, meaning here those among non-state actors that are most centralized and politically-oriented, can be considered the combatants in a traditional two-sided civil war against the state. These groups, often separatists or cohesive political opposition to the current powers, are incentivized to seek legitimacy and bargaining power in order to achieve wide-scale goals. One can assume that an organized opposition is motivated by causes shared among a significant portion of the population, though this is a broad description. This assumption points towards shared grievances and issues of relative deprivation as motivators, including ethnic or nationalist emotions and perceived or real discrimination by the state. A number of psychological and socio-economic factors interplay to cause an opposition to act, including the security, information, and credible commitment problems that prevent meaningful negotiation and increase the likelihood of violence. However, the distinguishing aspect of this type of non-state actor is its organized character and motive to capture land, resources, and political power.

Conflicts between ethnic groups, on the other hand, may or may not have a national policy focus. Ethnic groups clash on a variety of scales, from isolated violence between members of different groups to separatism or outright civil war. Though these conflicts have traditionally been attributed to ancient hatreds, a more rational approach based on grievance and greed is more compelling for examining how psychological and political-economic motives incentivize the move to violence. Particularly in nations with weakened national sovereignty, relatively autonomous ethnic groups may clash with the state or each other over territory, resources, and nationally representative power. Such conflicts are often provoked by entrepreneurs within a group who propagate fear and ideas of perceived security threats, and therefore use information breakdowns and uncertainties to their advantage. If their cause is to be successful, it is necessary to build a sustainable support base. Therefore, spreading ideas of universally condemnable actions by the adversary among group members is a significant potential source of support. It is not necessary for such accusations to be true, but only believable enough.

Lastly, a similar type of entrepreneurs, insurgents, may take a different approach but respond to lack of government provision in a similar way. Whether ethnically, politically, or economically motivated, insurgencies generally take the form of asymmetric conflict. The diminished reliance on an active support base led Collier and Hoeffler (2004) and Fearon and Laitin (2003) to find that their emergence in a conflict is most highly correlated with opportunities to conduct an effective insurgency, such as a weak state and large population, rather than the level of grievances existent in the society. Water scarcities provide such opportunities in a number of ways. For one, water scarcity, particularly acute drought, can reduce economic opportunities such as farming and

herding and therefore increase poverty and lower the opportunities costs of recruitment. Secondly, the capture of scarce water access points can be a lucrative opportunity to charge civilians for an essential resource and thus fund violence. In a more general sense, water scarcity and its economic effects could potentially weaken the state's capacity to deal with rebellion effectively and incentivize groups to try violent means.

Though ethnic division appears to be less of a predictor than opportunity for insurgency, rebellions that fall along ethnic lines may be increasingly divisive and certain reveal the existence of salient divides in a nation. Such insurgencies generally have goals unsustainable for the nation at large, and serve more to disrupt the status quo than to usher in a revolution. Often long and bloody, insurgencies typically have narrow goals to which greed may be the greatest driver, such as control over areas of a nation that contains lucrative resources or warding off government control in order to protect illicit businesses or practices. Though the ideological or economic motivations of insurgencies are not wholly generalizable, in order for an insurgency to sustain itself there are clear opportunistic elements that must be present such as the weakened ability of a state to combat a rebellion and a source of rebel funding. These factors provide incentives for rebels to seize the opportunity to exploit a situation and pursue their goals.

The incentives and interests of these various actors exist in many, if not all, societies, though the question of why some turn violent while others remain peaceful remains. The combination of factors that build upon existing tensions and bring them to a head is an important explanation for this difference. The current literature suggests that this is accounted for by either atypical amounts of greed, grievances, or opportunities conducive to the use of violence for political gain, with the most probably being the latter

(Collier and Hoeffler 2004, Fearon and Laitin 2003). As an exogenous shock to the situation, water scarcity compounds the concerns of these actors in terms of maintaining or increasing their current power in a nation and can fuel any of these three motives. In many areas, water is beginning to increasingly resemble a nonrenewable resource. Even more, the mystery of measuring and understanding groundwater supplies further incentivizes groups to act quickly to secure resources before they are gone at an unknown time. Though water scarcity is an issue also faced by many societies, it is at the intersection of both water security fears and prominent societal divides that these two potential instability-generating factors may together foment the existing fears of opposing groups and lead to conflict.

To examine how this may occur, it is necessary to make assumptions of how each type of actor may view their relationship to scarce water resources. The impact that concerns over water have on the decision-making of each type of actors are necessarily highly generalized here in order to simplify the potential connections. Technology, access to outside resources, and the severity of scarcity will all factor differently from case to case, though the importance of water scarcity, as opposed to sufficient or abundant availability, is the inherent uncertainty and competition that it may engender. As previously discussed, real and perceived supply, demand, or structurally induced scarcities can exacerbate both fears for the future and adversarial feelings towards other groups in the state, and therefore threaten the stability and goals of each actor. When these individual water-related concerns and interests intersect with those related to the goals of states and non-state actors in highly divided societies, the policy preference gap may widen, reducing the likelihood that adversarial groups will come to peaceful

solutions. When such divisions fall along ethnic lines, the political balance of in and out groups may be the determinant of the government's water allocation preferences (Cederman, et al. 2010). In groups, those that control significant power in a state and whose interests are represented in government, are better able to have their concerns heard and enacted on by the state. Out groups, those that have little government representation or are actively excluded from central decision-making power, are less able to rely on institutions and government processes to have their needs met. Outgroups may therefore be more likely to use extralegal methods to achieve their goals, being that they have little trust in the government to deliver on their concerns and may be actively threatened by the central government (Cederman, et al. 2010). Therefore, excluded groups may fear for their security for the future when they perceive their access to water resources are endangered, and seek to act early before discriminatory water distribution is entrenched and more difficult to upend. Ethnic dominance, as represented by major dominance or monopolization of central government power, represents levels of tension between these in groups and out groups. Hence, the second hypothesis:

H2. Water-scarce states with a strong ethnic dominance will have an increased likelihood of domestic conflict.

States that are scarce in water resources, according to the “ingenuity gap” argument, are also likely to be less capable of adapting to the social effects of increasing resource insecurity. While this is certainly not true in all cases and likely overshadowed by the effects of other factors, it is nevertheless worthwhile to note that weak states, whether because of coincidental with scarce water resources, are less able to manage the effects of scarce and depleting resources. Less able to adapt to the need for additional

technology and to the socio-economic impact of possible scarcity-induced migration, these weak states are also as a rule more susceptible to conflict. Combined with the presence of strong social divides, migration of water-seeking people into areas with increased may generate conflict as well.

In contrast to the state, an opposition force has a great incentive to ensure the capture of scarce water resources from the state in order to sustain itself. Because it is a critical resource to state growth and quality of life, water is a high-stakes prize when it is of limited quantity. Control of water access, such as the headwaters of rivers or wells, has the potential to be the new “salting of the fields”: that is, to seriously cripple an adversary in its ability to provide for itself. Oppositions are certainly subject to state-driven structural scarcities, which can increase the motive to act quickly and dramatically to secure a first-mover advantage in a conflict and seize critical resources. In particular, the presence of autonomous or opposition-held areas within a state often sees the opposition and the central governments act more like states in the international anarchical system. Though interstate conflict over water resources often leads to cooperation rather than conflict, the tether of sovereignty that the state claims over the autonomous region shifts the balance of power back to the state and deprives autonomous regions of their power. In essence, the state may discriminate against autonomous regions with water resources there because of its ability to determine the use of said resources, which it has a more legitimate claim on as the central authority. The critical threat of losing access to adequate resources incentivizes oppositions to secure said resources for themselves while they are able. Therefore,

H3: The presence of autonomous or opposition regions in water-scarce states will increase the likelihood of conflict.

This is a similar line of reasoning for insurgency entrepreneurs, which as Fearon and Laitin and Collier (2003) and Hoeffler (2004) are more likely to emerge when there are conducive conditions for insurgency than when there are simply grievances or opportunities for material gain. Generalizing that water-scarce states are often weak states with loose governance, insurgencies may have an opportunity to form with little harassment. The greed-based motive of access to critical areas, as well as the political motive of changing policy, can be achieved through capturing water resources. Particularly when water resources are scarce and distributed geographically unequally, areas that contain access to these resources will be more contentious as they are more desirable and likely make a decent tool for putting pressure on the adversary state. Furthermore, with water resources becoming increasingly unreliable in many parts of the world, the capture and sale of water resources by insurgent groups to local populations may be an increasingly attractive source of funding for insurgencies. The geographic distribution of water resources is important to the opportunity aspect of an insurgency, which is facilitated initially by the presence of significant divides (see H5). Lastly, if a population, particularly of a target group, fears that its access will be significantly less in the near future and therefore significantly detrimental to its way and quality of life, the opportunity costs of fighting versus allowing the discrimination to continue may increase the likelihood that conflict will constitute a reasonable measure. This will allow insurgency entrepreneurs to exploit the costs of waiting in the popular imagination and recruit members.

In societies where ethnic groups constitute a significant way of organizing people, and ethnic groups are well-defined, a sense of shared fate can drive groups to conflict to protect their interests. The critical importance of water to health and development, in concert with its often indeterminate, uncertain availability, makes it a ready issue for ethnic entrepreneurs attempting to garner support through fear. When water scarcity grievances exist and worry the entrepreneurs' target support group, they can play on existing mistrust of the government and adversarial groups to incite greater antipathy. This greed explanation frames water scarcity as an opportunity for small numbers of a group to initiate ethnic violence by creating community fears of future insecurity. Utilizing the Lake and Rothchild (1996) framework for explaining ethnic conflict, these entrepreneurs and activists for the ethnic cause, whatever their motivation, can indeed create a security dilemma over water. The uncertain nature of availability and other groups' usage of a shared resource can quickly generate information problems and problems of credible commitments to not pollute, overuse, or hoard water from other users.

Taking the grievances argument for conflict, ethnic groups may indeed be unequally affected by water scarcities either through supply/demand or structural factors. In the first case, real or perceived deprivation of water resources relative to other groups may motivate competition between ethnic groups. As opposed to measuring dominance in central government, polarization examines a more diffuse measure of the society as a whole and the potential for competition between various ethnic groups in society. In societies where ethnic groups are significantly polarized, as opposed to simply heterogeneous, they may act more like state in an anarchical situation and therefore suffer

increasingly from the effects of a security dilemma and information problems (Collier and Hoeffler, 2004). Therefore,

H4. Water-scarce states with strong ethnic polarization have a greater likelihood of experiencing ethnic civil conflict.

A number of situational factors also represent the juncture of scarcity and societal divides. For one, societies that contain major divides have often seen them emerge as a result of previous instability or conflict, and it is commonly understood that the time since last conflict episode is a strong predictor of the likelihood of future conflict.

Bringing in Homer-Dixon's (1998) concept of the ingenuity gap in a slightly different manner, it is reasonable to assume that societies significantly divided and suffering from the socio-economic, political, and infrastructural effects of recent conflict are less capable of effectively cooperating on scarce resource distribution. In such a case, it is likely that competition over water resources and the land containing them will be a motivator for combatants to reignite conflict, particularly when lack of development prevents the acquisition of adequate resources from outside options. As previously described, the potential information, security, and credible commitment problems that uncertain water resources may generate would be even more impactful in the context of a recent conflict.

Therefore, another hypothesis emerges:

H5. Societies with both a recent history of civil conflict and a water scarcity issue are increasingly likely to return to conflict than those with one factor or the other.

Opposition to discriminatory provision of water by the state, a form of structural scarcity, is a large part of this theory and a claim that may be taken up by any of the non-state actors discussed above. Whether based on ethnic or socioeconomic discrimination

or the inequitable allocation of water for state, rather than public, use, grievance-based arguments relevant to all of the actors emerge. On the other hand, the greed-based argument for capturing this necessary and potentially lucrative resource and the land it is accessible from also provides an explanation for initiating conflict. When a state relies heavily on groundwater, access to water generally concentrated at those few points that can tap into the resource. Wells and treatment centers represent these points, and their immobile nature may incentivize capture of areas containing them. Similarly, because of the hidden and often-inaccessible quality of groundwater as opposed to surface water, information problems, lack of credible commitments to not overuse shared water, and the security dilemma associated with gaining an advantage by renegeing on difficult-to-monitor agreements may be common. This uncertainty incentivizes non-state and state actors to ensure control of as large of a portion of the land containing water as possible at the exclusion of others. This valuable land may draw significant competition because of the difficult to calculate, though potentially dire, consequences of being shut out.

Therefore,

H6. Water-scarce and divided states with a disproportional reliance on groundwater will have a greater likelihood of conflict.

While the existence of a water scarcity issue may have quite different or diminished impacts in other contexts, the context of existing societal divides discussed here looks at a very specific intersection of two issues.

CHAPTER 4: METHODOLOGY AND RESEARCH DESIGN

The empirical testing of these hypotheses requires the aggregation of data from numerous sources in order to create an appropriate, thorough, and unique dataset. This dataset, which includes the whole world in country-year format from 1958-2010, also contains a number of variables generated specifically for this analysis from the initial sets.

The dependent variables observed in this analysis are the onsets of nonviolent or violent campaigns in a given country-year. These variables were generated from the NAVCO 2.0 Project Dataset's measures for the onset of a campaign, as well as the primary method of action taken during that campaign in a given country-year, either violent or nonviolent. This allowed for examination of the conditions related to the initial onset of a campaign, as well as the empirical differences in impact of various independent variables on the type of campaign that emerges.

The independent variables in this testing varied widely according to the construction of each hypothesis and are all sourced from the FAO Aquastat Database. Due to the five-year range of data in the Aquastat database, for example there would be one value for the years 1958-1962, the data were necessarily expanded to fit a country-year format. This was accomplished by applying the value for the five-year window to every year inside that window, yielding an observance for every year. The Aquastat variables representing water measures also varied for the purpose of testing numerous types of water scarcity or abundance in a nation. Though creating a variable strictly

representing “water scarcity” is a convoluted task and was confounded by missing data, a number of variables were used instead to test the relationship between increasing levels of water availability and the probability of conflict. The most general of these is *total renewable water resources per capita*, measured in cubic meters/inhabitant/year, which demonstrates a range of supply and demand induced pressure on the availability of water as a whole. This is also available in a total form for each country. In order to test a more dynamic measure of water availability in countries as opposed to having each recording repeated five times, a new variable was created to measure the *five-year difference in the total renewable water* available in a nation for a given year. To generate this, each observance for *total renewable water resources* was subtracted from the observance five years prior. Therefore, a negative value for the difference variable would indicate an overall reduction in the total amount of renewable water available in a country. Thus, a greater negative difference indicates greater supply-induced scarcity on the total water availability.

A more nuanced representation of scarcity is *total freshwater withdrawal per capita*, also in $\text{m}^3/\text{inhabitant}/\text{year}$, which measures real availability of useable water. This variable may be interpreted in a number of ways. For one, increased withdrawals indicates greater real access to water for inhabitants of a nation. This shows that more water is accessed successfully, reducing scarcity in terms of structural or access-restricted supply scarcity, for instance where groundwater is the main source. On the other hand, increased withdrawals also represent demand-induced scarcity, as it could indicate that a nation’s withdrawals are overexploiting existing resources. Similar to the first interpretation of withdrawals, *percent of total population with access to safe drinking*

water represents availability more relevant to domestic resources than agricultural withdrawals, in an attempt to capture a measure closely related to potential popular grievances. Finally, the withdrawal-induced pressure on available resources is represented by *freshwater withdrawal as a percentage of total renewable water resources*, which indicates greater pressure on resources as the percentage increases.

In additions to the water measures, this analysis uses a number of measures from the Ethnic Power Relations project to test the impact of ethnic fractionalization, exclusion, and discrimination in concert with the water measures on conflict onset. The most general measures for this include *linguistic fractionalization* and *number of ethnopolitically relevant groups*. These variables generally indicate whether a society is more homogenous or heterogeneous in its ethnolinguistic makeup and the number of ethnic groups for which, according to the EPR codebook, “at least one significant political actor claims to represent the interests of that group in the national political arena, or if members of an ethnic category are systematically and intentionally discriminated against in the domain of public politics.” These measures aid the analysis by allowing analytical comparisons of the importance of fractionalization and the number of potentially competitive groups in a society versus the impact of water scarcity on the onset of conflict.

Following this, the numbers of *included groups* and *excluded groups* as well as the *size of the excluded population relative to total population* represent the relative power of included and excluded groups in a nation. Included groups are those included in central political power, while excluded groups generally do not have access to government power. The numbers of these groups help test whether larger or smaller

numbers of each affect the outcome, while the percentage of excluded population in the total population helps to test the hypothesis that greater ethnic dominance and political exclusion increases the likelihood of conflict onset.

The percentages of the total population of *discriminated population*, *powerless population*, *only local power separatist population*, *dominant population*, and *monopoly population* were similarly used to test for probability changes relative to variation in these specific measures. According to the EPR codebook, discriminated populations face active, intentional, and targeted exclusion from central and regional power, while powerless populations face exclusion from power without being actively discriminated against. These are used to differentiate the possible impacts of active discrimination from a dominant group versus other reasons for lack of access to power. The *only local power separatist population* variable, which represents groups with secessionist intent and only local or regional power, is used to test whether the existence of significant percentages of the population in this category would positively affect the likelihood of conflict, as was the prediction of the theory. Monopoly population and dominant population are those in which elite members hold exclusive power or near-exclusive power at the executive level, respectively. This theory predicts that lower percentages of these measures, excepting zero percent, would indicate high levels of ethnic power concentration and engender increased discrimination with scarce resources. Lastly, the EPR variable *number of peace years* since a previous conflict controlled for the effects of recent conflict on the outcome of the dependent variables.

All models included standard control variables for political structure, development, and population. The control *polity2*, the combined Polity2 scores from the

Polity IV dataset ranging from full democracy (10) to autocracy (-10), represents the level of democracy in a nation and its impact on the potential for conflict. Polity2 also allowed for the creation of dummy variables for democratic and autocratic nations, which were used in the testing of Hypothesis 1. Gross Domestic Product per capita (lagged) controls for the impact of development and economic growth on conflict onset outcomes, as increased GDP is associated with greater stability. Finally, the log of population in each country-year is used as a control for the effect of population growth on conflict onset, as the two may be positively correlated. Controlling for these variables helps to show a clearer relationship between the water and ethnic division variables and conflict onset.

Analysis of this data took place in R using logit analysis of interacting and non-interacting variables. Though all of these variables factored into the analysis, many produced insignificant results and are therefore excluded from the discussion of more relevant findings. It should also be noted that although the dataset covers the whole world from 1946-2010, many models ran on subsets of the data based on the Ethnic Power Relation designation of North Africa/Middle East nations and Sub-Saharan African nations in order to examine regional influences on the issue of water and ethnic divisions.

CHAPTER 5: RESULTS AND FINDINGS

The results of this analysis demonstrate a number of interesting relationships between measures of water availability and various social and ethnic division measures on the onset of conflict. For the majority of these tests, the results for violent onsets are more likely to show significance than nonviolent onsets. Though these were also tested, they are generally excluded from the tables due to their lack of significant relationships and usefulness for comparison.

Hypothesis 1

In order to test Hypothesis 1, I used models 1, 2, 3, and 4. Like all other models, these included controls for polity, which was squared in this case, gross domestic product (GDP) in logged form, and the logged population for a given country-year. These models attempted to examine the relationship between government type, in particular autocracy, and the amount of water available in a nation according to different measures of access. These measures, which include total renewable water resources per capita, total water withdrawal per capita, and total population percentage with access to safe drinking water, aim to test varied ways in which the overall availability of water in a nation or the ability of a nation to extract and provide access to water resources affects conflict onset outcomes. These varied measures are used throughout this analysis in comparable models to test potential differences between supply-, demand-, and structurally-induced scarcity and pressure on water resources.

The models for this hypothesis unfortunately show little significance for either measures of water. Models 1 through 3 display interactions between autocracy dummy variables and water measures and show no significance with the interaction or the individual variables. Interactions such as appear here and in further models add to the analysis by testing whether the variable produce a different outcome in concert than they do individually. In other words, whether the variables affect one another and in what direction this effect alters the dependent variable outcome.

However, the one model without an interaction, 4, shows slight significance for the *total water withdrawal per capita per year* variable. Interestingly, the coefficient for this variable, .001 is positive. Whereas according to the hypothesis the more water available in a country-year the lesser the chance of conflict, this model suggests the opposite. This model suggests instead that a greater amount of water withdrawn per capita per year contributes to a slight increase in the likelihood of conflict. In addition to the other models for this hypothesis that showed no quantitative significance, this particular observation contradicts the theory that led to this hypothesis and does not support the hypothesis. One potential explanation for this positive coefficient, which is fairly weak to begin with, is the impact of data missingness on the accuracy of this test. With unfortunately large parts of the Aquastat database missing observances for whole variables or intermittently throughout the country-years, it is possible that the test is not comprehensive of the whole world and therefore may produce a falsely positive result based on the limited data available.

Another potential explanation lies in questions of allocation that are not captured in this analysis, and in particular the distribution and allocation of withdrawn water

among competing sectors and parties. In essence, the problem may lie in the steps taken post-withdrawal that contribute to increased competition, particularly in autocratic societies in which an increase in water withdrawal may be associated with a more clearly preferential allocation that in effect contributes to structural scarcity for some despite an overall increase in withdrawal.

Table 1

| | Violent Campaign Onset | | | |
|--|------------------------|---------------------|---------------------|----------------------|
| | <u>(1)</u> | <u>(2)</u> | <u>(3)</u> | <u>(4)</u> |
| Polity2 | 0.062 (0.039) | 0.130 (0.124) | 0.078 (0.065) | 0.127 (0.123) |
| GDP per capita (logged) | -0.155*** (0.038) | -0.138** (0.059) | -0.208* (0.113) | -0.138** (0.060) |
| Population (logged) | 0.197*** (0.075) | 0.304* (0.159) | 0.040 (0.151) | 0.310** (0.157) |
| Democracy (0/1) | -1.059** (0.436) | -0.659 (1.115) | -1.803** (0.821) | -0.632 (1.105) |
| Autocracy (0/1) | 0.141 (0.387) | 0.985 (1.381) | 0.501 (1.543) | 0.850 (1.251) |
| Total renewable water resources per capita (m ³ /inhabitant/year) | 0.00000 (0.00000) | | | |
| Autocracy: Total renewable water resources per capita (m ³ /inhabitant/year) | -0.00001 (0.00001) | | | |
| Total water withdrawal per capita (m ³ /inhabitant/year) | | 0.001 (0.001) | | 0.001*** (0.0002) |
| Autocracy: Total water withdrawal per capita (m ³ /inhabitant/year) | | -0.0001 (0.001) | | |
| Total population with access to safe drinking water (%) | | | -0.009 (0.014) | |
| | <u>(1)</u> | <u>(2)</u> | <u>(3)</u> | <u>(4)</u> |
| Autocracy: Total population with access to safe drinking water (%) | | | 0.005 (0.022) | |
| Constant | -5.232*** | -7.859*** | -3.462** | -7.842*** |

| | | | | |
|-------------------|----------|---------|----------|-----------------------------|
| | (0.741) | (1.670) | (1.606) | (1.668) |
| Observations | 6,486 | 2,418 | 3,142 | 2,418 |
| Log Likelihood | -443.216 | -81.990 | -142.035 | -82.016 |
| Akaike Inf. Crit. | 902.432 | 179.980 | 300.069 | 178.031 |
| <i>Note:</i> | | | | *p<0.1; **p<0.05; ***p<0.01 |

Hypothesis 2

Hypothesis 2 postulates a relationship between societies with strong indicators for ethnic dominance will be more likely to experience conflict when they also show signs of water scarcity than when they have greater amounts of available water. In order to test Hypothesis 2, I use models 5, 6, 7, and 8 using the variables *dominant population (%)*, *monopoly population (%)*, and *excluded groups (number)* to represent levels of exclusion and dominance. The water variables included in this table, *total water withdrawal per capita (m³/inhabitant/year)* and *total renewable water resources per capita (m³/inhabitant/year)* showed the strongest relationships of tested water measures for this analysis and provide comparison between the representations of water availability. The dependent variable in this test was restricted to violent campaign onset, given that the nonviolent campaign tests yielded insignificant results.

The most notable model from this hypothesis is 5, which tests water withdrawal per capita and dominant population percentage separately and as an interaction. Total water withdrawal per capita is significant by itself in this test with a coefficient of 0.001 (p= 0.00009), and the interaction with dominant population is significant with coefficient -0.003 (p=0.079). Again, total water withdrawal per capita gives surprising results in that it is significant and positive, indicating that when the other variables are held constant, increases in total water withdrawal per capita contribute to and increased likelihood of conflict. This does not support the hypothesis, but may be attributed to factors not

captured by this test or by data issues such as missingness. The interaction also yields an interesting result, as the significant and negative coefficient suggests that as water withdrawals per capita increase along with a share of the population that is considered to be in the dominant group, these two variables interact to decrease the likelihood of conflict. This perhaps suggests that the greater the share of the population that identifies with that group, the less that other groups are willing or able to engage in a violent conflict against the dominant population. This may be particularly true when adequate access to water resources reduces competition or the need to revolt against a dominant population. As this hypothesis would suggest that the smaller the proportion of the total population that is considered “dominant,” the more likely that conflict would occur because of unfair power concentration, this interaction result somewhat supports the hypothesis. The more equal power relations are across a larger proportion of the population, in addition to adequate water provisions, it may be anticipated that such a society may be more egalitarian with its water resource distribution and therefore reduce both grievance and greed (opportunistic) motives to engage in violence.

Table 2

| | Violent campaign onset | | | |
|---|------------------------|----------------------|-----------------------------|----------------------|
| | (5) | (6) | (7) | (8) |
| GDP per capita (logged) | -0.119* (0.062) | -0.157*** (0.039) | -0.125* (0.064) | -0.129** (0.064) |
| Polity2 | 0.037 (0.043) | 0.007 (0.018) | 0.042 (0.046) | 0.037 (0.048) |
| Population (logged) | 0.279* (0.168) | 0.218*** (0.072) | 0.368** (0.174) | 0.345* (0.201) |
| Ethnic Fractionalization | 0.454 (1.138) | 0.054 (0.377) | -0.333 (1.095) | 0.161 (1.093) |
| Dominant population (%) | 2.109 (1.310) | -0.835* (0.501) | | |
| Monopoly population (%) | | | -3.322 (2.689) | |
| Excluded groups (number) | | | | 0.092 (0.110) |
| Total water withdrawal per capita (m ³ /inhabitant/year) | 0.001*** (0.0003) | | 0.001** (0.0003) | 0.001* (0.001) |
| Dominant population: Total water withdrawal per capita (m ³ /inhabitant/year) | -0.003* (0.001) | | | |
| Total renewable water resources per capita (m ³ /inhabitant/year) | | 0.00000 (0.00000) | | |
| Dominant population: Total renewable water resources per capita (m ³ /inhabitant/year) | | 0.00001 (0.00001) | | |
| Monopoly population: Total water withdrawal per capita (m ³ /inhabitant/year) | | | 0.003 (0.002) | |
| Excluded groups: Total water withdrawal per capita (m ³ /inhabitant/year) | | | | -0.0002 (0.0002) |
| Constant | -8.255*** (1.876) | -5.618*** (0.731) | -8.124*** (1.842) | -8.443*** (2.016) |
| Observations | 2,414 | 6,469 | 2,414 | 2,414 |
| Log Likelihood | -78.906 | -438.007 | -81.145 | -81.769 |
| Akaike Inf. Crit. | 173.812 | 892.014 | 178.289 | 179.538 |
| Note: | | | *p<0.1; **p<0.05; ***p<0.01 | |

Hypothesis 3

Hypothesis 3 supposes a relationship between the existence of separatist or autonomous areas in a state and lower levels of water availability that increases the likelihood of conflict. Testing Hypothesis 3 with the standard control variables, different measures of water resources, and the Ethnic Power Relations data for *only local power population (%)* and *only local power separatist population (%)* yielded two most promising models, 9 and 10. These models interacted these variables with the water variables, yielding unreliable and insignificant results. Therefore, these models suggest that the variables do not work together to constitute any synergistic effects on the likelihood of conflict.

However, similar to the results of the Hypothesis 1 models, these models also suggest that an increase in total water withdrawals per capita has a slight positive effect on the likelihood of conflict, with a rounded 0.001 coefficient in both cases and 0.0890 p value for 9 and a 0.00961 p value for 10. Again, this may be due to the data or other factors. Perhaps an increase in water withdrawals demonstrates more water available per capita, but it may also represent stress on resources that affect conflict outcomes but is not explicitly visible in these models. However, this model demonstrates that there is no reason to expect a consistent quantitative relationship between the presence of large local power or local power separatist populations and water availability increasing the likelihood of conflict.

Table 3

| | Violent campaign onset | |
|---|-----------------------------|----------------------|
| | (9) | (10) |
| GDP per capita (logged) | -0.121* (0.062) | -0.132** (0.064) |
| Polity2 | 0.063 (0.048) | 0.035 (0.045) |
| Population (logged) | 0.316* (0.164) | 0.385** (0.173) |
| Only local power separatist population (%) | 8.815 (6.732) | |
| Only local power population (%) | | -1.675 (10.154) |
| Ethnic fractionalization | 0.093 (1.106) | -0.230 (1.033) |
| Total water withdrawal per capita (m ³ /inhabitant/year) | 0.001* (0.0003) | 0.001*** (0.0003) |
| Only local power separatist population: Total water withdrawal per capita (m ³ /inhabitant/year) | 0.001 (0.004) | |
| Only local power population: Total water withdrawal per capita (m ³ /inhabitant/year) | | -0.008 (0.023) |
| Constant | -8.039*** (1.778) | -8.330*** (1.810) |
| Observations | 2,414 | 2,414 |
| Log Likelihood | -79.671 | -81.742 |
| Akaike Inf. Crit. | 175.341 | 179.483 |
| Note: | *p<0.1; **p<0.05; ***p<0.01 | |

Hypothesis 4

According to Hypothesis 4, an increase in water availability should negatively impact conflict outcome probability, whereas an increase in ethnic polarization or an interaction between low levels of water availability and high divisiveness should increase the likelihood of a violent campaign onset. With violent campaign onset as the dependent variable, models 11, 12, and 13, tested total water withdrawal per capita (109m³/year), total renewable water resources per capita (109m³/year), and total population with access to safe drinking water (%) as water measures, and used ethnic fractionalization and number of ethnopolitically relevant groups to represent social fractionalization.

Though these and similar models not included in the chart tested various independent and interacting variables of water availability and ethnopolitical divisiveness, none of the models returned significant results. Despite being insignificant and therefore unreliable, it is interesting that some of the water measures returned coefficients counterintuitive to the theory. Increasing access to drinking water returned a negative coefficient as expected (coefficient = -0.022, $p= 0.136$), though increasing withdrawal and total resources per capita again increased the likelihood of a violent outcome.

Overall, these results do not uphold the hypothesis as presented with either independent or interacting variables representing water availability and social fractionalization. While there may be anecdotal examples in history of an interaction between these factors, there appears to be no observable quantitative relationship here that would add to the accuracy of predictive models for this interaction.

Table 4

| | Violent Conflict Onset | | |
|---|--------------------------|-----------------------|-----------------------------|
| | (11) | (12) | (13) |
| GDP Per Capita (logged) | -0.134** (0.065) | -0.158*** (0.040) | -0.206* (0.114) |
| Polity2 | 0.048 (0.047) | 0.009 (0.018) | -0.042 (0.036) |
| Population (log) | 0.293 (0.226) | 0.140 (0.097) | -0.001 (0.189) |
| Ethnic Fractionalization | 0.309 (1.461) | 0.280 (0.434) | -1.315 (2.371) |
| Number of ethnopolitically relevant groups | 0.009 (0.038) | 0.015 (0.017) | 0.030 (0.032) |
| Total water withdrawal per capita (10 ⁹ m ³ /year) | 0.001 (0.001) | | |
| Ethnic Fractionalization: Total water withdrawal per capita (10 ⁹ m ³ /year) | -0.001 (0.002) | | |
| Total renewable water resources per capita (10 ⁹ m ³ /year) | | 0.00001 (0.00001) | |
| Ethnic Fractionalization: Total renewable water resources per capita (10 ⁹ m ³ /year) | | -0.00001 (0.00001) | |
| Total population with access to safe drinking water (%) | | | -0.022 (0.020) |
| Ethnic Fractionalization: Total population with access to safe drinking water | | | 0.017 (0.036) |
| Constant | - 7.841*** (2.245) | -5.191*** (0.901) | -2.487 (2.025) |
| Observations | 2,414 | 6,469 | 3,129 |
| Log Likelihood | -82.217 | -439.182 | -139.980 |
| Akaike Inf. Crit. | 180.433 | 894.363 | 295.960 |
| <i>Note:</i> | | | *p<0.1; **p<0.05; ***p<0.01 |

Hypothesis 5

Hypothesis 5 expects that lower levels of water availability, in concert with lower number of peace years since last conflict, will contribute to an increasing likelihood of

conflict. Models 14, 15, 16, and 17 look at various measures of water availability (*total water withdrawal per capita* ($10^9\text{m}^3/\text{year}$), *total renewable water resources per capita* ($10^9\text{m}^3/\text{year}$), and *total population with access to safe drinking water (%)*) along with the number of peace years since last conflict and various control variables including binary representations of a nation's location in the Middle East or Sub-Saharan Africa. In this case, there was reason to include an interesting model with nonviolent campaign onset as the dependent variable, as this model showed significance for this interaction.

In general, these models showed little in support of the hypothesis. Though 14 showed the positive coefficient for total water withdrawals per capita observed in other models with a modest significance ($p = 0.0765$), 14 and 15 showed little significance in the results. In mod.h5b, which tested total renewable resources per capita and an interaction of this variable with number of peace years, both being in the Middle East (coefficient = 0.851, $p = 0.0088$) and having fewer peace years (coefficient = -0.0351, $p = 0.002550$) had strong significance for the likelihood of conflict, though the water measure was insignificant and this relationship could likely be explained by other factors unrelated to water.

However, 16 and 17 showed interesting results for peace years and access to safe drinking water. These models are identical except for the dependent variable, for which 16 is violent and for 17 is nonviolent campaign onset. Both models showed that an interaction between number of peace years and the percentage of the population with access to safe drinking water produced a negative effect on the likelihood of either violent or nonviolent conflict with the same coefficient of -0.002. Though the test for nonviolent conflict was more significant in this case, both models support the hypothesis

that fewer years of peace and more scarce access to water contribute to an increased likelihood of civil conflict. This is intuitive, as both measures are often associated with the weakness or strength of a state. This also demonstrates the impact of structural and supply-induced scarcity, as the lack of drinking water is likely a combination of both physical availability of the resources and the ability of states or communities within them to exploit these resources. However, this relationship may be more related in actuality to the strength of a state following a conflict, for in that time a state may or may not have the capacity to repair critical infrastructure such as water distribution systems. Water distribution infrastructure may serve as a weak representation of state capacity in this sense, but it appears that the conflict outcome may depend more particularly on the capability of the state to engage in projects like water infrastructure building that it does on the availability of water itself.

Table 5

| | Violent campaign onset | | | Nonviolent campaign onset |
|--------------------------------|------------------------|----------------------|--------------------|---------------------------|
| | (14) | (15) | (16) | (17) |
| GDP per capita (logged) | -0.131 (0.084) | -0.167*** (0.045) | -0.241* (0.136) | -0.030 (0.047) |
| Polity2 | 0.068 (0.057) | 0.017 (0.018) | -0.032 (0.036) | -0.057* (0.030) |
| Population (logged) | 0.184 (0.215) | 0.128 (0.084) | 0.049 (0.168) | 0.279** (0.117) |
| Number of peace years | 0.031 (0.041) | -0.035*** (0.012) | 0.092* (0.055) | 0.183*** (0.046) |
| North Africa/Middle East (0/1) | 1.397* (0.776) | 0.851*** (0.325) | 0.930 (0.704) | -0.992 (0.787) |
| | Violent campaign onset | | | Nonviolent campaign onset |
| | (14) | (15) | (16) | (17) |
| Sub-Saharan Africa (0/1) | -1.831 (1.298) | -0.207 (0.303) | 0.170 (0.570) | -0.677 (0.550) |

| | | | | |
|--|----------------------|----------------------|-----------------------------|----------------------|
| Ethnic Fractionalization | 0.534 (1.435) | 0.342 (0.457) | -0.164 (0.778) | 0.789 (0.776) |
| Total water withdrawal per capita (10 ⁹ m ³ /year) | 0.001* (0.0004) | | | |
| Number of peace years: Total water withdrawal per capita (10 ⁹ m ³ /year) | -0.0002 (0.0001) | | | |
| Total renewable water resources per capita (10 ⁹ m ³ /year) | | 0.00000 (0.00000) | | |
| Number of peace years: Total renewable water resources per capita (10 ⁹ m ³ /year) | | 0.000 (0.00000) | | |
| Total population with access to safe drinking water (%) | | | 0.004 (0.016) | 0.020 (0.017) |
| Number of peace years: Total population with access to safe drinking water (%) | | | -0.002* (0.001) | -0.002*** (0.001) |
| Constant | -6.468*** (2.248) | -4.640*** (0.874) | -4.392** (1.902) | -8.596*** (1.738) |
| Observations | 2,418 | 6,486 | 3,142 | 3,142 |
| Log Likelihood | -72.389 | -435.588 | -140.673 | -169.882 |
| Akaike Inf. Crit. | 164.778 | 891.175 | 301.346 | 359.764 |
| <i>Note:</i> | | | *p<0.1; **p<0.05; ***p<0.01 | |

Hypothesis 6

Hypothesis 6, which asserts that a higher reliance on groundwater increases the uncertainty of resources and therefore incentivizes competition over scarce access points, was unfortunately untestable with any validity based on the availability of data. In order to test the dependence of violent and nonviolent campaign onset on groundwater dependence, a new variable was created to represent the percentage of total freshwater withdrawn in a given country-year was of groundwater origin. This was tested with *polity*, *GDP per capita*, *population (log)*, and *ethnic fractionalization* as controls.

However, the missingness of large quantities of data from the Aquastat dataset degraded the validity of this test so as to make it unusable. In this case, it is impossible to determine whether the hypothesis is supported or unsupported by the test conducted.

CHAPTER 6: CASE STUDIES

The structure of this analysis begins with the examination of three cases to address the questions posed in the introduction. These three cases of the Israel/Palestine, Iraq/ISIS, and Sudan Darfur conflicts represent three distinct instances in which water is a clearly identified element, if not cause, of conflict. The level of conflict in these instances vary from mostly political, to asymmetrical, to all out civil war, demonstrating a variety of outcomes in the dependent variable. Therefore, the intent of this paper is not to prove a universal causality of water shortages to conflict, but to examine the importance of this independent variable in determining the relative importance of water issues as a factor in domestic conflict and a variety of ways in which these issues impact power and security in a nation. It is important to recognize that although the analysis of these cases focuses particularly on the water aspect of each, other socio-political and economic factors are recognized to play a major role in conflict onset as well. However, since this thesis asserts that water issues, as a large category, do indeed increase conflict likelihood through both opportunity and grievance related mechanisms, this analysis has a necessarily narrowed scope for examining this issue specifically.

Though this section studies mostly international cases outside of the United States, this issue has major implications for United States and global policy and intelligence communities. Therefore, this qualitative section focuses mainly on the intelligence and policy value of the trends extracted from these cases and the larger analysis. The United States Intelligence Community has increasingly recognized the topic

of water conflict in its estimates for emerging problems on the global scale, as a subset of the larger concerns of climate change impacts and the effects of depleting global natural freshwater resources. The US Intelligence Community acknowledged that these forces will in the future increasingly “threat[en] the stability of countries” and “heighten social and political tensions” in a number of regions, constituting a direct threat to the state of global security in which the US maintains a major interest (US National Intelligence Council 2016, 3). This concern is well founded and intimately tied to this paper’s discussion, as in the near future water resources will likely only continue to decline as a result of human and climatic forces at uncertain rates and with unclear consequences, thereby adding an imperative to this research. Hence, there are clear national security implications to this study, as it may provide better predictive insights into the ways in which water scarcity contributes to the destabilization of nations and regions by drawing out trends from both the abstract theoretical analysis of water and conflict and existing case studies on the matter. It is the intent of this thesis to contribute to the understanding of what intelligence is necessary to mitigate dangerous interactions of these factors and avenues for the intelligence community to manage associated future risks. This is accomplished by the following analysis of the cases to which we now turn.

Israel and Palestine

Perhaps the most generally well-known of these three cases, the Israel-Palestine situation has long been haunted by a less visible specter than outright violence: disputes over the right to water that flows unconfined between the regions. The issues here are manifold and convoluted, with each side manipulating the public perception of the

situation to demonize the other. Israel blames the Palestinians for failing to create institutions effective enough to provide water to their people (*The Issue of Water...*). The Palestinians blame Israel for embedding discriminatory provisions in the water sharing process and using its control over the resources to stifle Palestinian development (“Palestinian Water Sector”). In either view, and there is some truth to both, water has remained a major sticking point in negotiations between the parties and contributed to socioeconomic changes that could threaten the security of the area.

Figure 1: Map of the West Bank



Figure 1: This map combines a UN map with a rough approximation of the line between the Eastern and Western Mountain Aquifers. Clearly, the Eastern aquifer that was allocated by the Oslo Accords for the exploitation of Palestinians lies predominately in Israeli-controlled Area C, preventing much effective usage of this limited and degrading resource. (Adapted from: Knell, Yolande. "Stifled West Bank Economy Drains Palestinians' Hopes." *BBC News*. BBC, 16 Oct. 2012. Web. 01 Apr. 2017 and Swagerty, Ted. "Israel/Palestine/Jordan – EcoPeace/Friends of the Earth Middle East and the Good Water Neighbors Project." *The Eco Tipping Point Project*, Apr. 2014. Web. 01 Apr. 2017).

Israel and the West Bank share the Jordan River as well as the Mountain Aquifer that lies underneath both territories and provides freshwater in the absence of significant yearly rainfall (Kiser 2000). Israel and the Palestinian territories both depend extensively

on these groundwater resources, with the West Bank sourcing 98 percent of its water from underground reservoirs (AQUASTAT Israel and Occupied Territories). The Mountain Aquifer is hydrologically distinguished between its Western and Eastern halves. Though the Eastern part lies almost entirely in the West Bank, the Israeli national water company Mekorot heavily exploits it for Israeli use around the nation (“Issues Under the Oslo Accords”). To complicate the matter, an expected one-third decrease of useable aquifer water due to over pumping and pollution as well as a potential 20 percent increase in population by 2050 will further stress the area with supply and demand-induced scarcity (Chenoweth 2011, 409).

Though the limited and decreasing water resources are transboundary and inseparable, Israel and the Palestinian Authority have long debated the rights of each to access the water they share. The latest agreement to that point, the 1995 Oslo Interim Agreement – which was intended to last five years but continues to be the rule today – solidified the control Israel has effectively held over the aquifer since 1967 (Pendraza and Heinrich 2016). Since the 1967 agreement that established the sharing of the West Bank territory between the Israelis and Palestinians, Israel has controlled 90 percent of the territory’s water resources and all its surface water (Melham 2015). Since the 1995 Agreement, Israel has claimed 71 percent of the aquifer’s total renewable water production, while the West Bank is allocated 17 percent and Jordan receives a percentage as part of the agreement as well (Pendraza and Heinrich 2016). About 1370 million cubic meters (mcm) of water are shared between the Israeli and Palestinian territories out of the total 1800 mcm/year of renewable water available in the territories as a whole. Palestinians are only legally able to extract 118 mcm/year of these resources (Hareuveni

2012). It is estimated that Israel allocates three to five times the Palestinian share of water to Israeli settlements, and that approximately 113,000 Palestinians lack access to water distribution networks (Asser and Hass).

The renewable resources present in the territories could be sufficient for the Palestinian and Israeli needs with major efforts to increase efficiency in use and transport of water. However, the fact of poor management on the part of the Palestinians, such as failure to update and increase the efficiency of distribution systems or manage sewage and pollution, makes the meager share they receive insufficient for current and future needs (Chenoweth 2011). The huge disparity in allocation of the shared resources is echoed by the vastly different access of Israelis and Palestinians to clean water. The World Health Organization minimum standard for water access is 100 liters per person per day, and although most Israelis can expect this quantity to be available from legal, accessible sources without concern, the ability of Palestinians to access sufficient quantities of water varies significantly due to spotty infrastructure, degraded wells, and restrictions on movement to areas where water is more accessible (“Palestinian Water Sector”).

The present state of water disparity was cemented in The Oslo Agreements in 1995, which both set the current limits on the quantity and permitted locations of water extraction for both parties as well as created the Israeli-Palestinian Joint Water Committee (JWC) that must unanimously approve all West Bank water projects. This agreement allocated 80 percent of the water pumped from the Mountain Aquifer to Israeli use and 20 percent to Palestinian use, capping the Palestinian extraction at 200 mcm/year (Chenoweth 2011). This allowed the Palestinians to maintain the production of 118

mcm/year from existing wells and permitted the extraction of an additional 70-80 mcm/year but only from the Eastern Mountain Aquifer (Chenoweth 2011). Due to insufficient development of water resources, Mekorot sells the Palestinian Authority about 50 mcm/year of water from its own extractions for about \$50 million per year (Melham 2015). This supply plateau severely contributes to the growing gap between supply and demand for water in the West Bank.

The Oslo Agreements also created three zones in the West Bank under different levels of Israeli control names Areas A, B, and C. This sectioning further contributes to the lack of water resource development, for while the Palestinians are only allowed to drill in the Eastern Mountain Aquifer, nearly half of the aquifer lies under Area C, a noncontiguous zone entirely under Israeli military control (“Issues Under the Oslo Accords”). The restriction of movement in this area prevents Palestinians from accessing legal wells, and the combination of prerequisite JWC approval and an additional permit to drill wells specific to Area C gives the Israelis a double-veto over a large area of the only aquifer section allocated to the Palestinians for development (“Palestinian Water Sector”). In combination with the declining water tables at the few wells existing in Area C, the growing gap between water supply and access in Area C has driven migration out of the area and decreased resistance to further Israeli expansion (Carradin 2016). This allows Israel greater opportunity to expand, and increases pressure on already stressed urban water systems (Kiser 2000).

The vastly unequal access of Israelis and Palestinians to water is therefore explained by a combination of factors, many of which are likely to worsen in coming years, and associated with myriad geopolitical, environmental, and rhetorical elements.

Though Israel blames this gap on Palestinian Authority corruption, inefficiency, and chronic inaction, the Palestinian Authority points to the use of the JWC to stall approval of projects, degradation of the Eastern Aquifer, and restrictions on Palestinian movement and drilling into the healthier Western Aquifer (Isaac 1995 and “Issues Under the Oslo Accords”). The Eastern Mountain Aquifer, the only part that Palestinians are allowed to use according to the agreement, suffers from declining water tables from over-pumping, salinization, and pollution from agricultural runoff and fecal matter (Weinberger 2012). This degradation contributes to the failure of the Palestinian Authority to complete the upgrading of 50 pre-1967 wells and to develop JWC-approved wells less than 150 meters deep, allowances made in the Oslo Agreement (Hareuveni 2012). Though the JWC has approved 23 well sites since 1995, only one-third of the projects have been completed and very few measures to increase efficiency of water distribution in the Palestinian Territories have been implemented (Isaac 1995 and Hass 2014).

This is partly an issue of poor resource management from the Palestinians, though it is also a product of Israel’s heavy restrictions on Palestinian access to the aquifer and development of independent water infrastructure (Hass 2014). The antiquated West Bank water distribution systems are indeed in major need of replacement and repair, and although such an overhaul could potentially increase useable water by 40 percent, the Palestinian Authority has taken little action (Comair et. al., 2013). As a result, many Palestinians without access to regular water have drilled wells into the aquifer, which is prohibited in the areas controlled by Israel, or illegally hooked into Israel’s National Water Carrier pipeline (Kiser 2000).

Whether due to Palestinian inaction, as the Israelis assert, or the strong-arming of the Israelis on the JWC to stall project implementation or only approve sub-optimal sites, as the Palestinian side complains, the fact remains that existing resources are insufficient for the current and growing Palestinian population. This hinders economic development, forces Palestinians to spend disproportionate amounts of their household income on water (average is 8 percent for Palestinians, 3.5 percent worldwide and around 1 percent for Israelis), and is driving populations to more urban areas where water access is cheaper and more reliable (“Palestinian Water Sector”).

Considering the expansion of Israeli settlements and the continued guarantee of sufficient water to Israelis, feelings of relative deprivation grow among Palestinians in this convoluted situation. Visible and physical demonstrations of Israeli dominance over water such as the detonation of three illegal water wells in Hebron City in 2016 has only heightened the profile of water as a talking point in this conflict and increased accusations of discrimination and unfair treatment from the Palestinians (“Army Destroys...” 2016). Furthermore, the ambiguity surrounding the Palestinian water shortage due to a lack of international precedent for sharing between the entities and independent monitoring allows the parties to hide noncompliance behind blame of the other. The fact remains, however, that until the Palestinian Authority makes major strides with providing access, Palestinians are likely to continue to resort to illegal pumping and line tapping that only contributes to the feelings of animosity between the sides over water.

In general, the lack of clear international legal precedent for the allocation of water in this situation has allowed Israel wide leeway to utilize water as a tool to control

the movement and economic potential of the Palestinians. As a result, increased Palestinian movement into urban centers, increased poverty, and increased grievances brought about by visible relative deprivation in terms of nearby Israeli settlements, has exacerbated existing tensions between Israelis and Palestinians and hindered peacemaking efforts. Water is an essential issue to overcome for any agreement between the parties. Therefore, any water sharing agreement locking in inequality will be a problem for years to come, considering unequal and unpredictable levels of degradation and vastly different population growth rates and expectations for per capita water availability. This high-profile, unclear issue has led to increasing political conflict over water that often plays out in media and official documents as each side uses political and rhetorical manipulation of the situation in attempt to create the optimal negotiating stance for the future. Each side wants to secure resources for the future, and because water is a known sticking point between these sides, neither has incentive to go to the bargaining table unless they feel confident in their ability to obtain guarantees of their water rights for now and the future. Therefore, water will continue to hinder the establishment of peace between Israel and Palestine.

Sudan's Darfur Conflict

When the Sudanese Darfur region's rebel groups, the Justice and Equality Movement (JEM) and the Sudan Liberation Army (SLA), took up arms against the state in 2003, a conflict began that has ebbed and flared since, characterized by descriptions of genocide and war crimes committed by government-backed Arab-speaking rebel groups. Though the war is mostly attributed to grievances of political exclusion of non-Arab

communities and a major lack of infrastructure, experts also posit water infrastructure failures and environmental issues as key causal elements (“Darfur Conflict” Reuters 2014). A major drought in Sudan beginning in the 1980s coincided with the establishment of a new coup-empowered government in Khartoum in 1989 and the abolition of regional dispute-resolution institutions. As a result, drought and desertification in the north of Sudan pushed Arab herders into the territory of non-Arab farmers and fueled ethnically-charged competition over resources on the land in the absence of governing institutions (“Darfur Conflict” Reuters 2014). Though the conflict officially ended between the government and rebel forces in 2009, Darfur has continued to be ravaged by violence from smaller armed groups fighting over territory (O’Kelly 2013).

Sudan is not extremely water scarce on a national level, though the Darfur region’s water resources are highly dependent on local climate and seasonal variability, and water infrastructure is severely limited (Ali 2015). According to the FAO Aquastat data for Sudan, in 2015 only 55 percent of the population had access to improved drinking water sources, and in Darfur, this often means a long trek to a communal well to gather domestic water every few days (Schlein 2011). Sudan utilizes very little of the groundwater resources contained in its borders due to lack of government effort or capacity for widespread water access or distribution projects. Additionally, rainfall has been traditionally been sufficient for the majority of Sudan’s needs until the droughts began. Nevertheless, groundwater is critical in the few areas in which it is used, mostly for municipal and drinking purposes. It is a sporadically accessible but crucial resource particularly in pastoral areas of Darfur (AQUASTAT “Sudan”). Rain and surface water

have historically been the most accessible and utilized form of the resource, but with a one-third decrease in rainfall over the past 80 years, Darfur had long been headed towards a critical intersection of environmental scarcity and economic and population growth.

The conflict's beginnings are most clearly related to climatic changes that affected water availability in the environment and forced demographic changes. A period of severe drought related to warming ocean temperatures and decreased rainfall that began in the 1980s exacerbated the desertification of grazing land in Darfur (Abouyoub 2012). At the same time, a growing population of humans as well as grazing animals and agricultural expansion put greater stress on decreasing land and water resources. As a result, Darfur fell victim to the demographic effects of environmental changes and scarcity (Polgreen 2007). Scarcities in water and useable land, whether for farming or for herding in the case of the Darfur Arabs, are known to cause migrations and increase societal stress by causing economic decline. Both farmers and herders suffer from lower returns due to water resources decline and desertification (Abouyoub 2012). The Arab pastoralists found their nomadic lifestyle unsustainable in the drought conditions, and many moved south and east into lands historically dominated by non-Arab farmers. Existing social tensions, particularly between these ethnic groups, enflamed when migration from drought-stricken areas to areas of greater water availability increased interaction between sometimes adversarial groups and competition over scarce resources (Polgreen 2007 and Pedraza 2016).

Though relations between the Arab herders and non-Arab farmers have for centuries been characterized by intermittent periods of cooperation and competition, the

Darfur conflict that erupted in 2003 ushered in a marked change in relations as a result of the social consequences of environmental change (Abouyoub 2012). This causal relationship and the horrific violence of the conflict attracted strong concern from the international community and thrust the issue of environmental conflict into popularity among world leaders. Ban Ki-moon, former UN Secretary General, was critical to this recognition and wrote in a 2007 *Washington Post* article that the core of the Darfur crisis rested on issues of environmental degradation in concert with exploding population, severely decreased rainfall, and the persistence of tribal and ethnic tensions (Ki-Moon 2007). The combination of these factors created the mix of established competitive actors and competitive resources that resulted in conflict.

While surface water scarcity is more apparent in the beginnings of the conflict, competition over groundwater has further complicated the matter and likely contributed to the protracted nature of the conflict. Limited access to groundwater at well, as well as widely unequal distribution of surface water and inconsistent and declining rainfall make particular areas with known access to water much more desirable (AQUASTAT “Sudan”). Therefore, these areas engender greater competition and conflict between fighting factions. In fact, the Human Security Baseline Assessment for Sudan and South Sudan reported that on at least three occasions in 2014 fighters targeted and destroyed water access points, since they represent an easy and effective way to attack, manipulate, and force the displacement of civilians. This has continued despite international efforts to expand well access to the Lake Erie-sized aquifer under Darfur, amid concerns that the problem no longer lies in water scarcity, but rather in effective

government or regional management that encourages cooperation over conflict (Schlein 2011 and Stephens 2011).

According to UNICEF, the intensification of droughts in the summer months has shown a relationship to increased violence, demonstrating the real, ongoing impact of supply, demand, and structurally-induced water scarcity on this conflict (“Darfur...” 2008). Indeed, Darfur’s water scarcity is mostly a combination of short supplies of easily accessible surface water and a structural failure to access groundwater resources. Lack of knowledge about the available groundwater resources has also contributed to the situation by hindering potential progress in alleviating water scarcity, and does the lack of government interest or ability to develop and securely manage these resources that currently pose a greater risk than benefit to many civilians (“Water Find...” 2007 and AQUASTAT “Sudan”).

Though internationally-mediated peacemaking efforts have considered water, they have been mostly ineffective. The first attempt in 2006, out of which emerged the Darfur Peace Agreement, contained a water management section but its failure to include and address the concerns of many groups doomed it to be quickly abandoned. One major fault of the agreement was that it made only a passing reference to the resource concerns of the Arab pastoralists, particularly water and pasture, and left them feeling slighted (“Darfur’s Arab Armed Groups” 2010). By failing to address these concerns, the agreement only confounded the conflict even more by encouraging inter-Arab fighting over the resources that the agreement had failed to guarantee (“Darfur Conflict” Reuters 2014). Despite the 2009 end to the official war, the continued violence and drought conditions prove this dire situation is far from solved. The perfect storm of political upheaval, inattentive

institutions, existing social and ethnic tensions, and environmental change-induced resource competition all contribute to the eruption and continuation of this conflict.

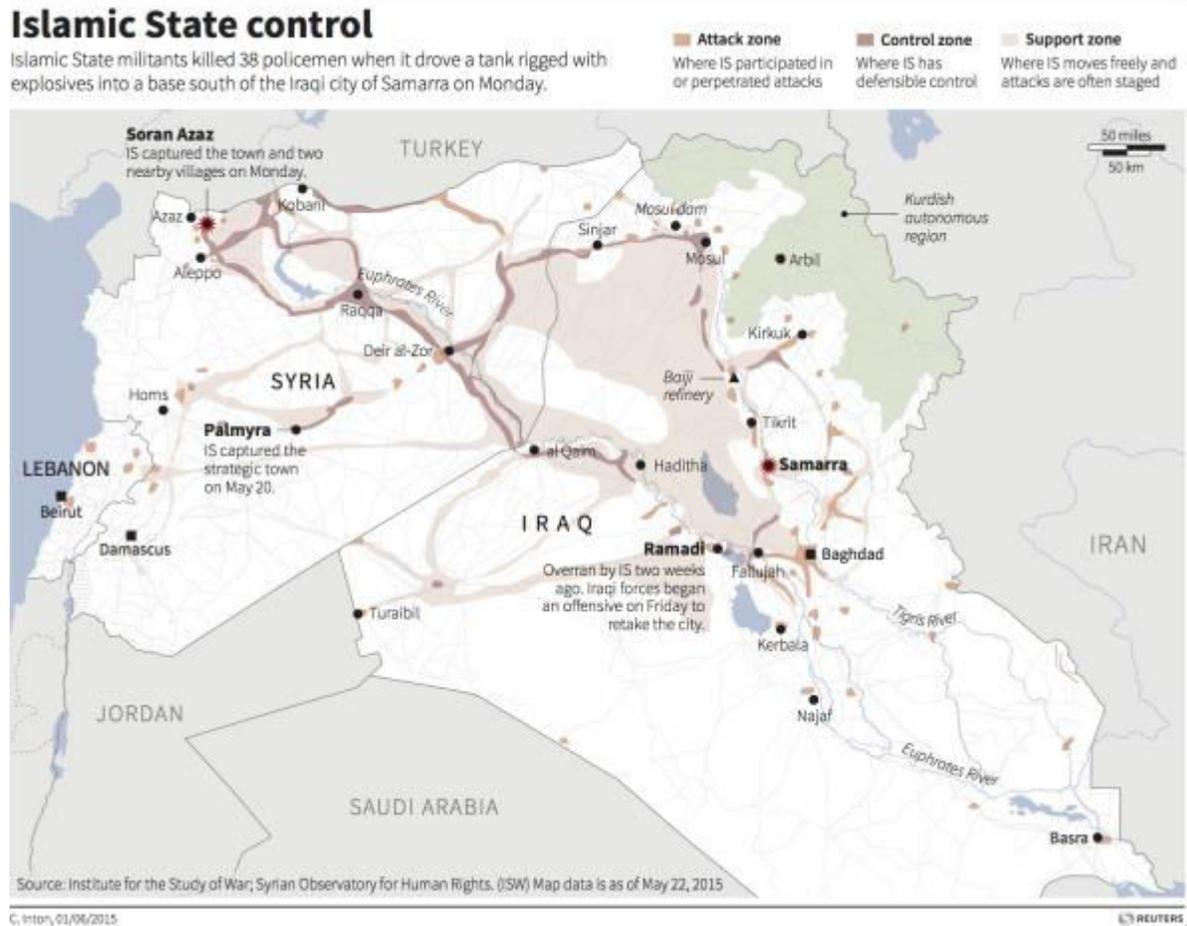
Though the drought conditions cannot be attributed sole responsibility for the transition from peace to violence, it is clear that this case is far from purely ethnically motivated and that the environment contributed one of the essential triggers for this conversion.

The Islamic State in Iraq

Iraq and the Islamic State (IS) present a fascinating case of too little and too much water and the politics of controlling these resources between a government and a well-organized non-state actor. Iraq is a water-scarce state in terms of rainfall and groundwater, which constitutes only about 3.65 percent of the nation's total renewable water resources. Iraq relies very heavily on its rivers and lies in the Tigris-Euphrates basin (AQUASTAT "Iraq"). The Tigris and Euphrates and their tributaries provide the majority of irrigation, industrial, and municipal water for the nation and provide electricity through a number of hydropower dams. Though this network of surface water provides a significant quantity of resources, recent decades have seen a major decline in the amount of water that reaches Iraq due to natural and anthropogenic reasons. For one, NASA's GRACE satellites found that climate-related reductions in rainfall and poor water management by basin nations, particularly in pollution prevention and inefficient irrigation and distribution, have caused the Tigris-Euphrates basin to lose water faster than any other area on earth besides northern India over the years 2003-2009 (Hammer 2013). On the other hand, Turkish water projects on these rivers far before reaching Iraq

and Syria have reduced the natural flows of the rivers by up to 80 percent (Hammer 2013).

Figure 2: Iraq's Dams and ISIS Control (January 2015)



Source: Paraszczuk, Joanna. "ISIS Is Waging a 'Water War' in Southern Iraq." *Business Insider*. Business Insider, 28 June 2015. Web. 03 Mar. 2017.

In this already water vulnerable situation, control of the Tigris and Euphrates Rivers in Iraq presents a major opportunity for ISIS to control the nature of the ongoing conflict there. Because Iraq relies so heavily on these rivers, particularly in the marshland south, a significant reduction in river flow by closing up stream dams can have major negative economic consequences downstream. Saddam Hussein demonstrated this tactic

in the early 2000s by intentionally cutting off water to southern Shi'ite communities in order to wreck their economic and political power (Paraszczuk 2015). Now, ISIS is using similar modes to threaten communities within and outside of its current territorial holdings. Since 2013, ISIS has held a number of dams and barrages in northern Iraq that have allowed them to cut off water to downstream cities and provinces, weakening their resistance capability. While the waters of the Tigris and Euphrates were already suffering from overuse, pollution, and projects restricting flow in Syria and Turkey, the ISIS capture of the Tabqa Dam in 2013 and the Ramadi Dam in 2015 severely exacerbated the situation by putting the people of Iraq at the mercy of unfavorable environmental circumstances and the malice of ISIS (Paraszczuk 2015). While dams in upstream nations may be partly to blame for the issue, the control of large and small dams and barrages on the rivers have major geostrategic importance in this conflict, allowing ISIS to exert remote influence on communities far outside its secure territory. In this case, control of the rivers is an essential part of political and military strategy and a significant vulnerability for the Iraqi forces.

Taking the page from Saddam's playbook, ISIS has been using its upstream position to threaten local communities and major cities. The organization has utilized the selective provision and restriction of water to various communities to control residents, punish uncooperative areas, and generally stress the health and productivity of the nation. First, ISIS seizes control of a water chokepoint. Then, it uses the selective provision of water and electricity to force residents back to cities, where ISIS attempts to create the image of a functioning nation by providing utilities services (Schultz 2014). ISIS's manipulation of the dams, completely irrespective of their intended release levels, has

also had major measureable impacts on river flow. For instance, the capture of the Ramadi Dam resulted in a 50 percent drop in the flow of the Euphrates (Paraszczuk 2015). Though residents are discontented by this manipulation, in many cases they have little choice but to cooperate in order to supply their basic needs (Cunningham).

Though ISIS's cutoff of water to downstream areas is the most present concern, control of the dams also presents the opportunity to threaten Iraq in other ways. For instance, control of the Haditha Dam on the Euphrates, the nation's largest dam, would also mean the ability to unleash a devastating flood and cripple the nation by cutting off the 30 percent of the nation's electricity that the hydroelectric dam produces (Vidal 2014). This particular dam has so far eluded ISIS, though the organization has used the threat and execution of floods and hydroelectricity cutoffs to manipulate, extort, and cripple smaller cities in Northern Iraq and to prevent the advancement of government forces (Peristianis and Abu-Hussein 2015). This may be achieved by either the closing or opening of the floodgates to target specific areas. The capture of the Fallujah Dam perfectly demonstrates the opposite effects made possible by opening or closing a dam. From January through April of 2014 ISIS, closed the dam to flood adjacent areas while cutting off flow to south and central Iraq (Collard 2014).

This tactic is effective for pressuring the capital and punishing uncooperative villages, but it also serves to line ISIS's coffers and build its image as a legitimate state. With control over access to water, hydroelectric production, and electricity to power well pumps, ISIS has extorted residents for large sums of money to supply these basic needs (Cunningham 2014). Even in Kurdish-recaptured areas of Iraq in which ISIS still maintains control of the water and electricity availability, residents are forced to either go

without these resources or to pay the “bill” to ISIS (Cunningham 2014). This facsimile of an infrastructure and public works operation may not increase the organization’s popularity, but it does force the dependence and reluctant cooperation of residents.

This case demonstrates water’s geostrategic potential as a tool for both crippling civilians and pressuring the very core of a nation. Hydrology and geography play a major role in the way water appears as a strategic tool in this and similar cases, as the rivers and dams provide clear chokepoints to target. Whether by parching or flooding, ISIS’s control of the dams upstream has clearly exacerbated the civilian suffering in this conflict and complicated the fight for the Iraqi military.

CHAPTER 7: ANALYSIS OF TRENDS AND IMPLICATIONS

In light of the information gleaned from these case studies, it is essential to consider how particular themes emerge when water engenders competition. Throughout these cases, as well as in the existing literature and in the findings of the quantitative analysis of this paper, it is clear that water scarcity in various terms is not a unique cause of conflict but rather a factor that exacerbates existing issues. Looking qualitatively at these cases, this section aims to examine the common ways in which water contributes to conflict via the social processes it initiates, its geographic effects on conflict, and its use as a political and physical tool in altering the course of conflict. With these themes in mind, this chapter also presents a number of concerns, opportunities, and challenges for the US government in dealing with situations containing these characteristics in order to contribute to the reduction of water's role in current and potential intrastate disruptions. Though these cases all fall in the Middle East and African regions, these lessons are certainly not geographically limited and are intended to inform any similar situations, such as current water shortage issues in Mexico City and Northern India. The following questions provide a framework through which to view various elements of the relationship between water and conflict.

What processes result from water shortages that consistently contribute to increased conflict vulnerability, such as migration or economic damage?

The most obvious of these processes is displacement and migration, which played a major role in the Darfur conflict. Because Darfur had little infrastructure for utilizing the major aquifer beneath the area, most water for agriculture and animal watering came from rivers fed by rains. The persistent drought that occurred in the years preceding the conflict, in combination with overgrazing-caused desertification exacerbated by drought, forced Arab herding communities to seek adequate resources outside of their historical territory and come into increasing competition with sedentary non-Arab farmers. Though the impact of this migration was aggravated by existing ethnic tensions, it is unlikely that conflict would have erupted without the combination of competition and existing tensions. This created grievances that elements of each side could leverage as reasons for violence. The demographic changes caused by this environmental scarcity contributed to the tensions and opportunities that led to the conflict.

Similarly, lack of reliable water infrastructure, poor management, and restrictions on wells have left many Palestinians without regular access to water. This condition hinders economic development, particularly agriculture, and a combination of lack of economic opportunity and water poverty has also increased Palestinian movement into urban areas where the potential for negative interactions with Israeli settlers increases considerably. Therefore, the economic impact of water scarcity results in a similar demographic effect with the addition of the conflict-generating potential of poverty stricken areas. In both cases, the lack of traditional economic opportunities decreases opportunity costs to fighting and encourages people to seek lucrative non-traditional or

illegal means of income. These effects increase the opportunity for potential return from illegal activities, contributing to insecurity.

Lastly, in the case of ISIS in Iraq water can create lucrative economic opportunities for those who control it by extorting civilians for access to this critical resource. In the greed versus grievance argument for why civil conflict emerge, this case falls into the greed or opportunity category. Because water access and hydroelectricity in Iraq are highly dependent on the control of dams, the non-state actor ISIS has gained an opportunity to control the population both economically and physically. Having cut off water and electricity at a number of dams, ISIS can extort communities for payment to turn back on these critical services and further fund its growth. Though this is relatively unique to ISIS among these three cases, it is similar to a common phenomenon in the West Bank and Jordan of selling trucked water for much higher prices than municipal water would be if it was accessible through a piped infrastructure system (Corrodin 2016). When water scarcity widens the gap between supply and demand increases desperation for resources, economic opportunities such as this provide ways for both non-state actors to fill a need while funding their (potentially terroristic or illicit) activities.

How do different hydrological and geographical distributions of water contribute to the role of water in political or physical conflict scenarios?

In Iraq, reliance on the rivers puts communities downstream at major risk of exploitation and coercion. Because the nation relies so heavily on the linear flow of water from headwaters to downstream communities and has already altered the natural state of flow through the creation of dams, it was relatively easy for ISIS to gain control of

chokepoints on the rivers and manipulate the release and withholding of water. Furthermore, this river-reliant situation allowed ISIS to make twofold threats: to either flood or dry out certain areas. This is a strategic vulnerability that is enabled by the presence of dams and barrages, as ISIS would not have close to this coercive or destructive power without its capture of the existing dams. Therefore, this case demonstrates the unique security risks associated with heavy reliance on singular water sources, particularly when the infrastructure that controls that water resource – not to mention produces hydroelectricity – is at risk for capture and exploitation as a tool of war.

Israel and Palestine suffer from a similar lack of resource diversity, though the problem is literally hidden underground. For one, the underground nature of the aquifer makes deception and misinformation more feasible, as measuring extraction rates and water table levels is complicated and invisible. The transboundary, non-linear nature of aquifers also makes it nearly impossible to accurately delineate the allotments of sharing parties or to assign blame for pollution and overuse. In this case, already mired in deception and blame, this hydrological situation facilitates the usage of ambiguities for political and rhetorical manipulation of the water issue and the larger Israeli-Palestinian negotiations. Furthermore, reliance on groundwater necessitates the development of working wells. Like the rivers in Iraq, wells create access points that can be more easily captured and exploited than diffuse sources. By preventing the Palestinians from drilling wells in many areas, Israel is able to stifle economic development and force migration. In addition, since the Palestinians are unable to meet their needs with the resources legally available to them they are essentially forced to illegally drill wells or skimp water from

pipelines belonging to Israel, which furthers Israel's rhetorical goals of painting the Palestinians as criminal.

In Darfur, the situation is similar to Palestine with a heavy reliance on groundwater today. However, this was not always the case, and the former reliance on rainfall and the subsequent decline due to climate change forced a demographic shift and a shift in water access that is increasingly concentrated in wells. This shows a transformation from a more diverse, diffuse distribution of water resources to a more limited distribution, the economic and demographic effects of which contributed to lower costs of violence and increased competition. Darfur shows clearly the dangers of such a transformation without appropriate anticipatory adaptations in place. The disruption of resources lead swiftly to socioeconomic disruption, which had a major hand in initiating this conflict.

In what ways do opponents use water realities or perceptions as political tools to alter the course of conflict?

ISIS's goal of creating a territorial state is evident in the way it manipulates civilians with water. Its threats to devastate regions of Iraq through flooding or parching bolter its presentation of physical power, making control of dams and essential part of its operation. However, the organization not only uses its control of dams as a physical tool, but as a propaganda one to build an image as a state rather than an invasion by co-opting existing infrastructure and using that control to establish water and electricity services. By selectively providing water and power, ISIS forces residents back into their towns, which are preferred to refugee camps, and governs them. From that point, ISIS can extort

money from residents to provide water and power. Through these tools, ISIS is able to both gain monetary resources and project the image of a functioning state, complete with citizens, taxes, and utilities managed by the government.

The political realities established by the 1995 Oslo Agreements in Israel and Palestine are a clear example of using institutions and legal processes to disenfranchise a discriminated party from its resource supply, as the allocations are highly unequal considering population and future needs. However, more interesting is the way in which outward compliance and enforcement of this agreement can obscure discrimination via water. Because these allocations and rules are cemented in international agreement, it is extremely difficult for the Palestinians to cry foul on Israel despite the obvious inequality. Israel can also focus attention on the failure of the Palestinian Authority to achieve water infrastructure development, whether or not this was a result of Israel's own design. Therefore, Israel can exploit this situation to frame Palestinians as mismanaging, unreliable, irresponsible, and criminal on the international stage and bolster its case against them.

Palestinians certainly don't shy away from this verbal back-and-forth, with a number of pro-Palestinian and Arabic language sources emphasizing the unfairness of the water sharing. One headline from Arabic news website "Palestine Today" reads "The Israeli Share of Water Equals Seven Times the Palestinian Share." The Palestinian rhetoric focuses on the malicious intentions of the Israelis to deprive Palestinians of their rights to water and land, and blames the lack of development on Israeli restrictions and the JWC. This rhetorical mudslinging, both sides claiming victim status and righteousness, in the context of the ongoing conflict between them represents

opportunities for each to bend the international community, and therefore its support, to their side.

In Darfur, the government may have allowed clashes over water and environmental issues to happen and used the opportunity to step in, framing the combatants as wild rebels that must be controlled (Polgreen 2007). Sudan's ethnically and politically charged society was and is vulnerable to this exploitation, for it allowed the government to use threats to and clashes over water for its own political goals. Using water, which has been the focus of significant aid and works from the international community, as a trigger to act gave these actions legitimacy in appearance while simultaneously allowing the government to use an overly violent hand to control its people.

Are there visible instances in which water helps mitigate, rather than exacerbate, political issues?

In the case of Darfur, a number of attempts to use water for peace emerged following the international recognition of the environmental roots of the conflict. In 2007, scientists found a useable freshwater aquifer the size of Lake Erie under Darfur territory (Polgreen 2007). Since that time, NGOs and government from around the world have supported attempts to expand access to this aquifer in the region with the goal of mitigating the environmental issues underlying the fighting. Indeed, many reports on the aquifer's finding questioned whether it would bring an end to the conflict, and in 2011 the International Conference on Water for Sustainable Peace in Darfur sought international fundraising for the application of water projects around the nation.

Nevertheless, despite this wave of international optimism for water cooperation the execution of these projects has continued to be limited by security concerns and lack of access to critical areas.

UNICEF's engagement in water table monitoring and water management education, including rainwater capturing and irrigation improvement, in Darfur are helping to show the beginnings of this potential by attempting to mitigate the worst conditions in the summer, when violence also tends to spike ("Darfur" UNICEF 2008). Furthermore, despite indications that local communities have been able to establish water sharing arrangements, there is considerable concern that simply placing wells will only contribute to the conflict by creating another incentive to capture areas with wells (Schlein 2011 and Polgreen 2007).

In order for water to contribute to widespread cooperation, it is essential that the most powerful body in a nation, the government, commit to establishing appropriate management practices that encourage resource sharing rather than resources capture (Schlein 2011). This is especially important in the cases of intrastate conflicts as studied here. Because actors are intrastate, international intervention is unlikely even when the lack of a strong central government authority permits violence. This is in contrast to interstate water conflicts, which are more heavily deterred by the threat of violence and international treaties. Therefore, the intrastate nature of these conflicts further facilitates the use of violence and reinforces the need for effective central or regional management.

CHAPTER 8: CONSIDERATIONS FOR UNITED STATES FOREIGN POLICY AND SECURITY

The US Intelligence Community has publicly recognized the potential impact of water degradation on US security through the disruption of political and economic stability in areas of interest to the US, which would degrade the security of the international system and adversely affect US foreign policy, economic, security, and development goals. From a foreign policy and intelligence standpoint, it is essential to create a mental framework through which to view and understand, identify, and mitigate the potential impacts of water issues on security. The creation of heuristics for understanding environmental impacts can prevent their being overlooked in analysis and policy. Therefore, to further that framework, the cases and the analysis of these issues demonstrate an array of mechanisms through which water affects conflict onsets, proceedings, and outcomes, and provides the following discernable trends.

Water scarcities affect socioeconomic and demographic realities

In all the cases, water scarcity has hindered economic growth, decreased opportunity costs of conflict by inducing poverty, and forced migration. These standard impacts have further predictable effects, such as increased competition between adversarial groups in Darfur. While it is essential to recognize standard effects such as these, it is also necessary to contextualize the effects in the situation of unique nations and societies in order to predict further impacts such as the onset of an ethnic war. When

left unmitigated, water scarcities whether chronic or acute are highly likely to contribute to socioeconomic grievances and shift demographics into potentially more insecure patterns.

Information is key

It is in the interest of the United States to invest in the gathering of accurate water data so that NGOs and policymakers can make clear, confident decisions on issues related to water. Though global water data is available in many varieties thanks to the efforts of international bodies and researchers, these instances call for greater on-the-ground, localized water intelligence on particular issues. This is particularly important for overcoming misinformation and deception and creating an objective picture of a conflict or potential conflict. The usage of the water issue by both Israel and Palestine to gain international sympathy is a foreign policy move itself, and in order for the United States to make fair, smart decisions on the issue it must have accurate, unbiased context. Similarly, the potential use of the massive aquifer under Darfur to aid the establishment of security is very promising, but without clear information on management practices on the ground and their efficacy it is difficult to make informed decisions on the usefulness of supplying aid or pursuing development projects. Because of the potential for water to contribute to conflict and for water resource development to mitigate it, the United States would benefit significantly from the small investment it would require to seek such information. International NGOs such as UNICEF are already engaged in attempts to conduct research and execute projects, and would be valuable partners in this undertaking (“Darfur – Overview” UNICEF).

Different hydrological and geographical distributions of water affect societies differently

Understanding these differences is critical to predicting ways in which water may be utilized as a tool of conflict or contribute to instability. Groundwater tends to evade clear measurement and division, which contributes to ambiguity. It also requires wells to access, which can be difficult to acquire and therefore contribute to a lack of community self-sufficiency and contribute to poverty. Both a high dependence on wells and rivers in water-scarce areas can be dangerous by creating chokepoints for adversaries to target and easily cut off access to large number of people or extort them to pay for access. Rivers and the dams on them carry significant vulnerabilities as well, as they provide the controller the ability to affect areas far below stream by either cutting off flow or flooding downstream areas.

In general, it appears that diversified water resources are the most stable and least vulnerable. Even a high dependence on rainwater, as Darfur had before the droughts, increases the vulnerability of a society. Societies dependent on any one of these resources are at a high risk of negative impacts if the availability of this resources changes, particularly when a sense of confidence and assurance in it has made water management and economic systems in the area inflexible and inadapttable to changes. These societies are most at risk of shocks from either climatic changes or human manipulation of the resources. Therefore, the United States would benefit national and regional stability by identifying vulnerable nations and aiding their diversification.

Preparation, prevention, and adaptation are necessary to avoid environmental shocks

Finally, among the most critical pieces of this issue is acknowledgement of the effects of changing climatic conditions and their ability to impact sociopolitical and economic realities. Though anthropogenic climate change remains debated as a cause of these changes, it is essential to recognize and prepare to adapt for the symptoms of a changing climate by any cause. Water resources are intimately tied to overall climate patterns, and therefore can be anticipated to change subtly and dramatically around the world in coming generations. By understanding the socioeconomic mechanisms associated with water scarcities, the necessity of current and accurate water resource data, and the importance of diversified water resources, the United States can lead the world in creating adaptive plans for unpredictable future environments.

The conflict in Darfur is a shining example of how entrenched socioeconomic systems were shocked by environmental changes and unable to cope effectively with the resultant changes. In the face of a changing climate and growing global population, it is highly likely that areas around the world will be increasingly threatened by water scarcity issues. It is therefore first essential to acknowledge these climatic developments and research their potential effects, and secondly to build effective coping strategies. Therefore, in order to encourage stability, the United States can identify similarly threatened societies and focus on providing aid to diversify resources, educate populations and governments, and support the capacity building of states so that they are more effectively able to make necessary adaptations. It is absolutely critical to consider the interaction of scarcity of resources and a lack of stability and governance, as one

encourages competition and one allows leeway for competitors to use extrajudicial means to acquire what they want.

In conclusion, it is in the strong national interest of the United States to build frameworks for understanding, identifying, and preparing for the destabilizing effect of changing water resources. By identifying the mechanism and relationships that link water and conflict, the United States can aid global and national security by investing attention in acquiring essential information, efforts to build capacity for effectively dealing with shocks, and mitigating the effect of water scarcity before they worsen.

CHAPTER 9: CONCLUSIONS

The aim of this thesis, to examine relationships between water availability or scarcity and conflict with social divides as an intervening variable, was executed successfully despite the lack of significant evidence to support the hypotheses. This design method very thoroughly examined multiple measures of water and representations of ethnic socio-political divides as they affect, both separately and through interaction terms, the likelihood of a violent or non-violent conflict onset. Though the lack of significance in the results is disappointing, it is also telling, and can easily be understood according to the existing framework around this relationship and through the case studies which show the various ways that water affects security without a direct causal link.

Most preceding studies acknowledged water scarcity, like other forms of environmental scarcity, as a contributor and perhaps a catalyzing factor in conflict but not as a direct cause. This study attempted to augment that understanding by more specifically looking at how those processes that are acknowledged to occur and contribute to conflict as a result of environmental change – for example, migration, economic downturn, and increased competition over resources – might be exacerbated by the presence of social divides. That is to say, to examine whether their existence might be a catalyzing factor that transforms a benign water-scarce situation into conflict by increasing motives for both greed- and grievance- driven conflict. While the quantitative section failed to capture this in significant results, the qualitative section was better able to discuss these less direct trends.

Though this study did not attempt to quantitatively measure these mediating processes and instead focused on the eventual outcome of violent or non-violent conflict campaign onset, it endeavored to capture them in the relationship between the independent and dependent variables. By testing various water measures to represent both supply-, demand-, and structurally-induced scarcity against measures for regime type, ethnic fractionalization, and inclusion and exclusion of population sectors from participation in governance, the tests found few significant results. These may be explained by missing data, but in general the models failed to support the hypotheses and therefore indicate that almost no causal relationships can be assumed from the presence and/or interaction of these two independent variables. Though some significant results appeared for violent conflict outcomes, only one model showed a result for nonviolent outcomes at any notable level of significance.

Perhaps the most surprising outcome of this analysis is the finding in multiple models that the measure *total water withdrawal per capita (m³/inhabitant/year)* was correlated with a slight positive increase (.001 invariably) in the likelihood of a violent conflict outcome with varying degrees of significance across models. This result goes against the relationships posited in the hypotheses that increasing water withdrawals would indicate better access and therefore decrease the likelihood of conflict. Though the invariable nature of the coefficient makes this result suspect to questions of whether incomplete data produced an inaccurate representation of the relationship, this result also leads to a different interpretation of water availability. Whereas the hypothesis and models assumed that increasing withdrawals would decrease competition, this measure could simultaneously be viewed as an indication of stress on water resources. As

withdrawals per capita increase, particularly in nations with lower levels of per capita renewable resources to begin with, resulting degradation of a nation's resources may be the root of increased competition for decreasingly available resources. Though this test was not included in this paper, further examination of water stress rather than availability would be useful for contextualizing this result.

In support of the theory, the models testing Hypothesis 5 indicated with significance that an interaction of *number of peace years* and *total population with access to safe drinking water (%)* had an expected negative effect on the likelihood of both violent and non-violent campaign onsets. Though both variables are likely associated with nations that in general are more developed, these models controlled for population and GDP, making the results more apparently related to the interacting variables themselves rather than simply the most likely context of a nation that is developed, peaceful, and able to build and maintain infrastructure. Thus, this relationship may be the result of the larger context of a stable nation, but the model indicates that a relationship between increased access to safe drinking water in combination with longer periods of peace may act to quell the greed and grievance influences on the onset of conflict as well.

Moving forward, it would likely be useful to re-conduct this study with more complete data that might better represent the reality of global water availability and therefore these relationships. Though this study found few significant results to support the theory, it is likely due to the missingness of data that these models may not be perfectly representative of the reality of this relationship. Though the NAVCO and EPR datasets are very comprehensive, the Aquastat data suffers from massive holes across variables and countries so that it actually represents a very limited amount of information.

Aquastat certainly provides useful data, but the set also epitomizes the difficulties faced by researchers attempting to examine similar questions and theories. Lack of information on water measures for the world in coded, accessible formats was a hindrance to the reliability of this analysis and demonstrates one of the reasons for lack of consensus on water's role in conflict in the political science discipline. Though indeed the results of this study may well represent the reality that there are no direct relationships to be found, it would be impractical to rely on such incomplete data to dismiss the possibility of a such outright.

Though Hypothesis 5 received support from the models, and the measure for per capita water withdrawals produced an unexpended positive result, it can be assumed that no other quantitatively recognizable relationships exist between water availability, in the method it was represented here, and conflict. Nor can it be said that the presence of ethnic socio-political divides informs or intervenes in this association in a way that it affects the outcome. Overall, therefore, the theory loses credence from the lack of quantitative evidence.

However, this result is telling in that it indicates the highly-individualized nature of water issues in conflict and emphasizes the importance of lessons gained from the case studies. Because a number of cases exist that have clear connections between water scarcity and conflict, such as Israel and Palestine, Darfur, and ISIS in Iraq, it cannot be said that water scarcity or management has no impact. Rather, the lack of quantitative evidence from this whole-world analysis suggests that when water does impact a conflict, it does so in individualized and ungeneralizable ways. In all, this last lesson may be the

most significant of all in understanding the elusive effects of this environmental issue on conflict outcomes.

These cases demonstrate relationships between water availability and security that elude the models tested in this thesis and further support the idea that water's relationship with conflict is present but convoluted and weak compared to other factors. In each, a scarcity of water makes the population more vulnerable and reveals the dangers of dependence on non-diverse water resources while providing opponents in a conflict an issue very important to civilians that can be rhetorically manipulated to garner support. They support the idea that migration and economic impacts are major effects of water scarcity that can drive tensions, particularly in ethnically divided societies, and further contribute to destabilization. They provide examples of how water access may be used as an exploitative tool to control populations by both the state and by non-state actors, or as a tool with which to threaten physical violence. However, they also reveal the potential for appropriate management of water to decrease competition between groups and aid in the institution of peace.

Both the quantitative and qualitative sections of this thesis contribute useable knowledge of water-related security trends applicable to United States national security interests. While the models showed little support for the hypotheses, this lack of significant results indicate the highly diverse effects of water on the potential for conflict and reiterates the importance of development, in terms of GDP in the models, on decreasing the likelihood of conflict. Therefore, the case studies move down from the global to the local level to identify generalizable trends in the water-conflict relationship not captured by the models. Identification of these trends indicates that the United States

can contribute to preventing water-related destabilization by aiding the development of nations and, in particular, their capacity to effectively handle water scarcities and their social and economic effects. From these cases, it appears that the United States can help nations evade these negative effects and better prepare for the uncertain climate conditions of the future by focusing on research and frameworks for identifying at-risk areas and applying knowledge of the potential impacts to prevent destabilization through capacity building and resource diversification. As a world leader in security and aid, it is certainly in the purview of the United States to engage in such a task. It would furthermore be an oversight to ignore water stress issues, as their contributions to destabilization may easily become transnational and regional. The United States' interest in protecting the homeland from the global social, migration, and economic effects of regional instability is therefore at stake in the decision to take up this charge.

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