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Environmental Footprints of Violent Conflict

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Dedication

To *Mumma*...

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Abstract

The effects of militarized conflict pervade countless aspects of society, yet scholars have focussed very little attention on the consequences of conflict. My dissertation assesses the cost of war by examining the relationship between violent conflict and the environment. I argue that the effect of conflict on the environment is an important consequence of war that is often overlooked in favor of other repercussions such as economy and health that are more politically expedient . I study this effect in the light of components of national environmental capacity and hypothesize that conflicts result in short-term and long-term impact on the quality of the environment. Moreover, wars pose a significant threat to the socially critical components of the environment which could engender further conflict. I present a framework to evaluate the complex linkages between war and environment, where environment is assumed to be at the center and not an exogenous factor that affects conflict. My empirical analyses explicate the mechanisms though which wars lead to degradation of the environment. In Chapter 1, I introduce the project and reflect on the importance of studying the environmental consequences of conflict. I discuss the extant literature on environment and conflict and underscore the importance of reformulating our understanding of *environmental security* in Chapter 2. Then, I lay out the conceptual and theoretical framework for this study in Chapter 3, outlining the ways in which conflict undermines our environment. In Chapter 4, I empirically analyze the effect of conflict, along with relevant political and economic factors, on overall levels of national environmental capacity over the past five decades. I extend this analysis to disaggregated measures of environmental capacity in Chapter 5. In Chapter 6, I go

on to assess the international regime and laws available to protect the environment during and after wartime. Chapter 7 concludes the dissertation.

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Chapter 1

Introduction

"A small grove massacred to the last ash,
An oak with heart-rot, give away the show:
This great society is going to smash;
They cannot fool us with how fast they go,
How much they cost each other and the gods.
A culture is no better than its woods."
–Wystan Hugh Auden

As I write this chapter, a brutal and devastating civil war in Syria continues. The international community is 'cautiously' debating the possible courses of action, including military intervention, to establish some political and economic stability in the region. Other countries and international agencies are closely monitoring the impact of the conflict on human lives and the economy of Syria to evaluate the costs and benefits of any international intervention. While the humanitarian, economic, and political consequences of such conflicts garner immediate international concern, their environmental impact often ranks very low to factor into any decision making. For example, very little attention is being paid to what the civil war is doing to an already drought prone Syria. Large displacement of people away from their lands has led to the suspension of any planting which will lead to soil erosion. Also, massive violence has disrupted and destroyed most of the irrigational infrastructure in the country which will make it extremely difficult to restore agriculture in the future and further deteriorate the soil.

According to the UN Refugee Agency statistics, nearly a million people have fled the country and more that 4.25 million people have been displaced. Several thousands

of these IDPs have taken shelter in the olive orchards at the border of Turkey and Syria. Many hundreds of year old olive trees in those orchards have been cut down to create space for make-shift tents and for fire wood for the people living in camps there. Similarly, the recent civil war in Libya destroyed oil fields and refineries in Ras Lanuf, Brega, Zawiyah, and several other places, where Gaddafi's forces bombed the oil infrastructure in their own country before retreating. Moreover, unrest in Libya and Egypt, during the last couple of years, have stymied the Strategic Action Program initiated by the International Atomic Energy Agency to sustainably use the Nubian Sandstone Aquifer System. This is the largest and one of the most crucial sources of freshwater in this arid region shared by four countries–Egypt, Libya, Sudan, and Chad–therefore, its management is critical from both environmental and social perspectives. However, since the social unrest in Egypt began, all talks to discuss any sustainable use of the aquifer have been suspended.

The above examples highlight only a few environmental catastrophes due to wars in recent years. Environmental destruction from wars has a long history. From the Romans in 146 BC salting fields around Carthage to impair food production to the destruction of the Libyan oil fields in the recent civil war, wars have always left a trail of environmental destruction. While the images of burning oil wells during the first Gulf War and the spraying of Agent Orange to defoliate the jungles in Vietnam woke up the international community to *environmental warfare*, other less-known, but no less significant, acts of environmental destruction have also been perpetrated by the warring factions during conflict. Such *scorched earth* tactics have historically included poisoning freshwater sources, burning down forests that might provide shelter to enemy combatants, killing livestock, and destroying agricultural fields. Scholars have used the term "ecocide" to describe such planned destruction of the environment carried out to harm the local population and achieve military objectives.

Although such ecological destruction during warfare has been carried out for thou-

sands of years, modern day warfare has made its impact increasingly severe. With the usage of advanced weaponry and aerial bombing, the scope and the impact of wars on the environment has increase manifold. Also, the presence of critical infrastructure like dams and nuclear reactors in our time has increased the *opportunity* for environmental destruction as part of warfare strategy.

Warfare induces a direct and immediate impact on the environment, such as millions of tons of pollutants being thrown in the air when nearly 800 oil wells were set ablaze by the retreating Iraqi army in 1991. According to the United Nations Environment Program (UNEP) reports, the fires took almost 9 months to be extinguished and their long term effects on soil quality and underground water are, as yet, unknown. Similarly, during the aerial campaign over Iraq in 1991, the US utilized approximately 340 tons of missiles containing depleted uranium. Chemical residue from these weapons has contaminated the water and soil of the region. Perchlorate, a toxic ingredient in rocket propellant, is just one of a number of contaminants that have been widely detected in the groundwater in the area. Aerial bombing over Yugoslavia by the NATO forces in 1999 destroyed millions of square kilometers of forests and also contaminated the soil with large amounts of depleted uranium. Such toxic and radioactive pollution not only poses a health risk to the human population but also alters the chemical composition of the soil and destroys its fertility, that can take decades to recover. These examples only outline the damage that conventional weapons can inflict. Obviously, the devastation caused by the use of nuclear weapons will be far greater and could even cause long term changes in the Earth's climatic cycle.

Apart from direct and immediate impact on the environment, warfare often leads to collateral (sometimes unintended) damage of the environment. This occurs when a country's hydrological facilities, nuclear reactors or chemical factories are targeted as part of the military strategy. For example, during the early stage of the Second

Sino-Japanese War in 1938 the Chinese government destroyed a series of dams on the Yellow River to create massive flooding in an attempt to halt the rapid advance of the Japanese forces. Similarly, during the 2006 Israel-Lebanon conflict, the Israeli forces bombed a power station in Jiyeh causing a massive oil spill that was environmentally disastrous for the region.

Violent conflicts can also inflict environmental damage in the long run in several indirect ways. For example, Sudan has experienced over two decades of civil war on its territory. One result of that war has been over 5 million internally displaced persons. This massive displacement of population has led to significant environmental damage, particularly around larger camps. In addition, it is feared that following the cessation of civil war, the large scale return of the displaced population to their homeland would engender a further wave of environmental degradation in some of the more fragile return areas. Exploitation of environmental resources to fund conflict as in the case of Liberia is another indirect environmental consequence of conflict. The fourteen year long civil war in Liberia was primarily funded by exporting "conflict diamonds" and "conflict timber" by Charles Taylor's administration. A similar illegal trade of diamonds and other precious metals helped in financing wars in Angola, Congo, Sierra Leone, Ivory Coast and Zimbabwe. In addition to perpetuating resource extraction based environmental damage, violent conflicts often destroy a state's political and economic infrastructure which might be directed to ensuring sustainable use of environmental resources. Violent conflicts also make it difficult for any international conservation task force or scientific groups to gather data and conduct research to protect the environment in the region.

Given that wars inflict an immense amount of damage to the environment–in several immediate and long-term ways–it becomes absolutely crucial to examine this relationship more closely. Also, the global community has been actively trying to assess the anthropogenic impact on the environment and since wars are one of the

biggest man-made catastrophes, it is important to look at how wars affect the environment. To elaborate upon the importance of this research question seems almost redundant and trivializes the significance of the environment and natural resources for our existence. What is surprising though is how little attention is paid to the impact of conflict on the environment in conflict literature. While the literature on conflict is replete with analyses of its causes, its consequences in general have been paid much less attention. There is some literature on the economic and trade related consequences of conflicts, and more recently, there has been some emerging research on the impact of conflict on health and education, however, there is a significant lacuna in the field when it comes to focusing on the environmental degradation as a consequence of conflict.

Studying the environmental consequences of war serves a threefold purpose–Firstly, it illuminates yet another cost of violent conflicts that is borne not only by the the present generation but by generations to come. Scholars of rational choice theories who study conflict assume that going to war is a rational decision, predicated by weighing the costs and benefits of the outcome. By highlighting the environmental cost of war, this study argues that environmental outcomes of conflicts should not be ignored while deciding on initiating any military action. The motivation for this study comes from a normative concern for the environment that often takes a backseat when pitted against military or economic necessity by states and decision-makers. Even during or after a conflict, fulfilling the immediate needs of the affected population comes at the expense of long term environmental damage. Unlike public health or economic development during and after wartime, which are the immediate indicators of a population's well being and hence easily become issues of domestic and international concern, environmental degradation ranks very low as a political priority. Gauging the environmental consequences of a conflict is often a more complex process that takes a considerable temporal commitment with slow results. For

example, the amount of depleted uranium released into the soil in Kosovo as a result of NATO bombing of the region is still under assessment. Moreover, saving a particular kind of plant or animal species is not deemed critical by the international community or the political leadership of a war ravaged country where people's lives are at stake.

Such a myopic attitude towards the environment, that forsakes the future well being of the environment for the sake of immediate military gains, is not just criminal but also leads to eventual social and economic backlash. Setting fire to oil wells, destroying forests or poisoning bodies of water are clearly acts of "ecocide" that compromise the environment and also affect the people dependent on these resources. This research underscores the fact that the environmental impact of war needs to be paid more attention to when decision-makers and researchers assess the cost of conflicts.

Secondly, as mentioned earlier, most of the research on international and civil wars focuses on their causes or termination. The body of work on consequences of war is still limited, with most scholars concentrating on the economic and political consequences of war. [Bayer and Rupert (2004), Blomberg and Hess (2002), Bodea and Elbadawi (2008), Collier (1999; 2009), Collier and Davies (2008), Elbadawi (2008), Flores and Nooruddin (2009), Koubi (2005), Pickering and Kisangani (2006)] Hence given the state of the field, looking at environmental consequences of war fills a significant gap.

Thirdly, and perhaps most importantly, this study aims to put the environment at the center of the theoretical frameworks analyzing the relationship between conflict and environment. So far, most of the research that has looked at the relationship between conflict and the environment has focussed on environmental factors, such as climate change or natural resources, as causes of conflict. These studies have also focussed on how often excess or lack of certain resources leads to violent conflicts.

[Gleditsch and NordŇs (2007), Gleditsch (2001; 2007) Reuveny (2007), Goldstone (2001), Barnett and Adger (2007), Deudney (1999), Homer-Dixon (1991), Volker (1999), de Soysa (2002a; 2002b) Renner (1996), Ross (2004)] What is common among all of these studies is that they treat the climate and natural resources as exogenous variables affecting social well being. However, in this study I argue that climate and environmental resources are not exogenous to but a function of our social and political realities. For example, droughts can often be man made, that occur because of problems with irrigational facilities or soil degradation. The recent drought in Maharashtra, a state in the western part of India, is one such contemporary case of man-made drought. Being lamented as the worst drought in the region in the last five decades, it is an outcome of inequitable and inefficient water management policies. Existence of the environment might be an exogenous factor, but what we deem as "environmental resources" and who has access to these "resources" or who gets affected by environmental calamities is a political and social issue. Moreover, given the increasing scientific evidence for the anthropogenic impact on the environment, where human beings are constantly transforming their natural environment, it is a fallacy to even consider the existence of environment as exogenous.

Therefore, it becomes critical to bring the environment back to the center of any analysis exploring the relationship between conflict and environment. This means not only exploring how environmental factors instigate conflict but also looking at how wars affect the environment. Such an altered way of looking at the relationship between conflict and environment moves away from a unidirectional analysis, where environment is treated as an exogenous variable, to a more comprehensive and interdependent view of the relationship.

This research underscores the need to alter our understanding of 'environmental security' in conflict and security studies. Traditionally, the notion of 'environmental security' is subsumed under the whole human security paradigm. The discourse

on human security emerged towards the end of the Cold War as a challenge to the dominant Neo-realist paradigm in international relations and security studies. As part of the Cold War outlook, the Neo-realist paradigm argued that security of the state is the paramount concern in international politics. However, as the Cold War ended, scholars and policy makers began to look at a more comprehensive notion of security that prioritized the security of human beings over the security of states. This notion of human security involved economic security, food security, health security, political security and all other social, political and economic contexts that can ensure a rich and fulfilling life for all human beings. This call for human security was in response to the changing milieu where the process of globalization was expanding and the Washington Consensus had failed to improve the lives of people living the poor countries of Asia, Africa, and Latin America. One important aspect of human security was considered to be environmental security which aimed to protect people from the threats of long-term and short-term environmental deterioration such as global warming, availability of fresh water, natural disasters, and so on. However, in this research I argue that by subsuming environmental security under human security, the international community is endorsing weaker regimes and laws to protect the environment. Utilizing insights from political ecology and critical geopolitics I claim that the environment should be put at the center of the environmental security discourse. Which means that we should focus on securing and conserving our environment for its own sake and not necessarily for human consumption and development. Given the clear evidence of anthropogenic impact on the environment, it is presumptuous to focus of securing the environment for human use, rather, the environment needs to be secured from the human beings.

The existing anthropocentric approach to environmental security has two significant drawbacks–one, prioritizing human and other types of security over securing the environment justifies the doctrines of proportionality or military necessity to dam-

age the environment during conflict. These gaps weaken the international laws and regimes to protect the environment during wartime and in turn, paradoxically, compromise human security. Second, by focussing on how environmental factors lead to social unrest and affect human security, we only look at a part of the full picture. To understand how conflict and environment relate to each other we also need to look at how conflicts as a human construct, affect the environment.

One of the broad questions that I attempt to answer in this research is–how do violent conflicts affect the environment? Moreover, how do different types of wars–intrastate and interstate–affect different aspects of the environment? Wars clearly have a negative impact on the environment due to bombings, chemical defoliation or air pollution from military activities. But wars also result in indirect impact on the environment through population displacement, destroying environmental institutions and infrastructure, and resource extraction for financing conflicts. Additionally, the nature of particular conflicts also influences the relationship between war and environment. For example, international warfare, that includes aerial bombing, can be more detrimental to soil productivity than civil wars which normally do not utilize advanced weaponry. On the other hand, civil wars could be more detrimental to forest cover if they are primarily financed by timber exports. Asymmetric warfare also engenders different environmental consequences for the countries involved. For example, the recent wars in Iraq and Afghanistan, led by the United States, have had a very serious impact on the environment of Iraq and Afghanistan, whereas the environment of the Unites States has been unaffected. Additionally, magnitude of the conflict should also be taken into account when assessing its impact on the environment. More severe conflicts, defined in terms of their duration and casualties, are likely to have a more profound impact on the environment. This study is designed to be a "first cut" in understanding these direct and indirect linkages utilizing large panel data which will help us in identifying some general trends and patterns, and

provide us pathways for future projects in this area.

The second part of the thesis discusses the various legal provisions and institutions available to protect the environment during war-time. How effective is the international regime to protect the environment during conflicts? Where are the gaps? What needs to be done to make this regime more effective? As history has shown us, wars are detrimental to the environment, but effective international safeguards and penalties could prove to be a deterrent for "ecocide." Also, adequate monetary compensation for environmental destruction by the guilty party during war-time could help in restoration and conservation efforts.

I attempt to answer the questions outlined above using an aggregate measure for the environmental well being of a country–national *biocapacity* data. This *biocapacity* data is widely used by ecologists, environmentalists, and national governments to estimate the environmental productivity and ecological consumption footprint in countries. To deepen my analysis on the impact of violent conflicts on a country's environment, I also look at four disaggregated measures of a country's *biocapacity*– forest land, agricultural land, grazing land and fishing grounds. These aspects of a country's aggregate *biocapacity* shed light on the productivity and quality of a country's land, forest cover and water resources. Additionally, forests, land, and water are critical resources for population sustenance and therefore degradation of theses resources due to various reasons, including conflict, can forebode social unrest in the future. In order to understand the relationship between conflict and environment, I assess the impact of different types of wars–international, civil, and ethnic–and their magnitude on the aggregate and disaggregate measures of national *biocapacity*.

Conflict adversely affects the environment and a social scientific study of this relationship would make theoretical, conceptual and methodological contributions to the disciplines of political science and environmental studies. Establishing the linkages between violent conflict and the environment would contribute to the international

conflict literature by assessing an important consequence of war. Drawing on conflict data from international relations sources and combining it with *biocapacity* data used in environmental sciences would make the study valuable for both disciplines. It also opens up the opportunity to draw on methodological expertise from the disciplines of international relations, environmental studies, and economics.

This study analyzes data on conflict, environmental biocapacity, and other variables of interest for 186 countries across a span of forty years. Such large-N analysis helps us in exploring broad patterns and developing baselines for the study of conflict-environment relationships. Since most literature in political science on this subject (as will be discussed in later chapters) focuses on area specific studies of environmental damage caused due to conflict, a large-N analysis of this relationship is a significant contribution to highlight the environmental cost of war in general. This broad spectrum study also shows how wars affect different aspects of environmental productivity, regardless of the specificity of processes within individual countries. Such information can be very useful for policy-making around war initiation and providing financial aid towards environmental protection in conflict zones. A large-N analysis also enables us to compare environmental impact of wars on different countries. In particular, this study highlights the issue of environmental injustice because some results point out that poorer countries suffer much more in terms of their environmental biocapacity as a result of wars than advanced industrialized democracies.

The implications of this project have broad relevance due to the interconnectedness of the issues involved in the relationship between conflict and environment. Environmental conservation and protection from anthropogenic activities has certainly become important in international policy making and domestic policy decisions for many countries. An understanding of the effect of war on the environment would inform the security policy of states as the costs of war become clearer. Just as the financial cost of waging war is taken into consideration before embarking on military

action, the environmental cost, if understood, could also be a factor in the decision to go to war. Further, an emphasis on strengthening the international regime for protecting the environment during wartime could contribute in shifting the norm towards environmental conservation as a priority. The study would also help inform various international agencies and international law experts to create more effective laws and international infrastructure to protect the environment during and after conflicts.

The academic audience for this study is also wide and diverse. The examination of the effect of conflict on the environment draws upon, and contributes to, the fields of conflict processes, development, and environmental studies. The number of socio-political, and economic factors involved in assessing the costs and consequences of war reflects the interconnectedness of various disciplines in social scientific work. Conflict and security scholars maintain a profound interest in causes and consequences of war, this study examines an important impact of conflict within a transformed notion of environmental security. Studying the security of the environment rather than security of human beings or security of states needs a fundamental shift in our our perceptions about ourselves and the traditional notion of security. This study also informs scholars who study resource based conflict or climate change induced conflict to broaden their analysis and move away from a unidirectional framework that treats environment and natural resources as exogenous variables. In stead, the study argues to create a more comprehensive framework, rooted in feedback loops, to understand the relationship between conflict and environment where wars and other types of social conflicts can destroy our environment or limit our access to natural resources, engendering further conflict.

The following chapter discusses the state of the discipline in analyzing the relationship between conflict and environment. I locate this analysis within the context of a much larger international debate on the idea of "environmental security." Taking a cue from the literature on Political Ecology and Critical Geopolitics, I argue that the

concept of "environmental security" needs to move away from the state centered or even anthropocentric notion of security where the environment needs to be "secured" by the states and for the states (and its population). Instead, the environment needs to be at the heart of "environmental security" where it is conserved and preserved for its own sake. Based on this transformed notion of "environmental security," I present a framework to analyze the relationship between environment and conflict in Chapter 3. Here I outline the existing research in the field that has focused on how environmental factors lead to violent conflicts, treating the environment as an exogenous variable. In addition to this framework, I suggest reversing the causal arrow and looking at how violent conflicts affect the environment. This approach to analyzing the relationship between environment and conflict brings the environment at the center of analysis and also highlights yet another cost of war. Chapters 4 and 5 comprise the empirical analysis and test the hypotheses related to the main questions posed in this study. In Chapter 4, I assess the effect of conflict on the overall quality of the environment (measured in terms of *biocapacity*) and provide a general understanding of this relationship. In Chapter 5, I evaluate the influence of wars on different aspects on the environment, such as forest cover, crop land, grazing land, and fisheries, whose deterioration can signal the occurrence of future conflicts. In Chapter 6, I analyze the international regime to protect the environment during wartime. Here I evaluate the strengths and weakness of various international laws and treaties designed to safeguard the environment during conflicts. Based on those evaluations, I argue that the international regime pertaining to environmental protection during wartime needs to undergo a *norm-shift* from that of "military necessity" to "environmental security" or "environmental preservation." Chapter 7 discusses the implications of this project and directions for future research.

Chapter 2

Environment, Conflict and Security

2.1 Introduction

Analyzing the impact of conflict on the environment within the traditional scope of international politics is a tough order. Studying the environment or natural resources forces us to think beyond the conventional analytical categories of system, state and individual. This is because the boundaries of our political existence circumscribing countries, governments, various groups and individuals do not overlap with the global environment. Water resources, atmosphere or even the utility of the existence of the rain-forests do not observe national boundaries. Yet, the global environment is managed by institutions that are constrained by political boundaries. This poses a challenge for policy and decision-makers who are trying to "manage" the global environment without compromising national interests and also for the researchers in choosing an appropriate framework of analysis to study.

Research on the environment within the field of International Relations can be broadly classified into two categories–one that analyzes the relationship between environmental/climate change and conflict and the other that looks at the impact of natural resources on political regimes and conflicts. The first category involves research that looks at the impact of climate change, desertification or natural disasters on conflicts. [Buhaug [2010], Homer-Dixon and Blitt [1998], Smith and Vivekananda [2012], Detraz and Betsill [2009], Hendrix and Glaser [2007], Podesta and Ogden [2008], Buhaug et al. [2010], Brown et al. [2007], Raleigh and Urdal [2007], Salehyan

[2008], Nordås and Gleditsch [2007], Reuveny [2007], Barnett [2003], Barnett and Adger [2007]] A substantial amount of work in the field has also been done to look at environmental agreements and negotiations as an analytical focus for research into the dynamics of environmental regime. [Helm and Sprinz [2000], Wapner [1996], Victor et al. [1998], Sprinz and Vaahtoranta [1994], Betsill and Corell [2001], Roberts and Parks [2006], Kütting [2000], Mitchell [2003], Luterbacher and Sprinz [2001], Falkner [2003], Young [1999]] The latter category was influenced by the concerns of political economy and looked at the impact of natural resources like oil and natural gas on economic development and political regimes in resource rich countries. [Soysa [2002], De Soysa [2000, 2002], Kahl [2002, 2006], Luong and Weinthal [2006], Dunning [2005, 2008], Sachs and Warner [1995, 2001], Levy [1995], Ross [1999, 2001a,b, 2004a,b, 2003, 2006], Midlarsky [1995]] Several theories of "resource curse" and "honey-pot effect" were put forward to explain how natural resources affect the political institutions and economic growth with in a country. [Sachs and Warner [2001], De Soysa [2000], Soysa [2002], Luong and Weinthal [2006]] This went on to spawn a large body of growing literature on how resources like diamonds, precious minerals, timber, oil and so on, affect conflict between and within countries. [De Luca et al. [2012], Sorens [2011], Rustad et al. [2008], Call [2010], Brunnschweiler and Bulte [2009], Le Billon [2008], Le Billon and Levin [2009], Lujala [2010], Colgan [2010], Hamilton [2012], Basedau and Lay [2009]]

In the decades of 1950 through 1990, as colonialism retreated and cold war came to an end, the world was looking at the newly independent countries in Asia, Middle East and Africa. Many countries in these regions were extremely rich in mineral wealth and natural resources like oil, natural gas, timber, diamonds and so on. The naive hope of development scholars and the international community was that given the wealth of their natural resources, these countries would develop and thrive quickly. Yet, to this date, many of these countries remain economically and politically unsta-

ble, some of them are now termed as "failed states." These developments perplexed international communities and by the 1990s many economists like Auty [1993] and Sachs and Warner [1995] tried to explain this "paradox of plenty." The four major economic explanations provided to explain the "resource curse" were–(1) a decline in the terms of trade for primary commodities, (2) the instability of the international commodity market, (3) poor economic linkages between the resource and the non-resource sectors, and (4) "Dutch Disease"–which describes the combined influence of two effects that commonly follow resource booms, the first is the appreciation of a state's real exchange rate caused by the sharp rise in exports (of the resource); the second is the tendency of a booming resource sector to draw away capital and labor from a country's agricultural and manufacturing sector, raising their production cost.

By the late 1990s political scientists began to look at other factors like regimes and conflicts associated with natural resource abundance, that explained lack of development in these countries. Some of the mechanisms that were put forward were those of a "Rentier State" where the state's biggest source of revenue is the income from the natural resource. This leads to low taxation, lack of development of political institutions, bloated and corrupt bureaucracy, resulting in a stagnant economy and weak political regime. Scholars who look at the relationship between natural resource abundance and conflict propose two mechanisms–(1)theories of "honey-pot' effect or "resource war" arguments where groups engage in conflict in order to control the abundant natural resource and (2)"Conflict resources" arguments where natural resources are extracted from conflict zones to fund or prolong the war.

In most of these analyses environment is in the background–an independent variable to analyze more conventional concerns of military and economic security. A small but growing literature on critical geopolitics and political ecology suggests that environmental degradation is very substantially driven by the processes implicit in the normal operations of international politics, hence most analyses on environment

and conflict take for granted precisely what they ought to investigate. [Dalby [2010], Lee Peluso [2012], Peluso and Watts [2001]] This difficulty is especially evident in the literature on climate change and natural resources in conflict studies. Most of the research on environment and conflict discusses the necessity of rethinking security, whether in terms of common, comprehensive or human security which includes environmental security. [Levy [1995], Dabelko and Dabelko [1995], Westing [1989], Barnett [2001], Myers et al. [1993]] The field of conflict studies is predicated on a certain kind of environment and human security framework where humans need to be "secured" from the changing climate or the abundance or lack of resources. The appeals of conservation and preservation in this research are also made for the sake of the human survival. However, this framework simply extends the dilemmas rather than shifting the analytical gaze to investigate the simultaneous causes of both insecurity and environmental degradation. Once this connection is directly addressed, ecology then opens up the possibility of more drastically rethinking the scope and purposes of international relations and conflict studies and the centrality of the assumption that security is the overarching rationale for the endeavor in the first place.

This chapter will first outline the main-stream environment and security paradigm, then it will go on to discuss the primary criticisms of this framework from the developing world and also from the foreign policy hawks in the developed world. The last part of the chapter will present a third line of criticism rooted in political ecology and critical geopolitics literature which argues against considering environment as an exogenous variable to human or national security and urges the academic and policy making community to look at both security of human beings and environment as a part of a singular system continuously interacting with each other.

2.2 The Environment and Security Framework

The relationship between environment and human security has perhaps been recognized since the beginning of mankind. It manifested in religious and spiritual beliefs of people where the elements of nature were worshipped for the protection and prosperity of human civilization. The very structure of human existence was aligned with that of the natural environment. Nature was feared and revered and all existence depended on it.

Even far back in the 4th century BC a noted Indian scholar, *Kautilya*, explicitly wrote about the utility of protecting and conserving the environment as part of statecraft. In many *sutras* in his work *Arthashastra*, *Kautilya* wrote about environmental consciousness along four dimensions–natural resources like land, forests, minerals, rivers, and so on, biological environment like animals and aquatic life, natural calamities like droughts and floods, and civic responsibilities such as hygiene and disposal of waste. He highlighted the need to protect natural flora and fauna and emphasized upon appropriate civic behavior for the long-term prosperity of the kingdom. [Rangarajan [1992], Modelski [1964]] The notion that environmental stress can induce human insecurity is also evident in other countless examples that exist throughout history like warfare in ancient China [Zhang et al. [2007, 2005]] or the collapse of Native American population centers in the United States. [Booth and Jacobs [1990], Gedicks [1994]]

As the awareness about the relationship between environmental stress and human security has increased, coupled with issues of population, development and globalization, the international community is waking up to more and more instances of environmental degradation. For example–Philippines is experiencing massive depletion of natural resources through deforestation, watershed abuse, overfishing and coral reef destruction. Such environmental degradation threatens the livelihood of the people, where more than 73 percent of the population is in the agriculture, forestry and fishery

sectors. The anti-government rebel groups in the country, like the New People's Army, take advantage of these declining conditions and governmental campaigns against the rebels often do not get any support from the rural communities who are disenchanted with the degradation of the environmental basis of their livelihood. The resulting lack of security has resulted in open conflicts in the country. [Castro and Nielsen [2003], Hirsch [1998], Homer-Dixon [1994]] Similarly in the last 60 years Haiti's forest cover has reduced from 60 percent to merely a 2 percent of its total land area. This has resulted in firewood shortages and cultivation of marginal soil, which is a recipe for social disruption and instability in such a low-income country.[Dolisca et al. [2007], Kreimer and Munasinghe [1990], Homer-Dixon [1994]] In another such case, during the 1960s, as a result of deforestation and improper agriculture practices, there was widespread soil erosion in Ethiopia's Highlands. The result was decline of farmland, inefficiency of agriculture, food shortages and exponential rise in food prices leading to urban riots. [Myers [1989]]

Literature on water-based conflicts is also replete with instances of social disturbances in many areas caused due to the lack of availability and improper distribution of water.[Conca [2005], Waterbury [2002], Khagram [2004], Stetter et al. [2011], Bernauer et al. [2012a], Weinthal and Vengosh [2011]] For example, two of Somalia's biggest rivers–*Jubba* and *Shebelle* originate in Ethiopia, and sharing these rivers has been an integral part of the longstanding conflict between Ethiopia and Somalia. Scholars argue that even after the end of the Ogaden war between the two countries in 1979, water distribution related issues between the Ethiopian refugees and local Somalis further complicated the conflict, which manifested in more intensified wars later on. [Gleick [1993], Reuveny [2007]]

The militarization of water conflicts is not a recent phenomenon. On numerous occasions, Israel and its neighboring Arab states have feuded over access to Jordan River waters. In the 1950s, a comprehensive Johnston plan was designed to facilitate

co-operative use of the Jordan River waters in the region. This plan eventually failed because of the mistrust among the four bordering states (Israel, Jordan, Lebanon and Syria). Since then each state has tended to follow its own water policies. In November 1990, former Israeli Minister for Agriculture Rafael Eitan stated that Israel must never relinquish the West Bank because a loss of its water supplies would threaten the very existence of Jewish State. Many military moves in that region like the 1967 occupation of the West Bank, the Golan Heights and Gaza Strip, at some level, were also said to be motivated by water supply issues in the region. [Nijim [1990], Wolf [1995], Selby [2004]]

Traditionally, such analyses of environmental security examine the threats posed by environmental events and changes to human population. The relationship between environment and security has been under consideration since the 1980s mainly by two groups–(1) the environmental policy community, addressing the security implications of environmental change and security, and (2) the security community and political scientists, looking at new definitions of national security, particularly in the post Cold War era. It was acknowledged by all groups concerned that the global impact of, for example, environmental change, the depletion of the ozone layer and transboundary pollution, have clear security implications. This in turn led the military authorities to re-evaluate the security dimension of environmental issues. Security was traditionally seen as a synonym for national security with two main objectives: (1) to preserve the territorial integrity of the State and (2) to maintain the preferred form of government, by political and military means. [Baldwin [1997], Walt [1991], Haftendorn [1991]] However, this traditional notion of security has been extensively debated over the last three decades given how the perceived threats to our security have changed from a nuclear war in a bipolar world to international terrorism, climate change, civil wars, cyber terrorism and so on.

Security Redefined

After the end of the Cold War in 1989, the security community's focus shifted from the global clash of superpowers to fragmented groups of stateless actors fomenting civil war and terrorism. This move towards expanding the notion of security picked up momentum in the early 1980s when the Independent Commission on Security and Disarmament Issues (ICSDI) developed and introduced the concept of "common security". Hence, the idea of national security began to assume a broader perspective beyond traditional security concerns. A range of diverse threats to both, individuals and the world, such as economic decline, social and political instability, ethnic rivalries and territorial dispute, international terrorism, money laundering, drug trafficking and environmental stress came into focus within this expanded definition of security.

Today "environmental security" has become a catch-all phrase which includes everything from climate change to oil exploration to agricultural subsidies or any other issue that connects the environment to human existence. Environmental security is now closely linked to national security and has become an integral part of the Human Security paradigm. Our understanding of the links between environment and security has evolved in the last twenty years to reflect the changing threat scenarios from chemical and nuclear warfare to resource-based warfare to terrorism to vulnerability towards climate change.

Our Common Future

In 1987, the World Commission on Environment and Development (WCED) clearly linked security with environment in its report named *Our Common Future*–"Humankind faces two great threats. The first is that of a nuclear exchange. Let us hope that it remains a diminishing prospect for the future. The second is that of environmental ruin world-wide and far from being a prospect for the future, it is a fact right now." [Brundtland et al. [1987, p. 99]] Following this inter-linkage, the UN General Assem-

bly officially introduced the concept of security and environment at its 42nd Session.[1] *Our Common Future*, was also one of the initial documents that defined sustainable development. Population, poverty, conflict, high levels of military spending, and the ultimate threat of nuclear exchange were highlighted as direct and indirect impediments to achieving sustainable development. Yet, the Brundtland Commission, named after its chair, former Norwegian Prime Minister Gro Harlem Brundtland, also called for a broader conception of security that included instability caused in part by environmental factors–as was to become the habit of many subsequent environmental security advocates.

The Brundtland report, in an under-appreciated chapter entitled "Peace, Security, Development, and the Environment," set the agenda for understanding multiple links between environment and security. [Brundtland et al. [1987]] In this chapter, the Brundtland report flagged both the environment's implications for security and security's impact on the environment. It highlighted the contributions of natural resources to violent conflict and their link to the well-being of humans and ecosystems. It also noted that the arms culture of superpower military confrontation and the subsequent war on terror had presented tremendous impediments to achieving sustainable development. The report even previewed some of the efforts to capture the power of environmental issues to build peace instead of conflict. "Some of the most challenging problems require cooperation among nations enjoying different systems of government, or even subject to antagonistic relations," wrote the commissioners. [Brundtland et al. [1987, p. 302]] In the introductory chapter, the commissioners stated, "The whole notion of security as traditionally understood in terms of political and military threats to national sovereignty, must be expanded to include the growing impacts of environmental stress–locally, nationally, regionally, and globally."

[1]UN Doc. A/40/553 (1986) 'Concepts of Security'; UN GA Res. 42/93 (7 December 1987), 'Comprehensive System of International Peace and Security'; UN GA Res. 42/186 (11 December 1987)

[Brundtland et al. [1987, p. 19]] While acknowledging these linkages were "poorly understood," the commission held that "a comprehensive approach to international and national security must transcend the traditional emphasis on military power and armed competition." [Brundtland et al. [1987, p. 290]]

While by no means the first advocate for this expanded notion of security,[2] the Brundtland Commission was a key legitimizing voice. Its influence was felt in the United Nations Development Program's (UNDP) "human security" frame, which gained traction in UN forums and was championed by select national leaders such as Canada's Foreign Minister Lloyd Axworthy.[3] The commissioners identified climate change, loss of arable land, fisheries, and water as factors likely to contribute to conflict and spur other security-related problems, such as migration and economic dislocation. The report flagged "environmental stress as both a cause and an effect of political tension and military conflict" and recognized that "environmental stress is seldom the only cause of major conflicts within or among nations" but could be "an important part of the web of causality associated with any conflict and can in some cases be catalytic." [Brundtland et al. [1987, p. 290-291]] It also highlighted poverty, inequality, and lost development opportunities as key factors in creating insecurity. Even as it called for altering the security paradigm, the Brundtland Commission made arguments firmly ensconced in a traditional statist security perspective. However, many of these arguments were later critiqued for being very Euro or Developed world centric in their orientation and prescription and faced tough resistance in the policy circles of developing countries like India, China and Brazil. [Lele et al. [2010], Lohmann [2009], Najam et al. [2003]]

[2]See L. Brown, *Redefining Security*, Worldwatch paper no. 14, Washington, DC: Worldwatch Institute, 1977.

[3] See UN Development Program (UNDP), *Human Development Report 1994*, New York: Oxford University Press, 1994; R. Paris, "Human Security: Paradigm Shift or Hot Air?" *International Security* 26, No. 2 (2001): 87-102, and L. Axworthy, "Introduction", in R. McRae and D. Hubert, eds., *Human Security and the New Diplomacy: Protecting People, Promoting Peace*, Montreal: McGill, Queen's University Press, 2001, Pp: 3-13.

The Brundtland Commission also identified political capacity as an important element in environment-conflict links. Ten years later it was recognized as a crucial variable by the field's researchers.[4] The commissioners stated that environmental stress could contribute to interstate or subnational conflict "when political processes are unable to handle the effects of environmental stress resulting, for example, from erosion and desertification." [Brundtland et al. [1987, p. 291]] *Our Common Future's* focus on environment and conflict provided a legitimizing foundation for what, just a few years later, became an explosion of analytical work within and outside of governments.[5] Apart from highlighting the environment's contribution to conflict and insecurity, the Brundtland Commission's report also highlighted the negative impact of conflict and the military on the environment. It reminded governments that the costs of conflict and militaries present direct and indirect tradeoffs to investing in sustainable development: "Arms competition and armed conflict may stimulate an ethos that is antagonistic towards cooperation among nations whose ecological and economic interdependence requires them to overcome national or ideological antipathies." Even "a state of 'peace' might well entail the diversion into armament production of vast resources that could, at least in part, be used to promote sustainable

[4]See T. F. Homer-Dixon, *The Ingenuity Gap*, (New York: Alfred A. Knopf, 2000); G. D. Dabelko and R. Matthew, "Environment, Population, and Conflict: Suggesting a Few Steps Forward," *Environmental Change and Security Project Report*, (2000): 99-103; and S. D. VanDeveer and G. D. Dabelko, "Its Capacity, Stupid: International Assistance and National Implementation," *Global Environmental Politics*, 1, No. 2 (2001): Pp:18-29.

[5]See T. F. Homer Dixon, "On the Threshold: Environmental Changes as Causes of Acute Conflict," *International Security*, 16, no. 2 (1991): 76-116; T. F. Homer-Dixon, "Environmental Scarcities and Violent Conflict: Evidence from Cases," *International Security*, 19, no. 1 (1994): 5-40; T. F. Homer-Dixon, Environment, Scarcity, and Violence (Princeton, NJ: Princeton University Press, 1999); G. Baechler, *Violence through Environmental Discrimination: Causes, Rwanda Arena, and Conflict Model*, Dordrecht, The Netherlands: Kluwer Academic Publishers, 1989; N. P. Gleditsch, ed., *Conflict and the Environment*, Dordrecht, The Netherlands: Kluwer Publications, 1989; P. F. Diehl and N.P. Gleditsch, eds., *Environmental Conflict* , Boulder, CO: Westview Press, 2001; D. H. Deudney and R. Matthew, eds., *Contested Grounds: Security and Conflict in the New Environmental Politics*, Albany, NY: State University of New York Press, 1999; UN Environment Program (UNEP), *Understanding Environment, Conflict, and Cooperation*, Nairobi: UNEP, 2003, and C. Kahl, *States, Scarcity and Civil Strife in the Developing World*, Princeton, NJ: Princeton University Press, 2006.

forms of development." [Brundtland et al. [1987, p. 290-294]] This resource-diversion or opportunity-cost argument has been used repeatedly in both expert and public discourses on environmental security.[6] The commissioners went so far as to identify tropical forest, water, desertification, and population priorities that could be funded with one month's share of the global military spending budget. During the 20 years that followed the release of *Our Common Future*, scholarly and policy interest in the linkages it highlighted has risen, fallen, and risen again.[7]

Since the UN General Assembly introduced environmental security in the 1980s, many international institutions like the United Nations Environment Program (UNEP), North Atlantic Treaty Organization (NATO), Organization for Security and Cooperation in Europe (OSCE) or the International Panel for Climate Change (IPCC) have been actively engaged with the issue of environment and security. These organizations recognized the urgency of looking at the environment and security nexus and worked to design a more comprehensive response in terms of capacity building and monitoring compliance.

The UNEP first dealt with environmental security in the joint PRIO/UNEP Program on Military Activities and the Human Environment in the 1980s. In 1988 an ad hoc experts' meeting on expanded concept of international security was organized by UNEP, followed by the international symposium "Towards a Comprehensive System of International Security" which was co-sponsored by UNEP. The main emphasis of this framework was to explore the interrelationship between environmental security

[6]See UN Secretary-General, Potential Uses of Military-Related Resources for Protection of the Environment, Report A/46/364 (New York: UN Office for Disarmament Affairs, 1993). This same argument against the "arms culture" was voiced in the Rio+10 forum of the 2002 Johannesburg World Summit on Sustainable Development where public interventions at IUCN's 3 September environmental security forum repeatedly focused on diverting U.S. military largesse to more productive and sustainable ends (Environmental Resources and Social Conflict Dialogue, Sandton, South Africa, 3 September 2002).

[7]See R. Matthew, B. McDonald, and M. Brklacich, "Analyzing Environment, Conflict, and Cooperation," in UNEP, Pp. 5-15; and G. D. Dabelko, "The Environmental Factor," *Wilson Quarterly* 23, no. 4 (1999): 14-19.

and comprehensive international security. As a follow-up, the PRIO/UNEP Program published a booklet on Environmental Security - A Report Contributing to the Concept of Comprehensive International Security.[8]

The General Assembly Resolution 42/186 mandated UNEP to deal with the issue; Paragraph 86 of the Resolution reads:

> "One of the roles of the United Nations Environment Program is to promote environmentally sound development in harmony with peace and security, and towards this end, issues of disarmament and security, in so far as they relate to the environment, should continue to receive appropriate attention."

The United Nations Task Force on Environment and Human Settlement addressed the issue in its 1998 Report:

> "[...] Monitoring and assessment are closely linked to early warning of possible environmental emergencies through the prediction of extreme events or unusual environmental conditions. This kind of warning is extremely valuable for environmental and economic decision-makers; for example, advance warning of drought conditions can enable farmers to plant drought-resistant crops. It may be possible to identify, on a long-term basis, potential 'hot spots' or areas that are likely to be subject to rates of change that exceed the limits of sustainability and thus pose threats to regional or global security. The Task Force also recommends that UNEP and Habitat Design maintain the system of information, monitoring and assessment so as to maximize its ability to provide early warning of possible environmental and human settlement emergencies. It further recommends that UNEP consider establishing a capability to identify potential environmental and environment-related conflicts and provide information and analysis to guide the development of preventive measures, for example by the negotiation of joint actions. [...]" [9]

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[8]See PRIO/UNEP, *Environmental Security - A Report Contributing to the Concept of Comprehensive International Security*, December 1988

[9]UN Doc. A/53/463 (6 October 1998) "Report of the Secretary-General on Environment and Human Settlements", Annex "Report of the United Nations Task Force on Environment and Human Settlements", Para. 41.

2.3 Critiques of Environment and Security Framework

The notion of environmental security, after it took root in the 1990s has been criticized along several dimensions. The developing countries criticized it as another form of western ideological dominance to undermine their sovereignty. Foreign policy hardliners within countries panned the idea of considering environment as a threat to national security because it would dilute the urgency and the seriousness of national security considerations. Even environmentalists and scholars from the developed countries opposed the idea of equating environmental security with national security on the grounds of normative motivations.[10] While recognizing the existing critiques of environmental security, this research uses the framework of political ecology and critical environmentalism to reformulate our understanding of environment and security for the purpose of this project.

Sovereign Overreach

Many developing countries vehemently opposed the ideas on environment, peace, and security put forth in the Brundtland Commission's report at the 1992 UN Conference on Environment and Development in Rio de Janeiro. The developing world did not endorse a global dialogue on environmental issues within the context of conflict and security, reacting negatively to formal environmental security proposals in UN forums. [Lohmann [1990, 2009], Najam et al. [2003], Lele et al. [2010]] The coalition of developing nations, the Group of 77, perceived the security frame as a Pandora's box that, once opened, could dilute their claims of absolute sovereign control over their resources. The United States was equally wary, fearing environmental issues might

[10]See Deudney [1990] where he primarily offers three arguments against linking environmental security with national security–(1) Environmental problems are unlikely to cause interstate wars, (2) secuity threats from wars are very different from security threats from environmental factors, lastly and perhaps more importantly, Deudney argues that (3) the emotive power of nationalism to promote environmental concern can prove counterproductive to developing a global approach to tackle environmental problems.

dilute and undermine military-focused security definitions in the midst of the Cold War. More practically, the environment, conflict, and security issues raised in the UN did not easily lend themselves to resolution in a multilateral environmental treaty, the preferred mechanism at Rio and of the international environmental community in general.[11]

The Soviet Union attempted–and failed–to institutionalize environment and security links at the United Nations prior to the Rio conference. In October 1987, in the wake of the Chernobyl accident, Mikhail Gorbachev launched his "Murmansk Initiative" in a speech in that northern city on the Kola Peninsula.[12] Calling for *glasnost* and greater cooperation (particularly among the Arctic states) in trade, environment, culture, and arms control, he proposed *ekologicheskaia bezopastnost* or "ecological security" as a top global priority for both bilateral relationships and international institutions. While aimed at environmental challenges, the Murmansk Initiatives were a *de facto* forum for moving beyond environmental goals to broader confidence-building efforts across the Cold War divide.

Gorbachev and then–Soviet Foreign Minister Eduard Shevardnadze, in speeches to the United Nations in 1988 and 1989, proposed creating ecological security institutions because, in Shevardnadze's words,"Overcoming the global threat to the environment and ensuring universal environmental security through prompt and effective action is an imperative of our times."[13] In early May 1989, Shevardnadze called for the creation of a "UN Center for Emergency Environmental Assistance" commonly

[11]The 1976 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD) and subsequent international law aimed at reducing the intentional use of the environment as a tool of war are exceptions to the global level agreement in this area. See J. E. Austin and C. E. Bruch, *The Environmental Consequences of War: Legal, Economic, and Scientific Perspectives*, Cambridge: Cambridge University Press, 2000.

[12]See D. Scrivener, *Gorbachev's Murmansk Speech: The Soviet Initiative and Western Response*, Oslo: The Norwegian Atlantic Committee, 1989 for a discussion of Gorbachev's 1987 Murmansk Initiatives and the Western response.

[13]"Soviet Union Proposes Center for Emergency Environmental Aid," Reuters, 5 May 1989.

referred to as the "Green Helmets," to be headed by a UN undersecretary-general. The foreign minister asked all member states to discuss this idea, in which a group of environmental experts would comprise a rapid-response force, "at a time when countries are starting preparation for a UN-sponsored conference on environment and development planned for 1992."[14] He also called on the UN General Assembly to create a UN Environmental Security Council. These specific proposals were predicated on the more fundamental premise that security had to be redefined.

The reaction to the Murmansk Initiatives and the subsequent UN proposals was mixed. The U.S. government response was "reserved," perceiving the Soviet ideas as posturing and rhetoric designed to play to the developing country galleries at the UN General Assembly.[15] Environment was not yet widely linked with security in U.S. diplomatic circles, with then–U.S. Senator Al Gore one of the few politicians regularly promoting the connection. With the concurrent collapse of communism in Central and Eastern Europe, the rest of the world glimpsed the massive toxic legacy lurking behind the Iron Curtain, which damaged the credibility of Soviet environmental decision-making. Shevardnadze's 27 September 1988 call for the United States and others to transfer funds from military programs to environmental efforts echoed similar efforts in the 1970s and 1980s by the Soviets to slow or constrain NATO weapons development by promoting international environment regimes. The Green Helmets proposal was highly unpopular with developing countries and became a political nonstarter. Countries such as Brazil feared (and continue to fear) developed country intervention seeking to stop exploitation of natural resources such as those

[14]"Shevardnadze Calls for Steps to Protect Environment," Information Telegraph Agency of Russia (ITAR-TASS), 3 May 1989.

[15]See B. Jancar-Webster and V. I. Sokolov, "Environmental Security: Challenges for the United States and Russia," in S. Cross, I. A. Zevelev, V. A. Kremenyuk, and V. Gevorgian, eds., *Global Security Beyond the Millennium: American and Russian Perspectives*, New York: MacMillan Press, 1999, 131.

in the Brazilian Amazon.[16] The sovereign right of nonintervention was employed as an argument against the Green Helmets proposal, cutting off UN General Assembly discussion of further ecological security proposals. This dynamic repeated itself 10 years later in the UN context when then–UN Environment Program Executive Director Klaus Toepfer reintroduced the Green Helmets idea, which was once again quickly rejected by the Group of 77 countries due to sovereignty concerns.

In more recent years this divide between the developed and the developing countries like India, China, Brazil, Indonesia and so on, has once again come into the forefront as part of the negotiations over the emissions of greenhouse gasses. The rapidly developing economies are very suspicious of any attempts made by the developed countries to limit their carbon emissions and development trajectory. Several mitigation mechanisms proposed in the Kyoto Protocol could potentially give developed countries the financial and political leverage to interfere with the developmental projects in developing countries in the pretext of environmental security and mitigating climate change.

Environmental Security as National Security?

This failure to achieve high-profile traction on environmental security linkages at the United Nations in the 1990s did not imply a commensurate lack of interest among certain individual nations and regional organizations. The end of the Cold War did not produce the expected peace dividends, as hostilities held in check by the superpower competition were unleashed and the number of conflicts actually spiked in the 1990s. Both policy analysts and academics studying conflicts such as those in Liberia, Somalia, Rwanda, and Haiti, indicated that governments should pay greater attention to the underlying demographic, environmental, and distributional origins of

[16]T. G. da Costa, "Brazil's SIVAM: Will It Fulfill Its Human Security Promise?" *Environmental Change and Security Project Report* 7 (2001): 47-58.

these conflicts. These concerns led to a raft of analytical and policy initiatives which were prominent in, but by no means limited to, the United States.[17]

In his 1994 Atlantic Monthly article entitled "The Coming Anarchy," Kaplan captured the attention of the policy-making community.[18] Kaplan held up demographic and natural resource pressures as primary explanations for West Africa's failing states, drawing heavily on Homer-Dixon's work on resource-scarcity. Many critics thought Kaplan oversold the environment as the national security issue of the twenty-first century, and his claims that West Africa's fundamental challenges were widely applicable to other regions of the world provoked an analytical and policy backlash when environmental scarcity did not prove to be the ultimate threat in the post-Cold War era. Environmental security would not provide an all-encompassing alternative security paradigm. [Deudney [1990, 1991], Levy [1995] Nevertheless, the contributions of natural resource scarcity and abundance to conflict, as well as the larger environmental challenges to traditional definitions of security, became institutionalized concerns for foreign, development, and security communities.

In 1994 the UNDP dedicated its annual *Human Development Report* to human security, suggesting that environmental security was one of seven areas that should constitute a new global security paradigm. The seven securities were economic, food, health, environmental, personal, community, and political. Japan, Canada, and a wide range of UN bodies now commonly use this framework, and small island states commonly invoke it to underscore the threat to survival posed by climate change–induced sea-level rise.

The environment and security framework faced an abrupt setback after the Septem-

[17]See G. D. Dabelko and P. J. Simmons, "Environment and Security: Core Ideas and U.S. Government Initiatives," *SAIS Review* 17, no. 1 (1997): 127-46; R. Floyd, "Typologies of Securitization and Desecuritization: The Case of US Environmental Security 1993-2006," PhD diss., University of Warwick, 2007; and D. C. Esty et al. *State Failure Task Force Report: Phase II Findings*, McLean, VA: Science Applications International Corporation, 31 July 1998).

[18]See R. D. Kaplan, "The Coming Anarchy," *Atlantic Monthly* 273, no. 2 (February 1994): 45-76.

ber 11 attacks. Just as the superpower confrontation of the Cold War provided little political space for a broader array of security concerns, the "war on terror" kicked other threats off policymakersï£¡ priority lists. The environmental security issue suffered another blow in 2003 when the UN-constituted Commission on Human Security, a blue-ribbon panel co-chaired by Amartya Sen and Sadako Ogata and similar to WCED, inexplicably dropped natural resources from its analysis. And the antipathy of U.S. President George W. Bush's administration to anything dubbed "environmental" set back efforts in international forums and pushed much of the official U.S. work on environmental security behind the scenes, or forced it to be relabeled as disaster relief. Yet interest in environment, peace, and security linkages continued to grow within the UN system, the bilateral development and security communities, and in countries experiencing conflict. As the "force-only" responses to the September 11 attacks have fallen short of achieving either military or human security objectives, policymakers and practitioners have been returning to more inclusive notions of security.

The recent rise of concern over climate change has both spurred–and been spurred by–climate-security connections. Prominent reports in the European Union, United States, United Kingdom, and Germany aimed at garnering more policy attention to climate change have emphasized its security linkages.[19] With a push from the United Kingdom, the UN Security Council devoted an April 2007 session to climate change, peace, and security, the first Security Council session on an environmental topic.[20] UN Secretary-General Ban Ki-moon subsequently linked UN efforts to battle climate

[19]See Military Advisory Board, *National Security and the Threat of Climate Change*, Washington, DC: CNA Corporation, 2007; German Advisory Council on Global Change, *World in Transition: Climate Change as a Security Risk*, London: Earthscan, 2007; J. W. Busby, *Climate Change and National Security: An Agenda for Action,* Council Special Report no. 32, New York: Council on Foreign Relations Press, 2007; and K. M. Campbell et al., *The Age of Consequences: The Foreign Policy and National Security Implications of Global Climate Change*, Washington, DC: Center for Strategic and International Studies and Center for a New American Security, 2007).

[20]See "Security Council Holds First-Ever Debate on Impact of Climate Change on Peace, Security, Hearing Over 50 Speakers," UN Security Council press release SC/9000, 17 April 2007.

change with its mission to address the underlying causes of conflict in Darfur, Sudan.[21] In March 2008, European Union High Representative for the Common Foreign and Security Policy Javier Solana presented to the European Council a short climate change and security paper responding to pressure (particularly from Germany) to raise the profile of climate-security connections. Mirroring some of the language used in prominent reports from German, British, and U.S. nongovernmental organizations, the brief called climate change a "threat multiplier which exacerbates existing trends, tensions and instability" that could "overburden states and regions which are already fragile and conflict prone," posing "political and security risks that directly affect European interests."[22]

The heightened attention to climate change has certainly boosted the prospects for constructively addressing environment, development, and security linkages. The wide range of potential climate impacts is re-energizing broader debates over human security that suggest redefining security beyond purely militaristic terms. Traditional security community's concern with climate change (and the social reactions it may produce, such as migration) has helped garner wider attention. Climate change and its implications for desertification, precipitation, and crops in vulnerable areas such as the Sahel may also help illuminate the preexisting but neglected connections between these environmental variables and social conflict. Even scholars like Levy [1995], who had sharply criticized including environment in the national security discourse, admit that climate change is a direct threat to a country's national security. Ironically, climate change mitigation efforts, such as increasing the use of biofuels, are arguably creating new natural resource and conflict links, as more forests are cleared for palm oil plantations and food prices are rising as we choose to grow our fuel supplies. These "unintended consequences" of climate change mitigation efforts present a new research

[21]K. Ban, "A Climate Culprit in Darfur," *Washington Post*, 16 June 2007.

[22]See EU Commission and the Secretary-General/High Representative, *Climate Change and International Security* (Brussels, Belgium: Council of the European Union, 3 March 2008), 2.

agenda for environment, development, and conflict scholars and practitioners.

The research community continues to debate links between environmental scarcity, resource abundance, and violent conflict. The study of the relationship between climate change and conflict has advanced noticeably in the past five years. With regard to how changes in precipitation may influence internal conflict, the one area where we now have a fair number of studies, the dominant view seems to be that rainfall abundance is associated with greater risks than drought and that in any case other conflict-generating factors are more important. Studies of how climate change may promote interstate conflict over water resources also seem to point in the direction of a weak or a null relationship. In recent reviews of this literature, Bernauer et al. [2012b], Gleditsch [2012] and Buhaug et al. [2010], conclude that although environmental change may under certain circumstances increase the risk of violent conflict, the existing evidence indicates that this is not generally the case. The present study argues that the existing uncertainty in many research findings that are trying to explore direct causal connections between climate change and human security or natural resource and conflict stem from the fact environmental factors are in fact endogenous to conflicts and share a circular, interdependent relationship rather than a one-way linear causal relationship. Therefore the environmental factors like climate change, resource scarcity or resource abundance are in fact a product of human conflicts, and political and social institutions. The next section will outline the a new approach–rooted in political ecology and critical geopolitics–that can used to reformulate the environment and security framework.

Political Ecology and Critical Geopolitics

Most academic and policy work on the environment-security framework works within the predominant state-centric paradigm in international politics. The literature outlined above focusing on scarcity and abundance of natural resources and conflict or

looking at climate change and conflict, basis its discussions on states, their performance, interactions and capabilities. Most of these analyses assume states as the central actors and the environment to be an external entity that has to be controlled, monitored and administered. Using language of "resource curse", "honey-pot" or "natural disasters" implies that environment is an external factor that affects political, economic and social circumstances of human beings without paying much attention to the role of mankind in shaping its natural environment.

This study attempts to reverse the causal arrow of environment and human security framework by looking at how human actions like wars have an impact of the environment. Drawing on the literature of political ecology and critical geopolitics, this study also goes on to argue that it is not meaningful to look at the relationship between environment and violent conflicts in terms of unidirectional causality, where one is a dependent variable and the other an independent variable. It is imperative that we consider human beings and the environment as part of a singular system allowing for feedback loops and systemic interdependence.

Based heavily on the Marxian Tradition in political ecology and Foucaultian tradition in cultural theory, political ecology concerns itself chiefly with the various ways in which global and local political economies parcelize the natural world, assign values to these parcels, distribute them in particular ways, and thereby contribute to patterns of exploitation and violence. Peluso and Watts [2001] notes that political ecology emphasizes "the entitlements by which differentiated individuals, households, and communities possess to gain access to resources within a structured political economy. It grants priority to how these entitlements are distributed, reproduced, and fought over in the course of shaping, and being shaped by, patterns of accumulation."(p.5) Peluso and Watts in principle reject the neo-Malthusian way of looking at environmental conflict. In the early 90s scholars such as Homer-Dixon and Kaplan argued that violence emerges due to scarcity of renewable resource such as forests, lands,

water, and so on. The scarcity induces marginalization and heightens competition. Peluso and Watts argue that this neo-Malthusian way of looking at environmental problems and violence is flawed in many ways. They reject the simplistic view and the automatic/linear relationship between scarcity and environmental conflict. They argue that there is much more than scarcity that can explain environmental conflict. For them conflict is a phenomenon that can be understood by looking at the interplay between local and extra local factors. Conflict is embedded in the historical context and wider processes that take place at higher level. Colonialism, the expansion of capitalism, and the integration of markets via globalization have historically meant that the value of natural resources has been largely constituted by the power, policies and consumption habits of the wealthy industrial countries and their allies among the elite in the developing countries. Moreover, the structure of both the contemporary international trading system and most domestic economies is such that the distribution of these resources is skewed in favor of these powerful actors. Consequently, many poor, subsistence and indigenous communities in developing countries experience so-called scarcities of vital natural resources for distributional reasons, even under objective conditions of global or local abundance. Environment is an arena upon which stakeholders attach value, contest claims, struggle for legitimacy, etc. Thus, environmental conflict cannot be reduced to scarcity alone, it must be understood within the web of social, historical and political contexts and the interrelations among them.

Even though a somewhat similar criticism of environmental determinism has been made in the literature on critical geopolitics, the field of political ecology is especially germane. It particularly locates itself against the scarcity-based arguments made by Homer-Dixon's approach to explain environmentally driven conflicts. In his writings Dyer [2011, 2002, 2001a] has sought to completely reformulate the environment and security framework by suggesting that the literature in international relations deal-

ing with these issues needs to confront the question of which contains what. Global environmental change is much more than international change and the suggestion is that it drives international responses, whether in terms of security, economy or other matters. "In some respects environmental change is the greatest challenge for international relations theory since this appears as a material externality to the international system rather than as an internal variable which can be addressed in terms of familiar political structures and their supporting social values. Thus environmental change may present security concerns which are qualitatively different from traditional security threats, and in itself present a material basis for a broad shift in social values." [Dyer [2001b, p. 234]]

This directly raises the question of whether the environment is to be understood as a matter of international politics, a matter of potential security concern and a matter for regulation in various international regimes or is international politics to be understood as a matter that happens within the environment, a matter of politics within natural circumstances which get priority in how matters are conceived and policy devised? This slightly reformulates the earlier questions in the environmental security discussion as to whether what is implicitly getting secured is the international order or the natural environment. What cannot be assumed is that there is a necessary congruence between these two. Indeed the whole premise of the parallel discussions of sustainable development in the last couple of decades is precisely that the conventional modes of economic activity practiced in most parts of the world were not sustainable. How can we then imagine a qualitatively different understanding of security where environment is not an external variables against which human beings and political institutions are being secured? What kind of contribution can the field of international relations and conflict studies make to include environment in its discourse? It is a an extremely challenging undertaking that requires thinking in unconventional ways.

As outlined in the above sections, since the late 1980s the discussion of environmental security has continued apace with conceptual arguments intersecting regularly with both empirical research and policy advice. While there is agreement in most of the literature that environmental changes are unlikely to directly cause inter-state warfare, there remains considerable discussion about the likely trajectories of environmental change causing state "failures" and the likely disruptions–like civil wars–that might result. [Gleditsch [2012], Young [1999], Raleigh and Urdal [2007], **?**] Likewise there is considerable discussion of the appropriate policies to anticipate such failures and the possibilities of aid packages as preventative interventions. Not surprisingly the main focus in many of these discussions is on states, their performance, interactions and capabilities. In so far as the conclusion that states are unlikely to go to war as a result of environmental scarcities or changes holds, the question then becomes in what way is this a matter for detailed attention by international relations scholars and especially those interested in security studies.

Environment is a catchall residual category which usually refers to the non-human material context of human activities. Premised on the extraordinary modern assumption that divisions between humanity and the rest of the biosphere are a useful ontological starting point the term environment has come to encompass the definition of the part of "nature" that provides the backdrop for human affairs. When it shows up in discussions of security it is frequently the changes in specific environments in terms of resource scarcity that are the focus of analytical attention. Other considerations of the disruptions caused by climate change and related matters also appear in the environmental security literature, although these are often speculative exercises in constructing plausible future scenarios, or extrapolating from contemporary events.

But the assumption of a stable backdrop that is being changed in some places is not now an adequate representation of what the scientific literature on global ecology has been describing in increasing detail for the last few years or what environmental

history has been investigating. In Hugh Dyer's terms–the material context driving international politics is changing [23] and that point has to be integrated into the conceptual frameworks that link environment to security, and especially so in terms of the discipline of international relations, where at least some of the change in political arrangements needed to address this changing context will have to be studied

[23]What is now frequently simply called global change science has, in the last few decades, begun the task of synthesizing knowledge from many disciplines while extending the monitoring of numerous aspects of the planetary biosphere. It has also incorporated historical research into the planet's past and looked in detail at the crucial matters of atmospheric composition and climate change. A number of noteworthy conclusions have already been reached which affect our understanding of ecology in ways that matter in terms of what security might now mean. While the sheer scale of change is important, the most worrisome matter is the unpredictability of forthcoming changes. Three aspects of the contemporary literature on global change are especially salient.

First is the importance of understanding the scale of anthropogenic disruptions of the atmosphere, and in particular the fact that humanity has altered the composition of the gases in the air to such a degree that there is no parallel in the last 400,000 years for which science now has a fairly comprehensive geologic record. That period has been recorded in the so called Vostok ice cores extracted from Antarctica and analyzed in detail in the last few decades. The conclusions from this analysis are quite clear in that climate is related to carbon dioxide concentrations through the last four glacial periods. Climate and carbon dioxide oscillated within a fairly stable range during that period, but we are now already outside that range of relative stability. In the words of the International Geosphere Biosphere Program (IGBP) authors we are living in a "no-analogue state", a situation where we are already beyond the bounds of the system that produced ice ages and "interglacials" in between. This alone ought to be reason for great concern, and it has been through the 1990s where scientists have repeatedly called for dramatic reductions in emissions of carbon dioxide from human activities in the hope that CO2 levels can be reduced to within the historic ranges that provided relative stability to the earth's climate in the past and provided the conditions for the emergence of human civilization.

Second, is the recognition that it is not only the atmosphere that we have changed but other important natural systems too not least nitrogen and phosphorous cycles in the biosphere. The cumulative impact of these parallel disruptions of other material and energy cycles and maritime systems and terrestrial land uses suggests to the IGBP that the geological period known as the Holocene, the last 10,000 years since the most recent ice age, is now effectively over. They have coined the apt term the "Anthropocene" to denote the arrival of a new geological period where a dramatic new series of forces have been unloosed in the planetary biosphere changing the atmosphere as well as geomorphic processes and most natural cycles that involve a biomass of any substantial size. Literally we have entered a new geologic period in which humanity has become an agent in remaking some of the essential systems of the global biosphere.

Third, is the fact that these changes interact and cascade through the earth's natural systems in ways that are hard to predict precisely because so many things are changing at once and interacting in ways that are impossible to comprehensively grasp and model. But they do so in ways that are not likely to give either immediate or linear responses. Lagged effects due to inertia, and non-linear responses due to the crossing of crucial thresholds of relative stability, are likely results in complex interconnected systems. Given that science does not know where the critical thresholds of many of these systems may be, or whether we have in fact already crossed some of them, thinking hard about ways of reducing the overall impact of human disruptions has become a pressing necessity if the long term survival of human civilization is taken seriously.

and analyzed. Whether what will result will be international relations as currently practiced is highly doubtful, but prior to discussing such matters the question of the changing material context needs more detailed study.

The reality of the changing material context of our political framework suggests that the assumption of the environment as the backdrop or context for human history is no longer an appropriate way of thinking. There is no longer a stable "environment" that can be "secured". Neither is there a predictable environment that might be said to threaten humanity in precise ways. Humanity is actively, albeit inadvertently, changing the overall conditions of its existence. No longer can nature be seen as something external to human designs. In the language of astronomy and space exploration we are already "terraforming" the earth, changing the overall patterns of basic life systems in the process of remaking our specific contexts, not least to supposedly secure our modes of life. This terraforming changes the basic assumption of human-nature relations.

2.4 Environment, Security and State: A New Framework

Studies on conflict and environment still operate within the assumptions of neo-liberalism and neo-realism in international relations theory where states are the key entities. A neo-liberal stance in these studies often broadens the concern of a state from traditional military security to issues of economic development, health, environment and climate change. These studies also consider an wide array of actors such as international organizations, non-governmental organizations, businesses and transnational organizations. However, the main concern of such research remains focussed on the state and its economic and political development, separated from its physical environment. Shifting the focus to global environmental changes suggests that this separation of state and environment is not useful in understanding what is generally understood as 'security' and the relationship between institutions like the state

and the environment. Many environmentalists and environmental politics scholars have been arguing for some time that the trans-boundary "flows" of environmental politics have challenged the assumptions of sovereignty in many ways that require international cooperation on many themes. They argue that states may well be essential for administering agreements and enforcing laws, but innovation frequently comes from outside the structures of state bureaucracies and in spite of government planning. They assert that ecological processes are not constrained by state frontiers and environmental security is not just about state policies and initiatives. Scholars like Liftin, Wapner, Conca and Lipschutz point out that a sense of "greening" of sovereignty [24]is occurring making the importance of international cooperation evident. However, even these studies that tend to argue for diffusing boundaries of political institutions like the state often fall short of diffusing the boundaries between political and environmental.

One of the most critical points in thinking about states and international relations in the face of global environmental issues is the simple but compelling argument that states are precisely the agencies that, in the twentieth century, built the infrastructure that requires huge inputs of carbon fuels and other materials that disrupt biospheric systems. One of the most obvious facets of this is the active promotion by states of the automobile culture. Building highways and roads was part and parcel of state functions in most parts of the world in the twentieth century, a trend that shows few signs of abating with developing countries like India and China making huge investments in building road infrastructure. Just as states were active in facilitating the construction

[24]See Litfin [1998] for a comprehensive discussion on international environmental politics and the issue of sovereignty. In this edited book, Litfin, Wapner and Lipschutz and others argue that the concept of sovereignty has evolved over time from absolute control of the monarch to rule of the people and that it needs to continue to evolve to address the issue of environmental degradation. The scholars in this book argue that at one place sovereignty of states needs to dilute to to address environmental issues on a global scale, at the same time, sovereign authority in many countries needs to be strengthened to implement international environmental treaties at a domestic level. Therefore, according to the authors of this volume, the notion of sovereignty is a "moving target"–constantly changing and shifting–and it needs to do some more changing to deal with ecological issues.

of railways in the nineteenth century they built road networks, ports and airports in the twentieth producing an economic mode that is literally driving climate change. Environmental disruptions are frequently caused by economic activities supported by the state such as supplying resources to distant markets, insurgency in Bougainville is caused by demands for metals far from the remote provinces of Papua New Guinea; vegetable purchasing preferences on the part of supermarket company produce buyers at Heathrow airport near London drive the practices of Kenyan farmers. The enormous differences between states in terms of capabilities and development levels also belies simple assumptions about them as the most effective agent of change in many places. The fundamental inequities between North and South stand in the way of progress on many things, although the recognition of this difficulty is finding its way into both international negotiations and efforts to think intelligently about such things as "sustainability science".

Therefore understanding issues of environment and security suggests a more fundamental reorientation of thinking which no longer considers states–which operates outside environment–as a focus of our concern. The conventional political assumptions in state thinking, that environment is an external entity to be controlled, patrolled, surveyed, monitored, catalogued and administered is not new. Rather such environmental practices, what Tim Luke might call "environmentality" is a long-standing mode of rule that can be directly traced to colonial arrangements in many places over the last few centuries. [Luke [1997]] Tracing matters to the long term history of imperial ecological arrangements suggests once again the inadequacy of contemporary institutional arrangements for grappling with the scale and scope of contemporary environmental transformations. The modern state system is of recent origin; in many parts of the world it post-dates the emergence of the technological systems literally driving climate change. Assuming that this administrative framework is necessarily adequate because of the contemporary attribution of sovereignty

to states is an obvious response to environmental difficulties, but not one that reassures those who look to the long term political ecology of the planet. The processes in motion predate states in many places and in many ways call into question the basic functions of contemporary states that are so frequently better understood as development agencies. The infrastructure they provide is in many ways the source of contemporary ecological disruptions, hence the assumptions that these agencies are necessarily the solution is not one that can be taken for granted.

Acknowledging the above argument, this research aims to refocus the existing analysis of environment and conflict on the environment, instead of states and their political and economic concerns. We argue that instead of looking at environment and natural resources as external variable that affect the political stability, economy and human security in states, we need to look at how states and their political and economic actions affect the environment. Just as the industrial revolution, development of transportation or commerce are state driven activities that have affected the environment, for this study we focus on violent conflicts like international, ethnic and civil wars and how they affect environment in the short-term and in the long run. By reversing the causal arrow we concern ourselves with the security of the environment for environment's sake and not just the security of people removed from their environment. This study is the first step towards integrating political institutions like states with their material environment and to understand them as one interdependent system where one affects the other in tight feed-back mechanisms.

Chapter 3

The Theory and Concept of Conflict and Environment

As elaborated upon in the previous chapter, this study is arguing for reversing the causal arrow to study the relationship between violence perpetrated between and with-in states and the environment. This approach is a move towards blurring the line between the "political" and the environment. Political institutions like the state and political activities like war, and the environment should be analyzed as a complete system where all the entities are interdependent and affect each other. The approach presented here contradicts most of the existing models of looking at conflict and environmental issues where the environment is treated as an exogenous variable affecting human lives. The first step towards such analysis is to understand how conflict affects the environment, which is the focus of this project.

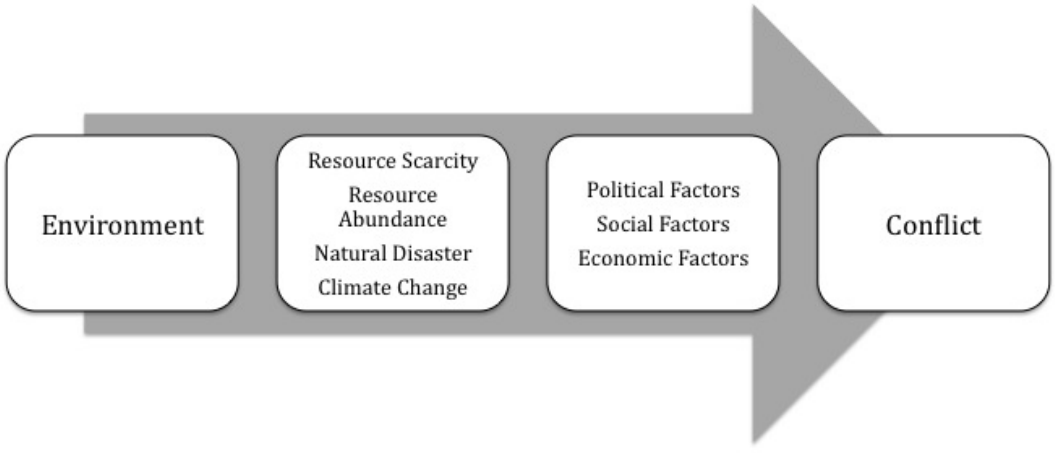

Figure 3.1: A Schematic Representation of How Environmental Conditions lead to Conflict

Figure 3.1 is a graphic representation of how most research on conflict and environment in the field of conflict studies or environmental politics has viewed the relationship between environment and conflict. The previous chapter outlined how studies have argued that both abundance of natural resources like oil, gemstones, minerals and scarcity of natural resources can lead to conflicts, by weakening the political and economic structures in a state. Similarly, climate change and natural disasters put pressure on political and economic apparatus of state which compromises human security and lead to conflict.

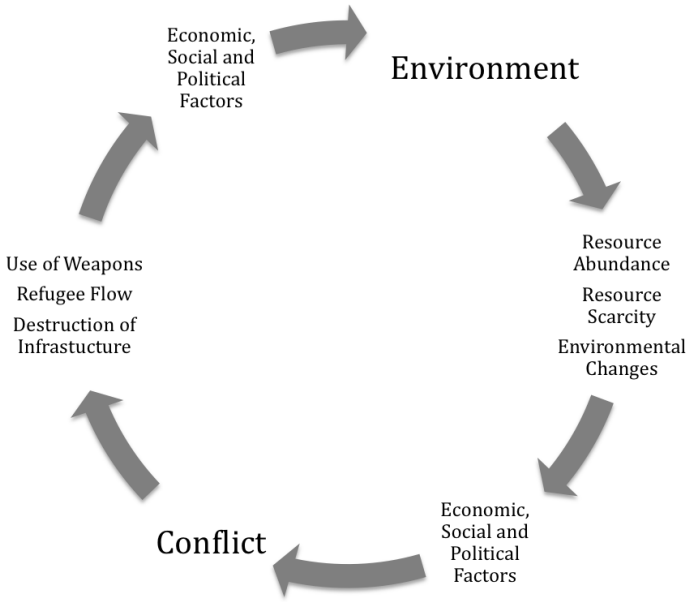

Figure 3.2: A Schematic Representation of the Feedback-Loop between Environment and Conflict

Figure 3.2 however, presents a different approach to looking at the relationship between environment and conflict where environment and conflict are both connected though complex feedback mechanisms mediated by social, political and economic factors. Such a view forces us to reconsider our focus on resource abundance or resource scarcity or natural disasters as causes of conflict and breach of security. These environmental factors are not a given but are rather created by social, economic and political factors. For example, who gets affected by natural disasters leading to

social tension is an outcome of active social, political and economic choices. Also, as mentioned in the previous chapter, many 'natural' disasters are a result of human actions, so to consider climate change and natural disasters as exogenous entities is a fallacy in such analyses. Similarly, our political and economic actions have determined where minerals are located–by creating political boundaries–and who has access to those resources. Our economic relations have also made certain "resources" more valuable than others, thereby creating notions of "abundance" and "scarcity".

In the conflict studies literature, most of the research on international and civil wars focuses on their causes or termination. The body of work on consequences of war is still very nascent, where most of the scholars are concentrating on economic and political consequences of war (Bayer and Rupert 2004; Blomberg and Hess 2002; Bodea and Elbadawi 2008; Collier 1999, 2009; Collier and Davies 2008; Elbadawi 2008; Flores and Nooruddin 2009; Koubi 2005; Pickering and Kisangani 2006). In recent years there has been some research on consequences of war on health and education. [See Lai and Thyne (2007), Iqbal (2006), Hoddie and Smith (2009)] Hence given the state of the field, looking at environmental consequences of war fills up a significant lacuna. Studying environmental consequences of war, within the field of conflict studies, serves a three fold purpose–firstly, it embodies a normative concern for the environment. This research hopes to illuminate yet another cost of violent conflicts that are borne not only by the present generation but by generations to come. Secondly, often during or after a conflict, fulfilling the immediate needs of the affected population comes at the expense of long term environmental damage. Also, unlike public health or economic development, which are immediate indicators of a population's well being and hence easily become issues of political concern, environmental concerns take a backseat. Gauging environmental consequences of a conflict is often a more complex process that takes considerable temporal commitment with slow results. For example the amount of depleted uranium released into the soil

in Kosovo as a result of NATO's carpet bombing of the region is still under assessment. Or saving a particular kind of plant species or a animal species usually features very low on the priority of the international community or the political leadership of a war ravaged country where people's lives are at stake. Lastly, by focusing on environmental degradation as a consequence of conflict, this study hopes to add to a whole body of literature analyzing environmental variables such as climate change and natural resources and their relationship to conflict (Gleditsch and Nordas 2007; Gleditsch 2001, 2007; Reuveny; Goldstone 2001; Barnett and Adger 2007; Deudney 1999; Homer-Dixon 1991; Volker 1999; de Soysa 2002a, 2002b; Renner 1996; Ross 2004) and to become a significant building block for any future research exploring a circular or spiraling relationship between conflict and environment. Several studies (Alao and Funmi 2002; Collier 1999, 2000; Collier and Hoeffler 1998; Deihl and Gleditsch 2002; Hauge, Wenche and Ellingson 1998, Renner; Homer-Dixon 19999, 2000) have begun to indicate towards a circular relationship between environmental degradation and political conflict, where environmental degradation feeds into causes of conflict through several political, socio-demographic and economic channels.

Most previous studies conducted on environmental damage caused due to violent conflicts–by individual researchers, environmental groups and international organizations–have focussed on specific regions or specific conflicts. This study presents an empirical study exploring the said relationship in a fairly comprehensive manner. The study analyses environment and conflict data on 186 countries from 1961 to 2005. The dependent variable in my statistical model–overall quality of the environment–is measured in terms of national *biocapacity*. I also estimate several other regression-based statistical models with four disaggregated components of *biocapacity*–forest land, grazing land, fishing ground and cropland. I measure the impact on environment based on the total number of conflicts a state is involved in and also the types of conflict–international, civil and ethnic–a state is embroiled in. We control for

population density, trade openness, refugee flow and economic growth in my model.

This chapter will outline how I conceptualize the relationship between conflict and environment with particularly focusing on the impact of conflict on the environment. I will also conceptualize and define a number of variables–Environment, Conflict, Democracy, Economic Growth, Trade Openness, Refugee Flow and Population Density–utilized for this study. Lastly I will talk about the data I have used to measure these variables to understand the impact of conflict on the environment.

3.1 Our Model of Environment and Conflict Relationship

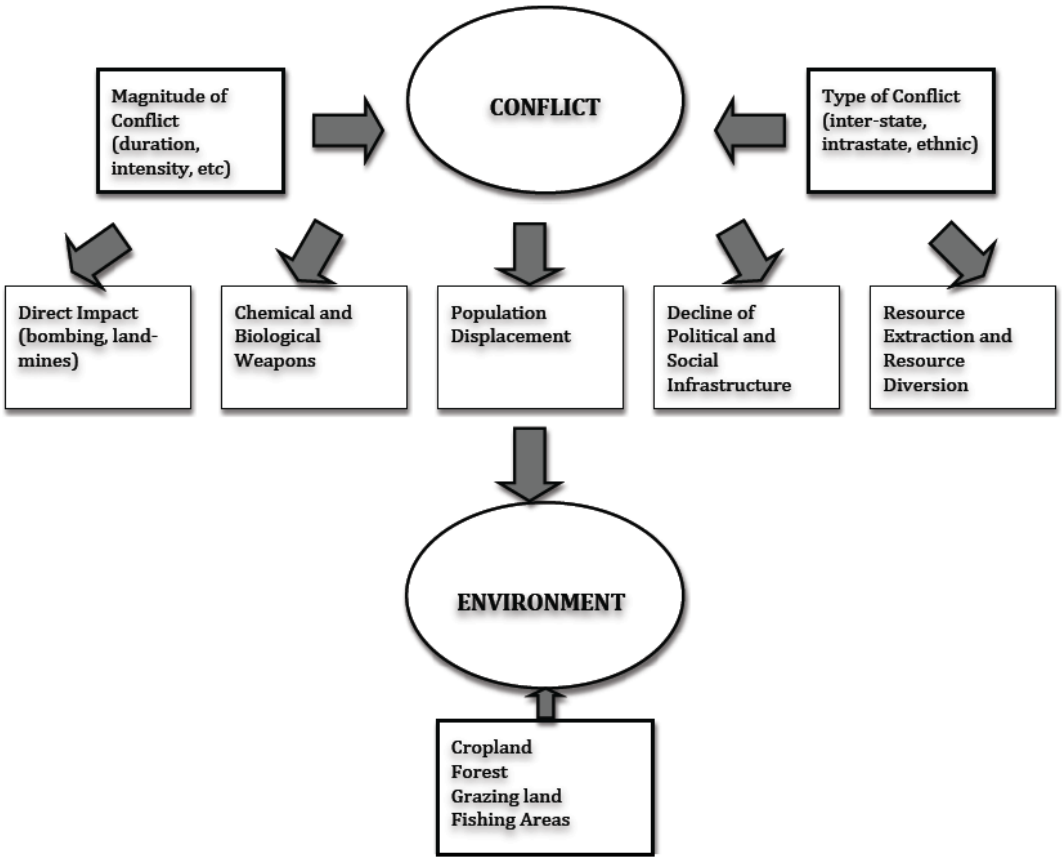

Figure 3.3: A Schematic Representation of How Conflict affects the Environment

Figure 3.3 represents my analysis of how conflict affects the environment. The

first step to understand this relationship is to classify conflicts on the basis of their intensity and type. Intuitively, more intense conflicts (as measured by their duration and number of deaths involved) will have a greater impact on the environment. Also, the type of conflict, whether it is international or confined within sovereign territorial boundaries can have an impact on its environmental aftermath. Similarly, whether the conflict is rooted in ethnic differences also affects its relationship with natural resources in terms of motivation and impact. These conflicts can have a very direct environmental impact during bombing, which can destroy the chemical composition of the soil or destroy environment related infrastructure like dams, oil refineries and so on. Chemical and biological weapons used during conflicts can also inflict immense damage to the environment by poisoning water bodies, altering soil composition or causing massive deforestation. The indirect impact of warfare on the environment are often harder to gauge. But wars cause longterm damage to the environment by destroying political and economic infrastructure to manage environmental resources and by breaking down traditional conservation practices. Environmental resources are also used to prolong conflicts and resources that could be used for environmental protection are often channeled towards the state's war machine. Another long-term and indirect impact of conflicts on environment occurs through populations displacement and refugee flows.

3.2 Modeling the Impact of Conflict on the Environment

As alluded to earlier, violent conflict may affect the environment and its capacity to regenerate through a host of means. This includes a direct impact on the environment due to bombing, land mines and other chemical wastes generated by weapons used in warfare. Violent conflicts can also lead to damage to the infrastructure of the society which is instrumental in preserving the environment. Other indirect effects of conflict on environment include refugee influx which puts pressure on the environ-

mental resources of the host nation, diversion of economic resources to warfare and environmental mutilation to fund the conflict. One important factor in analyzing the relationship between conflict and environmental degradation is the nature of political institutions that govern a state. According to Li and Reuveny (2006) democracy substantively reduces environmental destruction. Active democracies due to their institutional structures that allow free media and interest groups are better at raising public awareness towards environmental issues and encouraging environmental legislations. This section discusses my dependent variable and other control variables of interest in my model.

Conceptualization and Definition of Variables

Measuring Environment

Measuring the environment has been a controversial endeavor. Assigning a value or measure to all that our environment provides us is fraught with political, economic, and above all, moral dilemmas. The United Nation's Millennium Ecosystem Assessment (MA) report released in 2005 made an attempt to measure the Earth's natural environment in terms of "ecosystem services." This approach is certainly not devoid of controversy or criticism, but it is considered to be one of the most established ways to conceptualize and measure environment. The MA report defines ecosystem services as "benefits people obtain from ecosystems" and distinguishes four categories of ecosystem services. These four broad categories of ecosystem services include: *provisioning*, such as the production of food and water; *regulating*, such as the carbon sequestration and purification of air and water; *supporting*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational benefits. This study uses *national biocapacity* data to measure the overall quality of the environment in a country. The *national biocapacity* data has been developed by the Global Footprint Network as part of their study on National Footprint Accounts. Ewing et. al.

define *biocapacity* as the *"measure of the amount of biologically productive land and sea area available to provide the ecosystem services that humanity consumes"* (p.1). This implies that *biocapacity* data primarily captures the provisioning services of the ecosystem. To some extent, the data also captures regulating services by including carbon sequestration in its measurement of forestland biocapacity.

It is truly hard to put a value on cultural and supporting services of the ecosystem and there is very little consensus in the field of environmental economics or ecological sciences to put a price cultural and supportive significance of ecosystem. Therefore whenever this research refers to the "environment" or "environmental" I am refering to environmental productivity or or provisioning services of the ecosystem. *Biocapacity* may not a comprehensive measure of the overall environment, but it is one of the best available measure of *what can be measured for now* of the human interaction with the ecosystem in terms of overall environmental productivity.

Most previous studies (Reuveny 2006, Jorgenson et al. 2010) that have looked at the relationship between natural or environmental resources and violent conflicts, consider raw data on natural resources such as forest cover, timber, oil, carbon emissions and so on. These number also reflect the environment in terms of its provisioning services but they do not control for different eco-system types. If one is concerned about the impact of violent conflict on the overall environment (measured in terms of environmental productivity or the ecological provisional services) of a country, then it is useful to consider an aggregate and standardized measure of environment the environment such as the *biocapacity* data for useful analysis across countries and time-periods.

The calculations of biocapacity are based primarily on international data sets published by the Food and Agricultural Organization of the United Nations (FAO ResourceSTAT Statistical Database 2007), the International Energy Agency (IEA 2006), the UN Statistics Division (UN Commodity Trade Statistics Database – UN

Comtrade 2007), and the Intergovernmental Panel on Climate Change (IPCC 2006). Other data sources include studies in peer reviewed science journals and thematic collections. Of the 200 countries analyzed in the National Footprint Accounts, 150 had populations over one million and were covered consistently by the UN statistical system.

Calculation of biocapacity is based on the following fundamental assumptions:

- Environmental resources or Earth's resource supply can be quantified and environment can be measured in terms of biologically productive area depending on how much environmental resources it can generate.

- By weighing each area in proportion to its bioproductivity, different types of areas such as crop land, forests or fishing grounds, can be converted into the common unit of global hectares, hectares with world average productivity.

- Because a single global hectare represents a single use, and all global hectares in any single year represent the same amount of bioproductivity, they can be added up to obtain an aggregate indicator of a state's or global biocapacity.

Biocapacity "measures the ability of available terrestrial and aquatic areas to provide ecological services" (Ecological Footprint Atlas 2008, 7). Biocapacity is an aggregate measure of amount of land available, weighted by the productivity of the land. It represents the ability of the biosphere to produce crops, livestock (Pasture), timber products (forest), marine life, as well as to sequester waste such as CO_2. It also includes how much regenerative capacity is occupied by built-up land. National biocapacity is calculated by the following equation:

Biocapacity = Area X Yield Factor X Equivalence Factor

Where *Biocapacity* is the capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans, using current management

schemes and extraction technologies. Useful biological materials are defined as those used by the people's economic and social activities. Since wars and conflicts are human activities, their impact is factored into countries' biocapacity through direct and indirect means. *Area* refers to the total bioproductive land and water that supports significant photosynthetic activity and and accumulation of biomass. Bioproductive areas are differentiated as-Cropland, Grazing land, Forest Land, Fishing Ground and Built-up Land. *Yield Factor* accounts for differences between countries in productivity of a given land type. Each country and each year has different yield factors for different types of bioproductive areas. *Equivalence Factor* is a productivity-based scaling factor that converts a specific land type (such as cropland or forest) into a universal unit of biologically productive area, a *Global Hectare*. A Global Hectare is a productivity-weighted area used to report both the biocapacity of the Earth, and the demand on biocapacity (the Ecological Footprint). The global hectare is normalized to the area-weighted average productivity of biologically productive land and water in a given year. Because different land types have different productivity, a Global Hectare of, for example, cropland, would occupy a smaller physical area than the much less biologically productive pasture land, as more pasture would be needed to provide the same biocapacity as one hectare of cropland. For land types (e.g. cropland) with productivity higher than the average productivity of all biologically productive land and water area on Earth, the equivalence factor is greater than one. Thus, to convert an average hectare of cropland to global hectares, it is multiplied by the cropland equivalence factor of 2.64. In a given year, equivalence factors are the same for all countries.

A more detailed discussion on Environmental Footprint data and its merits as a measure of environment quality are offered in the following chapter.

Conflict

Perhaps the most brazen impact of an international conflict on the environment that the world has experienced was the American nuclear attack on Japan during the SecondWorld War. The sheer amount of heat and radioactive emissions caused due to a nuclear attack is enough to destroy the quality of land, air and water. Needless to say that this kind of a nuclear attack affects not only humans but also plants and wildlife. As a fallout of the attack, the effects could be spread even further, and might make the city (and an area of countryside stretching tens of kilometers downwind) uninhabitable for many weeks or even years. Apart from nuclear attack, even the production and testing of nuclear weapons leads to considerable environmental damage; several substances like plutonium, PCBs, uranium, cesium, mercury, that are released due to manufacturing and testing of nuclear weapons are carcinogenic and hazardous and they remain in the environment for thousands of years. Contaminants from nuclear weapons production and testing have often traveled far down wind and down stream. Many square miles in Russia, Belarus and the US have been rendered unusable by contamination of the soil due to production and testing of nuclear weapons. Conventional international wars also impose heavy damage on the environment by destroying forest cover as in the case of Vietnam War where nearly 20 per cent of the forest areas in South Vietnam were destroyed. Dense tropical forests were also converted into arid grass lands as a result of the war. Herbicides used during the course of war killed several species of wildlife and birds. (Dudley et al. 2002) The Iran-Iraq war in the 1980s saw desertification of many wetlands in the region.The UNEP reports that the extensive date palm forests along the Shatt al-Arab estuary were completely destroyed as a result of this war. Aside from the Iran-Iraq war, the Gulf War also saw destruction of numerous oil wells in the region causing significant damage to the atmosphere and a precious natural resource like oil. (UNEP Desk Study 2003) The Gulf War, even though short, also had a harsh

effect on terrestrial, marine and coastal ecosystems (Price and Robinson 1993; Dudley 2002, 322). Jorgensen et al. (2010) argue that even in the absence of armed conflict, military institutions and their activities consume vast amounts of nonrenewable and other resources for research and development, maintenance and development of overall infrastructure. At the same time, they generate large amounts of toxic waste, which contribute to the contamination of land and water.

Apart from the direct effects of international conflicts on environment there are other intervening factors that exacerbate environmental degradation after a war. Political instability or lack of political institutions often experienced as a result of conflict acts as an intervening variable between conflict and environmental deterioration. These factors perhaps hold more for politically fragile, developing countries where political institutions are weak and civil societies; virtually non existent. Wars result in the disruption of government services and functions, destruction of physical resources and infrastructure and depletion of human and economic capital (Gleditsch 1997). A break-down of political institutions leads to stagnation in natural resource and environmental management and often deterioration of resources. Lack of effective institutions to monitor environment also makes countries vulnerable to external exploitation where foreign firms and multinational countries often participate in "natural resource loot" by helping warring factions in return. Similar to international wars, civil wars also induce direct and indirect harm to the environment and wildlife. Military, paramilitary and guerilla groups involved in civil wars, unknowingly or knowingly exert a great deal of pressure on their own habitat. Such environmental destruction could be due to warring groups' greed or poverty. Civil wars (that have recently occurred in mostly poor countries of the world) often lead to resource extraction by the parties involved. Also, most countries enmeshed in civil conflicts do not have the required political and economic capital to undo or monitor the damage caused to the environment due to conflict.

Most military and guerilla forces involved in civil wars in poor, resource abundant countries tend to live off the land. They use the area's natural resources for food, housing and other material goods. Since these guerilla forces don't have the advantage of having a well organized supply line to furnish their daily needs, the fighters or soldiers have to often subsist partially or completely on animals and plants, available in areas or forests they operate from. These military and guerilla fighter often hunt large animals for food in war-zones and disputed territories and opportunistic, accidental and random shooting of animals by combatants in free fire zones may be a significant cause of mortality among wild life and stock populations (Dudley et al. 2002, 322; Martin and Szuter 1999, Plumpetre et al. 1997). Other kinds of direct damage to the environment are caused by guerrilla activities such as movement of vehicles for transportation across forested regions. This requires clearing up land to construct pathways for vehicle movements. Deforestation for such reasons has occurred in civil war ridden countries like Liberia, Angola, Mozambique and Sierra Leone (Collier 2002; Alao and Olonisakin 2002; Auty 2003).

To assess the presence and intensity of violent conflict, this study uses data from from "Major Episodes of Political Violence (MEVP) and Conflict Regions" created by Monty G. Marshall at the Center for Systemic Peace. Major episodes of political violence in this data set are defined by the systematic and sustained use of lethal violence by organized groups that result in at least 500 directly-related deaths over the course of the episode. Episodes are coded for time span and magnitude (on an 11 point scale: 0-10) and assigned to one of seven categories of armed conflict: international violence, international war, international independence war, civil violence, civil war, ethnic violence, and ethnic war. The next chapter will cover this measure of conflict in more details.

Democracy

From what we know of democracies and their nature it would not be erroneous to hope that democracies would do better at managing footprints of conflict. Democracies are known to be more responsive to the needs of the society, they allow free flow of information, they tend to be more law abiding. All of these structural and cultural characteristics within democracies should make them better at restoring environment after conflict.

According to Schultz and Crockett (1990) and Payne (1995), democracies ensure political rights and freedom of information that promote the cause of environmental interest groups in society. This not only raises public awareness but also encourages and enforces environmental legislation. Environmental groups, therefore, are often more successful at informing people and organizing them to act on environmental problems in a democracy than in an autocracy. An autocratic regime censors information flows, and its decision making is more autonomous than that of a democratic government.Environmental degradation may not be reported by the media to the people. In contrast,as democracy allows for free media, environmental problems are more likely to be reported in the news. People in a democracy, therefore, are more likely to be informed about the environment and have the ability to influence decision making to check environmental degradation.

Closely tied to the above argument of information flow, Kotov and Nikitina (1995) argue that Democracies are more responsive to the environmental needs of the public than are autocracies. This argument works through electoral accountability and the ability of groups to mobilize socially, achieve political representation, and influence public policy making. Democracies hold regular and free elections, which can bring to power new parties, including those friendly to the environment (e.g., the Green Party in Germany). In an autocracy, the distribution of political power is concentrated, reducing the likelihood that environmentalists will come to power. Thus, environ-

mentalists stand a greater chance of affecting policy making in a democracy than they do in an autocracy. Weiss and Jacobsen (1999) argue that democracies are also more likely to comply with environmental agreements at domestic and international levels because they respect the rule of law. Moreover the costs of environmental regulation and legislation are borne better by democracies than autocracies (Congleton 1992) because in autocracies, ruling elites hold a much larger share of national income than most people in democracies. Since environmental regulations impose a cost on production and consumption, a small group of ruling elite in an autocracy may be unwilling to bear the burden of that cost. On the other hand, the cost of implementing more environmental friendly technologies is better distributed in a democracy.

Having said that, on average democracies tend to have higher overall environmental footprint. This is because democracies are generally wealthier and enjoy a steady economic growth. This leads to more utilization of natural resources, negatively affecting a nation's biocapacity. However, economists like Bhagwati (2002) have argued in favor of the environmental Kuznet's Curve where greater economic growth and environmental footprint share a curvilinear relationship because economic growth initially leads to environmental exploitation but eventually that economic prosperity also enables wealthy countries to develop environment friendly and sustainable technologies. This process eventually leads to economic growth that is environmentally sustainable.

To measure the level of democracy or nature of the political regime in a country, I use the POLITY IV scores. These scores range from -10 to 10, with higher scores denoting higher levels of democracy.Thus, a state with a score of 10 is considered completely democratic, and one with a score of -10 is an autocracy. Apart from using POLITY scores as is, for this study, I have also categorized countries with a score of -7 or lower as 'Non-Democracies', -6 to 6 as 'Mixed Regimes', and 7 or higher as 'Democracies'. This is because it is difficult to differentiate between for example, a

level 6 and a level 7 democracy so using a broad categories for measuring political regime might help us establish a stronger connection between polity and environment.

Economic Growth and Trade

A large literature argues that economic growth has competing effects on environmental quality. A larger economy generates more output and, therefore, more pollution and waste. Some types of technological progress, which are associated with growth, also may damage the environment (e.g., greenhouse gases). The effect is typically referred to as the scale effect. As income per capita rises above some threshold, the importance of environmental quality for people is said to rise, and they begin to use cleaner production techniques and fewer natural resources, thereby increasing investment in environmental regulation. This behavior is referred to as the income effect. The combined operation of the scale and income effects is often said to generate an inverted U figure when environmental degradation is plotted against income per capita.

The inverted U shape is known in environmental economics and environmental politics as the environmental Kuznet's curve (EKC). Its empirical existence, as mentioned earlier, is hotly debated. Relevant to my analysis, one may also frame the Kuznet's curve debate in terms of whether this is an economic effect (environmental quality as a luxury good that is affordable at higher per capita incomes) or a political effect (the emerging middle class as a byproduct of industrialization asserting itself politically on issues of air and water quality).

Even though the, existence of the Kuznet's curve is debated, most studies allow for it in statistical models by including income per capita and its squared term. If the environmental Kuznets curve exists, the coefficient of income per capita will be positive, the coefficient of income per capita squared will be negative, and the coefficient of income per capita will be larger than the absolute value of the coefficient

of income per capita squared. I measure economic growth in terms of Gross domestic product (GDP) per capita. I use GDP data from the World Development Indicators (2008) (purchasing power parity (PPP) adjusted, constant 2000 international dollars).

The trade and environment literature argues that trade can affect the environment in two broadly defined ways. In one way, the pattern of domestic production and consumption, and the methods of production, change under trade openness as countries follow their comparative advantages and/or adopt certain more efficient, cleaner or not, technologies to produce for other countries. For example, a country that trades environmentally clean goods will see its environmental quality rise, and vice versa. This channel also involves changes to environmental regulation, as some international trade treaties countries sign may require regulatory changes at home. In addition, trade may also affect the environment by promoting economic growth, and hence, altering people's behaviors over time. While the combined empirical effect of trade on the environment is debated, it needs to be included in the model. My research uses a popular measure of the importance of trade openness to a national economy, which is the sum of national exports and imports divided by GDP, from the Penn World Table 6.1.

Refugee Population

One of the important social outcomes of a civil conflict is displaced population and cross-national refugees. Wars and civil strife in many parts of Africa have led to dispersion of refugees in various remote areas that lie along national boundaries. Prunier (1995) discusses the Rwandan civil war where nearly 50 percent of the civilian population fled out of the country to escape the atrocities of the incumbent junta. A massive number of these people (about 3.5 million)settled within the eastern regions of the Republic of Congo. Of these, approximately 860,000 refugees were concentrated in the vicinity of Virunga National Park, with another 332,000 camped in the

Democratic Republic of Congo near Kahuzi Biega National Park. Such large refugee camps often lead to severe destruction of the nearby environment. In order to prepare food, refugee populations have to resort to slash-and burn agriculture and over harvesting of vegetation for fuel, forage, and construction materials that may result in widespread deforestation and erosion. Such desperate times also prompt refugees to fight with the local population for maintenance of livestock and crops. The refugee populations under these circumstances often have to resort to eating bushmeat and wild food plants for their survival (Plumptre et al. 1997) as breakdowns in food production and looting of livestock by transients may result in the indiscriminate slaughter of wildlife for food and marketable byproducts such as meat, horn, hides, and ivory. (Dudley et al. 2002 p. 469) This hints at the environmental impact of population displacement caused due to international and civil wars. To analyze the environmental impact of population displacement I use refugee data by the country of asylum from World Bank's World Development Index. I would ideally also like to use Internally displaced people (IDPs) for this study) but unfortunately due to data limitations I have to restrict myself to only looking at international refugees by "host" countries.

Population Density

The effect of population density on environmental degradation can have competing effects. A rise in population density is normally expected to put more demand on the biocapacity, as a larger population consumes and produces more. A greater population implies more pressure to use agricultural land for food and industry and, therefore, more land degradation. But on the other hand, many densely populated nations tend to be more urbanized and depend less on the environment for livelihood (e.g., consider West European countries such as the Netherlands or Belgium). As such, they may clear fewer forests. Data on population density are from the World

Development Indicators (2008). World Bank defines population of a country as- "mid-year population, based, in most cases, on a de facto definition, which counts all residents regardless of legal status or citizenship." (WDI, 2008). It is also important to note that refugees not permanently settled in the country of asylum are generally considered to be part of the population of their country of origin. Population density, is calculated by the World Bank as the midyear population divided by land area in square kilometers.

3.3 Conclusion

It is crucial to study the environmental impact of conflicts. This analysis is important because it forms the first step towards looking at a more complete picture of the conflict environment relationship where environment is not removed from conflict and both are related to each other through complex feedback mechanisms. Secondly, the literature on consequences of conflict has not addressed the environmental impact of wars sufficiently, therefore this study illuminates another cost of conflict not only for the purposes of human well being but for the sake of the overall environment. The study attempts to put forth a more accurate measure of environment–*environmental biocapacity*–to measure the environmental impact of violent conflicts. The extent of this impact is also related to the intensity and type of conflicts and several economic, social and political factors like economic development, political regime, refugee flow and population density. In the next chapter I examine the effect of conflict on a country's environmental biocapacity in the long run and short-term, considering the relevant economic, social and political factors.

Chapter 4

Conflict and Environmental Impact

In the previous chapter, I outlined some important elements of the relationship between conflict and environment and the ways in which wars-both international and civil, can lead to exploitation and decline of environment. In this chapter, I examine the effect of militarized conflict on the environment of the countries by evaluating the relationship between war and environment, taking into account relevant economic and political factors, including democracy and wealth.

I test the following hypothesis:

H1. The overall environment will decline if a state is involved in conflict and the intensity and number of conflicts of conflict is positively related to the environmental decline.

H2. The decline in overall environment is likely to be greater in the short term after the war but continues in the long run.

H3. States with higher levels of wealth and economic openness experience a decline in their environment but this effect could be reversed as levels of wealth go higher.

H4. Higher levels of democracy in a state are associated with better environment.

H5. The impact of conflict on environment is higher in states with larger population densities.

I argue that interstate and intrastate conflicts influence the environment negatively. I assess the magnitude of this relationship by analyzing data on composite measure of environment for 200 states between 1961 to 2005 in the light of relevant political factors, including wealth, trade and regime type. Involvement in violent conflict lowers the overall quality and capacity of the environment, especially in countries without established democratic institutions and with lower levels of income; there is a decline in the overall environment in the short-term and the long run. The findings suggest that the negative effect of war on environment is closely linked to the levels of income, trade and democracy.

4.1 Measuring Environmental Capacity

Biocapacity refers to the amount of biologically productive land and water areas available within the boundaries of a given country. Global Footprints Networks calculates Biocapacity for five major land types: cropland, grazing land (which also includes other wooded land), fishing grounds (marine and inland waters), forest, and built-up land (infrastructure and hydro). The National Footprints Account (NFA) includes built-up land biocapacity because though built-up land does not generate resources, buildings and infrastructure do occupy the biocapacity of the land they cover. However, for the purposes of this study we will use data for overall biocapacity of countries and disaggregated biocapacity data for cropland, grazing land, fishing grounds, and forest.

As mentioned in the previous chapter, most studies on conflict and environment or natural resources in past have used raw environment data, which can be problematic if one is looking at various countries in different ecological zones with different ecological capacity across time. There are at least three distinct advantages of using data on biocapacity over using raw data on natural resources–first, biocapacity is a more comprehensive measure of the interaction of anthropological activities and ecological

environment than raw natural resource data. Second, biocapacity data, measured in Global Hectares (using Yield Factors), normalizes the bioproductivity of different countries across different years. This makes it possible to compare two or more countries that lie in different ecological zones and experience different environmental vulnerabilities, with each other and across time. Third, this data creates a common standard for measuring different bioproductive areas by using Equivalence Factors. Therefore it becomes becomes possible to compare how different bioproductive areas such as cropland or fishing land get affected by conflict. The national biocapacity data used in this study come from National Footprint Accounts (2008) that calculate ecological footprint and biocapacity of 186 countries, from 1961 to 2005. This study also uses disaggregated biocpacity data, for the same period of time and number of countries, on four different types of bioproductive areas–Cropland, Grazing land, Forest for timber and fuelwood and Fishing grounds. As mentioned in previous chapter, biocapacity (BC) of a country for any land use type is measured by:

$$\mathrm{BC} \quad = \quad \mathrm{A} * \mathrm{YF} * \mathrm{EQF} \tag{4.1}$$

where A is the area available for a given land use type and YF and EQF are the yield factor and equivalence factor, respectively, for the country, year, and land use type in question.

Normalizing Biocapacity–From Hectares to Global Hectares

Average bioproductivity differs between various land use types, as well as between countries for any given land use type. For comparability across countries and land use types, Ecological Footprint and biocapacity are usually expressed in units of world-average bioproductive area. Expressing Footprints in worldaverage hectares also facilitates tracking the embodied bioproductivity in international trade flows, as gha measure the ecological productivity required to maintain a given flow. Global

hectares provide more information than simply weight - which does not capture the extent of land and sea area used - or physical area - which does not capture how much ecological production is associated with that land. Yield factors and equivalence factors are the two coefficients needed to express results in terms of global hectares (Monfreda et al., 2004; Galli et al., 2007), thus providing comparability between various countriesÕ Ecological Footprint as well as biocapacity values.

Yield Factor

Yield factors account for countries' differing levels of productivity for particular land use types. For example, the average hectare of pasture in New Zealand produces more grass than a world average hectare of pasture land. Thus, in terms of productivity, one hectare of grassland in New Zealand is equivalent to more than one world average grazing land hectare; it is potentially capable of supporting more meat production. Table 4.1 shows the yield factors calculated for several countries in the 2010 Edition of Global Footprint Network's National Footprint Accounts. Yield factors are country-specific and vary by land use type and year. They may reflect natural factors such as differences in precipitation or soil quality, as well as anthropogenic induced differences such as management practices. The yield factor is the ratio of national average to world average yields. It is calculated in terms of the annual availability of usable products. For any land use type L, a country's yield factor YF_L, is given by:

$$YF_L = \frac{\sum_{i \epsilon U} A_{W,i}}{\sum_{i \epsilon U} A_{N,i}} \tag{4.2}$$

where U is the set of all usable primary products that a given land use type yields, and $A_{W,i}$ and $A_{N,i}$ are the areas necessary to furnish that country's annually available amount of product i at world and national yields, respectively. These areas are calculated as:

$$A_{N,i} = \frac{P_i}{Y_N} \quad and \quad A_{W,i} = \frac{P_i}{Y_W} \tag{4.3}$$

where P_i is the total national annual growth of product i and Y_N and Y_W are national and world yields, respectively. Thus $A_{N,i}$ is always the area that produces i within a given country, while $A_{W,i}$ gives the equivalent area of world-average land yielding i. With the exception of cropland, all other land use types included in the National Footprint Accounts provide only a single primary product, such as wood from forest land or grass from grazing land. For these land use types, the equation for the yield factor simplifies to:

$$YF_L = \frac{Y_N}{Y_W} \tag{4.4}$$

Due to the difficulty of assigning a yield to built-up land, the yield factor for this land use type is assumed to be the same as that for cropland (in other words urban areas are assumed to be built on or near productive agricultural lands). For lack of detailed global datasets, areas inundated by hydroelectric reservoirs are presumed to have previously had world average productivity. The yield factor for carbon uptake land is assumed to be the same as that for forest land, due to limited data availability regarding the carbon uptake of other land use types. All inland waters are assigned yield factors of one, due to the lack of a comprehensive global dataset on freshwater ecosystem productivities.

Equivalence Factor

In order to combine the Ecological Footprints or biocapacities of different land use types, a second coefficient is necessary. Equivalence factors convert the areas of different land use types, at their respective world average productivities, into their equivalent areas at global average bioproductivity across all land use types. Equivalence factors vary by land use type as well as by year. The rationale behind Equivalence

Table 4.1: Sample Yield Factors for Selected Countries (2008)

Yield	Cropland	Forest	Grazing Land	Fishing Grounds
World Average	1.0	1.0	1.0	1.0
Algeria	0.3	0.4	0.7	0.9
Germany	2.2	4.1	2.2	3.0
Hungary	1.1	2.6	1.9	0.0
Japan	1.3	1.4	2.2	0.8
Jordan	1.1	1.5	0.4	0.7
New Zealand	0.7	2.0	2.5	1.0
Zambia	0.2	0.2	1.5	0.0

Source: National Footprints Accounts (2008)

factors' calculation is to weight different land areas in terms of their capacity to produce resources useful for humans. The weighting criterion is therefore not just the quantity of biomass produced, but also the quality of such biomass, meaning how valuable this biomass is for humans. Net Primary Production (NPP) values have been suggested for use in scaling land type productivity (Venetoulis and Talberth, 2008); however this would not allow incorporating the "quality" criterion in the scaling procedure. Usable NPP data could theoretically be used as weighting factors as they would allow to track both the quantity and quality of biomass produced by land use types (Kitzes et al., 2009); however usable-NPP data availability and their use in calculating equivalence factors has not been tested yet by Global Footprint Network. As such, equivalence factors are currently calculated using suitability indexes from the Global Agro-Ecological Zones model combined with data on the actual areas of cropland, forest land, and grazing land area from FAOSTAT (FAO and IIASA Global Agro- Ecological Zones 2000 FAO ResourceSTAT Statistical Database 2007). The GAEZ model divides all land globally into five categories, based on calculated potential crop productivity. All land is assigned a quantitative suitability index from among the following:

- Very Suitable (VS) – 0.9

- Suitable (S) – 0.7
- Moderately Suitable (MS) – 0.5
- Marginally Suitable (mS) – 0.3
- Not Suitable (NS) – 0.1

The calculation of the equivalence factors assumes that within each country the most suitable land available will be planted to cropland, after which the most suitable remaining land will be under forest land, and the least suitable land will be devoted to grazing land. The equivalence factors are calculated as the ratio of the world average suitability index for a given land use type to the average suitability index for all land use types. Figure 4.1 shows a schematic representation of this calculation.

For the same reasons detailed above, the equivalence factor for built-up land is set equal to that for cropland, while that of carbon uptake land is set equal to that of forest land. The equivalence factor for hydroelectric reservoir area is set equal to one, reflecting the assumption that hydroelectric reservoirs flood world average land. The equivalence factor for marine area is calculated such that a single global hectare of pasture will produce an amount of calories of beef equal to the amount of calories of salmon that can be produced by a single global hectare of marine area. The equivalence factor for inland water is set equal to the equivalence factor for marine area. Table 4.2 shows the equivalence factors for the land use types in the 2010 National Footprint Accounts, data year 2007. According to the table, croplandÕs equivalence factor of 2.51 indicates that world-average cropland productivity was more than double the average productivity for all land combined. This same year, grazing land had an equivalence factor of 0.46, showing that grazing land was, on average, 46 percent as productive as the world-average bioproductive hectare.

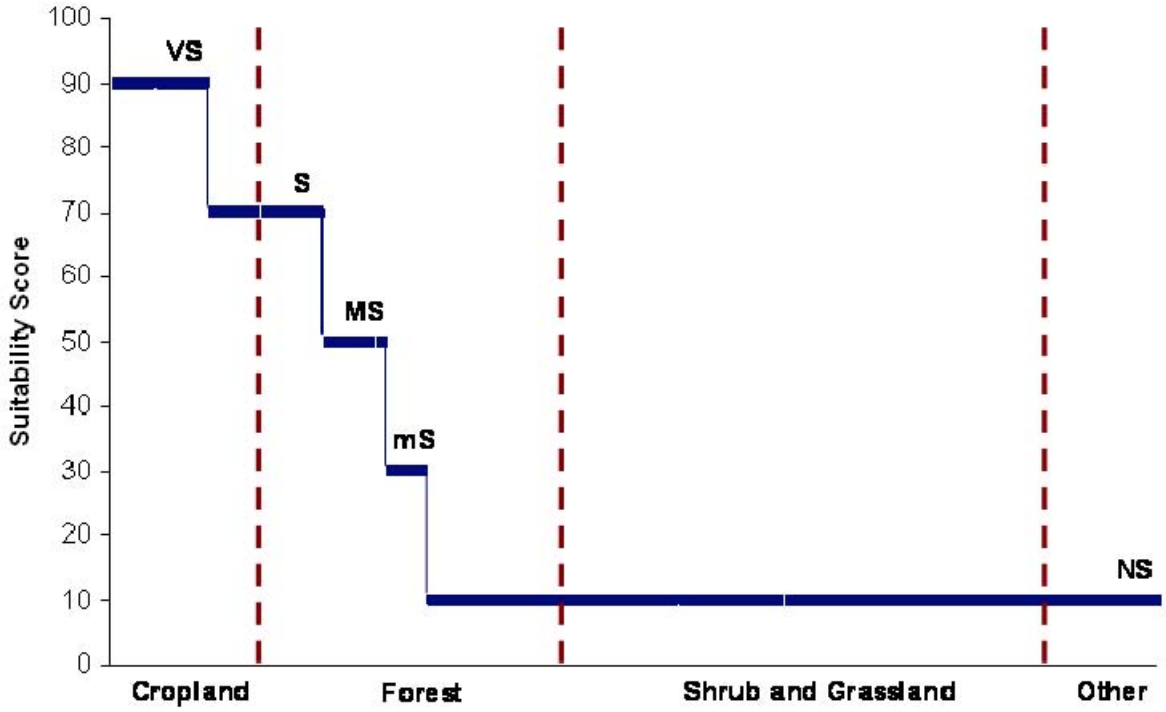

Figure 4.1: Schematic Representation of Equivalence Factor Calculations

Note: The total number of bioproductive land hectares is shown by the length of the horizontal axis. Vertical dashed lines divide this total land area into the three terrestrial land use types for which equivalence factors are calculated (cropland, forest, and grazing land). The length of each horizontal bar in the graph shows the total amount of land available with each suitability index. The vertical location of each bar reflects the suitability score for that suitability index, between 10 and 90.

4.2 Measuring Conflict

To measure conflict, this study uses "Major Episodes of Political Violence" (MEVP) Data, 1946-2008 created by Center for Systemic Peace (CSP). CSP defines major episodes of political violence as systematic and sustained use of lethal violence by organized groups that result in at least 500 directly-related deaths over the course of the episode. Episodes are coded for time span and magnitude and assigned to one of seven categories of armed conflict: international violence (IV), international war (IW), international independence war (IN), civil violence (CV), civil war (CW), ethnic violence (EV), and ethnic war (EW). Each episode is designated to span a

Table 4.2: Equivalence Factors (2007)

Area Type	Equivalence Factor (Global Hectares per Hectare)
Cropland	2.51
Forest	1.26
Grazing Land	0.46
Marine and Inland Water	0.37
Build-Up Land	2.51

Source: National Footrprints Accounts (2008)

certain number of years ("inclusive years") and judged to have been of a certain, general "magnitude of societal-systemic impact" (an eleven-point scale, 0-10; magnitude scores are considered consistent and comparable across categories and cases, that is, approximating a ratio scale). The episode's "magnitude of impact" score is entered for each year of the designated time span and for each country considered to have been directly affected by the warfare experience. Countries that engage in military intervention in an episode taking place solely in another country are generally not considered to be "directly affected" by the violence. When more than one episode of a particular MEPV category occurs in a single country in a single year, the episode scores are summed and the sum is entered for that category variable in the data set. For analyzing the impact of international and domestic violence on the environmental *biocapacity*, I have combined all the intrastate episodes (IV and IW) in "INTOT" variable and all the interstate episodes (CV and CW) are in "CIVTOT" variable. I also analyze the impact of ethnic conflicts on the environment by combining all the episodes of ethnic conflicts (EV and EW), which are a subcategory on intrastate conflicts.

4.3 Analysis and Results

The fact that these data comprise repeated observations on a large number of cross-sectional units raises the specter of both temporal correlation and non-constant error

variance. To address these issues, I adopt the method of generalized estimating equations (GEE) (Liang and Zeger 1986, Zorn 2001). This approach has been shown to provide consistent and asymptotically efficient estimates of the parameters of interest. In particular, I estimate a GEE model with a first-order autoregressive temporal covariance structure. All independent variables have been lagged to take into account the delayed effect of the levels of covariates on biocapacity and its disaggregated indicators. As levels of factors such as GDP and democracy increase or decrease for a given country, their effects on the overall biocapacity and its components is assumed to take some time to materialize. Lagged independent variables capture temporal effects and, therefore, more adequately reflect the relationship between the covariates and the dependent variable.

Another design issue concerns the possibility of endogeneity for the right hand side variables. My empirical framework treats conflict, democracy, GDP per capita, trade and population density as exogenous variables. One might argue that environmental degradation can affect these variables. As mentioned earlier in this paper, scholars have argued that environmental degradation can lead to conflict or that loss of cropland may affect the agricultural exports of a country. Therefore, lagging the right hand side variables also mitigates the potential risk of simultaneity in this study. I have also addressed the issue of multicollinearity among the exogenous variables by running a variance inflation factor (VIF) diagnostic on the data. All the dependent variables and the exogenous variables–GDP per capita, trade, refugee population and population density have been logged due to diminishing marginal returns.

Two data related issues that often persist in conflict data sets are of missing data and too many null data points (because conflicts after all are rarer than no conflicts). Since this is a monadic data on conflict, too many null data points is not an issue. However, it is important to consider any systematically missing data on the environment due to conflict. This is especially important because conflict can prevent

international or domestic institutions from gathering data. International or domestic agencies are unable to send employees or volunteers into conflict zone to gather data or collect samples and so on due to lack of safety and infrastructure. The National Footprint Accounts methodology uses extensive measures to deal with missing data and other data related inconsistencies. The data cleaning algorithm used by NFA excludes data points that are beyond a fixed distance from the median value of the reference time series data. The fixed distance is a user-defined multiple of the median value of the time series in question. To replace the removed outliers and/or to fill in data gaps for non-endpoints, the algorithm interpolates the average value of the two neighboring points. To replace endpoints (outliers or missing data), the algorithm extrapolates values based on the Akaike Information Criterion. [Akaike (1978)] The data clean-ing algorithm was implemented on the following trade datasets used in the NFA 2011 Edition: the COMTRADE dataset, the FishSTAT Commodity dataset, and the TRADESTAT dataset from FAOSTAT.

I estimate two models to test my hypotheses. The first model measures the effect of the independent variables on the overall level of environmental capacity as expressed by national biocapacity for a given year ($Y_{it} = X_{it}\beta + \mu_{it}$). The second model employs the change in environmental capacity, taking the difference between the national biocapacity for the current year and the previous year ($\Delta Y_{it} = \Delta X_{it}\beta + \epsilon_{it}$). This model assess the immediate short-term effect of conflict on environmental capacity. The effect on biocapacity in the first model is a better indicator of how the state would maintain its environment and environment related infrastructure in the long run after the conflict; the change in environmental capacity due to conflict indicates the direct effect of conflict in the year following the violence. For each model, I present separate results for different type of conflicts-intrastate, interstate and ethnic.

Long-Term Effects

Table 4.3 presents the summary statistics for the model estimating the long-term impact. Table 4.4 presents the long-term effects of conflict and other covariates on environmental capacity. In the first model I find that the overall environmental capacity of a country declines as the magnitude of conflict it is involved in increases. This finding, illustrated in Figure 4.2, reveals that each unit of increase in the magnitude of conflict in a country, leads to a loss of biocapacity for that country on an average. This is consistent with our earlier discussion about the impact of violence on environmental capacity of a country through direct impact and other factors like destruction of infrastructure, generation of refugee flows, and diversion of resources away from environment related spending. These factors hinder the ability of a state to protect and conserve its environmental capacity and also skew its priorities in the aftermath of war towards economic development, providing health care facilities and so on away from long-term environmental concerns.

Table 4.3: Summary statistics: Long-term Effects

Variable	Mean	Std. Dev.	Min.	Max.
Dependent Variable				
log(Total Biocapacity)	7.06	0.992	2.904	9.273
Independent Variables				
Lagged POLITY score	-0.09	7.517	-10	10
Lagged log(Per Capita GDP)	3.266	0.683	1.794	4.8
Lagged log(Trade Openness)	1.768	0.312	0.036	2.794
Lagged log(Population Density)	1.606	0.709	-1.006	3.814
Lagged log(Refugee Population)	3.79	1.322	0	6.644
Lagged log(Per Capita GDP squared)	11.135	4.547	3.219	23.041
Lagged POLITY score squared	56.506	31.624	0	100
Lagged Total Conflict	0.576	1.66	0	14
Lagged International Wars	0.084	0.588	0	11
Lagged Civil Wars	0.491	1.455	0	11
Lagged Ethnic Wars	0.213	0.945	0	10

Note: N=8800

The level of democracy has a significantly negative impact on the long-term en-

vironmental capacity of a country which seems to indicate that as countries become more democratic their environmental capacity declines. But considering the coefficient of the squared POLITY score, which is negative and significant, we can deduce a curvilinear relationship between levels of democracy and biocapacity. Which means that countries with low democracy scores and countries with high democracy scores both have higher environmental capacity. For countries with high levels of democracy, one could contend that an active civil society and a responsive government ensure protection and conservation of biocapacity of that country.

One could also argue that countries with high levels of democracy often tend to be advanced, industrialized economies that can afford to spend on environment friendly technology. On the other hand countries with very low democracy scores perhaps experience a very strict and controlled use of their environmental resources. Alternatively countries with low democratic scores are also likely to be "underdeveloped" economies where their environmental capacity has not been tapped yet.

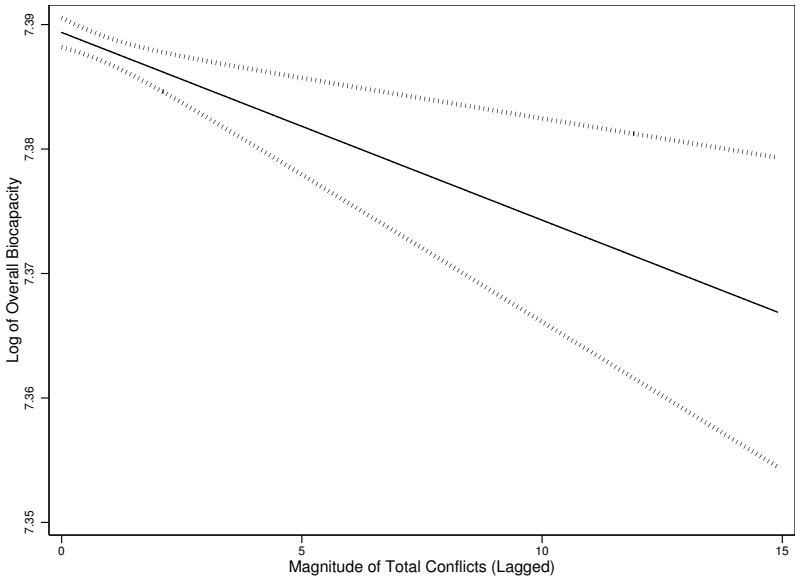

Figure 4.2: The Effect of Conflict on the Overall National Biocapacity

Levels of democracy in a country also becomes crucial in the wake of conflict

and its environmental impact. My findings suggest that as the magnitude of conflict increases, the role of democracy and democratic institutions increase in rebuilding biocapacity. Figure 4.3 presents the effect of conflicts on environmental capacity by democracy scores. The dashed line represents the effect of conflict in countries with high democracy scores (7 or higher) and solid line represents the impact of conflict on biocapacity in countries with low democracy scores.

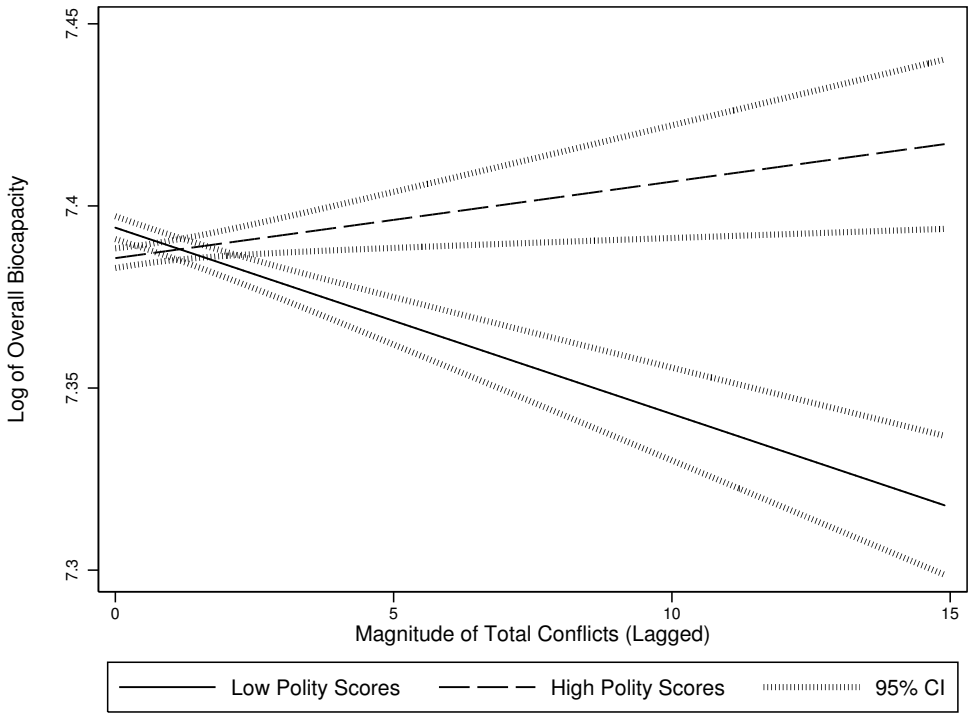

Figure 4.3: The Effect of Conflict on the Overall Biocapacity by Democracy Scores

The results indicate that countries with low levels of democracy lose biocapacity as the magnitude of wars increases as opposed to highly democratic countries that seem to be doing fine in terms of environmental capacity in the long run. Weak democracies or autocracies supposedly have weak institutions and infrastructure to look after the environment, moreover a non-democratic regime is not likely to be very responsive towards the general population who become the victims of environmental

degradation. Therefore, weak democracies/non-democracies have neither the will nor the resources to rebuild and conserve the environment after conflict. On the other hand strong democracies tend to be better at responding to the needs of the electorate which includes looking after the environment after war time. Strong democracies also have better institutional infrastructure and civil society organization to deal with post-conflict environmental reconstruction. Therefore in the long-run, stronger democracies tend to do better at rebuilding and conserving environment that non-democracies. Having said that, such argument may not hold true for international conflicts where strong democracies have "outsourced" most of their wars in the last fifty years. Which means that strong democracies do not experience the impact of conflict on their own territory to have any direct or indirect long-term effect on their environmental capacity. This argument brings forth the idea of ecological justice or injustice where the same conflict has an uneven impact on different countries involved depending on their economic and political status in the international system.

Economic growth has a significantly positive impact on long-term environmental capacity of a country. Moreover, there is an evidence of a curvilinear relationship between GDP and biocapacity. This implies that as a country's GDP increases its biocapacity increases, presumably by employing more environmentally efficient technology and investing more money to environment related research and development. But this increasing effect decreases as the GDP continues to grow because even though we can slow down the degree of environmental degradation due to environmental growth by employing more efficient technology, it does take its toll on a country's biocapacity.

Trade openness has a significant negative impact on environmental capacity, hinting towards the environmentally exploitative nature of globalization. My model suggests that population density has a positive impact on environmental capacity, which seems a little counter intuitive since population pressure is often linked to environmen-

tal degradation. However, scholars have also suggested that high population density could also hint at urbanization and perhaps more efficient use of environmental resources. Presence of refugee population also has a negative impact on a country's biocapacity in the long run which is in line with our earlier discussion about "living off the land" consequences of displaced populations.

When comparing different types of conflicts–international, civil and ethnic–my findings suggest that on an average, international and ethnic conflicts are more devastating for the environment than civil conflicts. However all three type of conflicts do perpetrate a significant amount of damage to the environment in the long run. Level of democracy becomes critical for countries facing all the three types of conflict in managing environmental capacity in the long run. Refugee population has a negative impact on environment in countries facing civil wars and ethnic wars.

Short-Term Effects

The second model assesses the short-term relationship between the explanatory factors and environmental degradation by looking at changes in national biocapacity and independent variables. The changes in biocapacity is calculated by taking the difference in the values of national biocapacity for the current and the previous year ($\Delta Biocapacity = Biocapacity_{it} - Biocapacity_{(it-1)}$). Similar calculations are made on covariates to measure yearly changes. As in the previous model, which assesses the overall levels of biocapacity, The conflict variable is disaggregated along type– International, Civil and Ethnic. Summary statistics for this model are presented in Table 4.5. The results for this model are shown in Table 4.6 and reveal a significant decline in biocapacity in the short-term, when countries are experiencing international wars. There is no statistically significant decline in environmental capacity if a country is involved in civil or ethnic wars at least within a span of one year.

Trade openness seems to have a positive impact on national biocapacity in the

short-term but wealth does not have a statistically significant effect on national biocapacity in this model. Varying levels of wealth does not have any significant impact on environmental biocapacity in this model.

Democracy does not have any significant impact on environmental capacity of a country in a short span of time. Different levels of democracy also does not seem to matter for the environment in the aftermath of a war. Population density has a positive impact on the environmental biocapacity in the sort-run, which again hints at a positive correlation between urbanization and environmental biocapacity.

The impact of refugee population on the environment is negatively significant in the short-run if a country is involved in a civil conflict. This is perhaps explained by the nature of civil conflicts and porousness of borders among neighboring states, whose populations might be involved in those civil conflicts. However refugee populations don't seem to have a statistically significant impact on the environment in the case of international or ethnic wars. The variable of refugee or displaced population is very crucial to post-conflict environmental degradation and needs further unpacking. Unfortunately due to the limitation of the data and scope of this research I can't include it in this analysis. In this research I'm only accounting for international refugees and not internally displaced populations, because of data constraints. Including data in internally displaced populations could shed more light on subnational trends of environmental degradation due to population displacements within a country.

4.4 Discussion

The findings of this analyses in this chapter indicate that conflicts have a very destructive impact on the environment which may not become very apparent in the short-run but can lead to a significant loss of biocapacity for a country in the long-run. My analysis also suggests that different type of conflicts can have different impact on a country's environment, for instance, international and ethnic conflicts have a more

detrimental impact on a country's environment in the long-run but in the short-run only international conflicts seem to impact the environment, which could be explained by the large scale of the international conflict and the nature of weapons used for interstate wars.

The results also validate earlier claims made in the thesis that governments and international political institutions often ignore the environmental impact of conflict because it is not immediate. Environmental impact of a conflict can take years to manifest through several direct and indirect means and political institutions need to be be cognizant of this temporal aspect of environmental degradation after a conflict. My analysis also finds a significant relationship between democracies and environmental management after conflicts in the long-run. The results, therefore add to the already vast literature on democracy and conflict, focussing on the benefits of democratization vis a vis environmental protection post-conflict. However these results need further investigation because democratic countries often don't fight international wars on their own turf, thereby endangering and destroying environmental capacity of other countries in the process. Environmental consequences of war, therefore, bring forth the issue of justice and equity not only for the populations (directly dependent on the environment for their day to day living, hence more vulnerable, verses economically better off population groups), but also for countries who initiate conflict knowing that they will experience negligible environmental loss as a consequence of their actions.

Apart from political factors, economic factors also have a significant impact on environmental capacity of a country in both short-term and long-term. Work on consequences of conflict has mainly focussed on effects on states and institutions, including political, economic and health related impact of violence. The real costs of violent conflict can not be understood completely without a clearer comprehension of the mechanisms through which war affects individuals and their environment. This

study furthers the goal of understanding the environmental cost of war by examining the effect of conflict on environmental resources that humans so closely depend on. It is crucial to study the impact of conflict on environmental capacity of a state because environmental capacity or natural resources often affect economic growth and political outcomes in states. Also, environmental degradation in states due to conflict can engender further conflicts. In this chapter, I looked at the impact of conflict on the overall biocapacity of a country, in the next chapter I will examine the impact of conflict on disaggregated indicators of biocapacity. These indicators are crucial for social sustenance, which, if destroyed, can lead to further conflict.

Table 4.4: Determinants of Environmental Impact: Long Term Effects, 1961-2005

	(1) Total	(2) International	(3) Civil	(4) Ethnic
Lagged Total Conflict	-0.0014**			
	(0.0004)			
Lagged POLITY score	-0.0003*	-0.0001	-0.0003*	-0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Lagged log(Per Capita GDP)	0.2523***	0.2675***	0.2572***	0.2551***
	(0.0201)	(0.0199)	(0.0201)	(0.0200)
Lagged log(Trade Openness)	-0.0258***	-0.0230***	-0.0256***	-0.0258***
	(0.0047)	(0.0047)	(0.0047)	(0.0047)
Lagged log(Pop Density)	0.0897***	0.0870***	0.0899***	0.0888***
	(0.0053)	(0.0052)	(0.0053)	(0.0052)
Lagged log(Refugee Pop)	-0.0013	-0.0008	-0.0042***	-0.0020***
	(0.0328)	(0.0049)	(0.0012)	(0.0008)
Lagged log(Per Capita GDP) sq	-0.0310***	-0.0332***	-0.0317***	-0.0313***
	(0.0031)	(0.0031)	(0.0031)	(0.0031)
Lagged POLITY score sq	-0.0002***	-0.0002***	-0.0002***	-0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Total ConflictXPOLITY	0.0003***			
	(0.0001)			
Lagged International Wars		-0.0030*		
		(0.0012)		
International WarsXPOLITY		0.0005**		
		(0.0002)		
Lagged Civil Wars			-0.0013**	
			(0.0005)	
Civil WarsXPOLITY			0.0002***	
			(0.0001)	
Lagged Ethnic Wars				-0.0030***
				(0.0008)
Ethnic WarsXPOLITY				0.0005***
				(0.0001)
(constant)	6.8272***	6.8015***	6.8178***	6.8225***
	(0.0337)	(0.0333)	(0.0337)	(0.0336)
N	4912	4912	4912	4912

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.5: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.
Dependent Variable				
Δ (Total Biocapacity)	0	0.026	-0.352	0.274
Independent Variables				
Δ POLITY score	0.085	1.785	-18	16
Δ log(Per Capita GDP)	0.007	0.027	-0.301	0.28
Δ log(Population Density)	0.009	0.008	-0.193	0.136
Δ log(Trade Openness)	0.006	0.057	-0.608	1.165
Δ Lagged log(Refugee Population)	-0.002	0.407	-3.575	3.539
Δ log(Per Capita GDP squared)	0.052	0.165	-1.707	1.665
Δ POLITY score squared	0.048	10.083	-100	100
Lagged Total Conflict	0.576	1.66	0	14
Lagged International Wars	0.084	0.588	0	11
Lagged Civil Wars	0.491	1.455	0	11
Lagged Ethnic Wars	0.213	0.945	0	10

Note: N=8380

Table 4.6: Determinants of Environmental Impact: Short-Term Effects, 1961-2005

	(1) Total	(2) International	(3) Civil	(4) Ethnic
Lagged Total Conflict	-0.0003			
	(0.0003)			
Δ POLITY score	0.0002	0.0001	0.0002	0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Δ log(Per Capita GDP)	-0.1325	-0.1315	-0.1308	-0.1288
	(0.0776)	(0.0775)	(0.0776)	(0.0776)
Δ log(Pop Density)	0.2649*	0.2759*	0.2678*	0.2730*
	(0.1088)	(0.1085)	(0.1090)	(0.1089)
Δ log(Trade Openness)	0.0305***	0.0305***	0.0306***	0.0307***
	(0.0075)	(0.0075)	(0.0076)	(0.0075)
Δ Lagged log(Refugee Pop)	- 0.1957*	-0.3340	-0.5678***	-0.2580
	(0.1088)	(0.1085)	(0.0976)	(0.1289)
Δ log(Per Capita GDP sq)	0.0055	0.0055	0.0054	0.0052
	(0.0131)	(0.0131)	(0.0131)	(0.0131)
Δ POLITY score sq		0.0000	-0.0000	
		(0.0000)	(0.0000)	
Δ Total ConflictXPOLITY	-0.0001			
	(0.0001)			
Lagged International Wars		-0.0053***		
		(0.0009)		
Δ International WarsX-POLITY		-0.0013		
		(0.0009)		
Lagged Civil Wars			-0.0002	
			(0.0004)	
Δ Civil WarsXPOLITY			-0.0001	
			(0.0001)	
Lagged Ethnic Wars				0.0000
				(0.0006)
Δ Ethnic WarsXPOLITY				-0.0001
				(0.0002)
Constant	-0.0012	-0.0011	-0.0010	-0.0016
	(0.0016)	(0.0010)	(0.0011)	(0.0015)
N	4760	4760	4760	4760

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Chapter 5

Impact of Different Conflict Types on Disaggregated Measures of the Environment

In the previous chapter I examined the relationship between conflicts (and their different types) and the overall environment of countries in the context of other relevant social and political factors. The measure of environment that I have used in my analysis is the national *biocapacity* calculated by the National Footprint Accounts (NFA). *Biocapacity* is the ability of ecosystems to produce biological materials useful to humans beings and to absorb all the waste generated by human activities. All of this, of course, is dependent on the prevailing management schemes and extraction technologies where "useful" materials are defined as those demanded by the human economy. As I have argued before, *biocapacity* is a better measure of the environment to understand the relationship between conflict and environmental resources because it provides us with a uniform measure of the environmental capacity across different ecosystems. This enables us to compare a country like Mongolia which primarily lies in the cold Gobi desert located in the trans-Himalayan region, to Gabon, 85 percent of whose land is covered with tropical rain forests. Calculations of *biocapacity* also normalize disaggregated measures of the environment like–forest land, cropland, grazing land and fisheries, using Equivalence Factors (EF), so that they can be compared to each other. This gives us a critical advantage in looking at the impact of conflict on the environment in a deeper way. By understanding how conflicts affect different aspects of environmental biocapacity or ecosystem "services" we can get a sense of

what other future crisis will ensue in the light of a specific environmental degradation during and after violent conflicts.

In this chapter I deepen the analysis presented in the previous chapter and focus on four disaggregated measures of biocapacity. I examine the effect of the intensity of conflicts (measured in terms of duration and number of fatalities) on cropland, grazing land, forest land and fishing grounds. These four environmental assets or "services" are crucial to human sustenance in terms of sustaining life-stock, providing raw materials for industries like timber, providing food, fish and water. Degradation of these resources during or after conflict not only affects the overall quality of the environment but also engenders further scarcity, access or distribution based conflicts among contentious groups.

In this specific study I, once again, use data from the National Footprints Accounts (2010) from 1961 to 2008 for 186 countries to measure *biocapacity* of cropland, grazing land, forest land and inland fishing grounds. The NFA uses raw data on agricultural land, forested land and fishing grounds from the Coordination of Information on the Environment (CORINE) and the Food and Agricultural Organization (FAOSTAT) to calculate disaggregated *biocapacity*. Raw data for marine fishing grounds comes from World Resource Institute (WRI).

Just as in the previous chapter, this analysis uses "Major Episodes of Political Violence" (MEVP) Data, 1946-2008, created by the Center for Systemic Peace (CSP). CSP defines major episodes of political violence as systematic and sustained use of lethal violence by organized groups that result in at least 500 directly-related deaths over the course of the episode. Episodes are coded for time span and magnitude and assigned different categories of armed conflict. The three categories that I use for this analysis are international war, civil war and ethnic war. Each episode is designated to span a certain number of years and judged to have been of a certain, general "magnitude of societal-systemic impact" (an eleven-point scale, 0-10; magnitude scores are

considered consistent and comparable across categories and cases, that is, approximating a ratio scale). When more than one episode of a particular MEPV category occurs in a single country in a single year, the episode scores are summed and the sum is entered for that category variable in the data set.

I also include critical political, economic and demographic variables in this analysis. I use POLITY IV dataset to measure the level of democracy within a state. I use data from World Development Indicators (2008) to measure national per capita GDP and I measure trade openness using data from Penn World Table (6.1). I measure population density and refugee population using World Development Indicators (2008) data. The summary statistics for all these variables, including all the dependent variables are presented in Table 5.1.

Table 5.1: Descriptive Statistics

Variable	Mean	Std. Dev.	Min.	Max.
Dependent Variables				
ln Cropland Biocapacity	14.704	1.896	6.918	18.204
ln Grazing Land Biocapacity	15.442	2.059	8.915	18.648
ln Forest Land Biocapacity	14.286	2.212	7.142	18.496
ln Fishing Grounds Biocapacity	13.704	1.824	8.757	16.291
Independent Variables				
Lagged POLITY score	-0.09	7.517	-10	10
Lagged *ln*(Per Capita GDP)	3.266	0.683	1.794	10.8
Lagged *ln*(Trade Openness)	1.768	0.312	0.036	4.794
Lagged *ln*(Population Density)	1.606	0.709	1.006	3.814
Lagged *ln*(Refugee Population)	3.79	1.322	0	6.644
Lagged *ln*(Per Capita GDP squared)	11.135	4.547	3.219	23.041
Lagged POLITY score squared	56.506	31.624	0	100
Lagged Total Conflict	0.576	1.66	0	14
Lagged International Wars	0.084	0.588	0	11
Lagged Civil Wars	0.491	1.455	0	11
Lagged Ethnic Wars	0.213	0.945	0	10

Note: Number of observations varies across models.

The following sections discuss each disaggregated measure of *biocapacity*–cropland,

grazing land, forest land and fishing grounds. I also propose and analyze possible hypotheses regarding their relationship with different conflict types.

5.1 Impact on Agricultural Land

When agricultural land and crop related systems are disrupted by war they take a long time to recover. Apart from directly destroying fertile land, violent conflicts also disrupt the food demand and supply chains. As basic as it may sound, war destroys agricultural equipment like tractors or combined harvesters affecting crop yield. Conflicts can also destroy irrigation systems and hydrological management plants that otherwise ensure maintaining suitable soil for plantation. Afghanistan, for example, after decades of civil and international conflict has lost more than 70 percent of its irrigational network. This loss is critical for an arid country like Afghanistan that lacks natural water supply and rainfall. Similarly, the recent NATO bombing in Libya destroyed irrigation pipelines from the Nubian Sandstone Aquifer System–the primary source of freshwater in an otherwise desert country. Livestock may be killed as a strategy of war–especially during civil and ethnic conflicts, or incidentally, as a result of disease during wartime. Transportation infrastructure, that often suffers heavy damage during war, renders it difficult for farmers to buy seeds or sell and transport their crop and for buyers to buy any produce. Production goes down when it becomes unsafe for farmers to leave their homes for their fields. Fewer acres are planted resulting in lower quantities of crop and food production, resulting in massive inflation of food prices in what could be an already fragile economy.

Another by-product of conflict—land mines are a major problem in many countries such as Afghanistan, Croatia, Cambodia and Vietnam. In such developing countries where agriculture is a major source of livelihood and export revenue, the presence of mine-contaminated agricultural land represents a major obstacle in social and economic reconstruction efforts. A significant proportion of the available agricultural

land in these countries cannot be used because it is contaminated by land mines and other unexploded ordnance (UXO). De-mining with current methods is slow and expensive. Aid agencies and governments need to support large refugee populations for several years because the threat of land mines has forced them off their land. Also, long delays in de-mining cause loss of fertility and degradation that could be avoided if the land was used. In Afghanistan, for example, one of the World Bank policy reports on food price inflation suggest that it may take up to 10 more years before all designated high-priority areas can begin to be cultivated.[D'Souza and Jolliffe [2010]] This long clearance period presents problems in terms of depreciation in the economic value of the land, particularly as fruit trees are an important component of agriculture in Afghanistan, and it will take years to re-establish productive orchards. Similarly, in Bosnia-Herzegovina where about 200,000 ha of agricultural land is still mined, the Bosnia-Herzogevina Mine Action Center estimates that it will take another 40 years to de-mine the land. Apart from the loss or decline in productivity of land for farmers, markets and contracts lost during the war are often filled by competitors from other countries, presenting a further obstacle to agricultural recovery.[Bolton [2010]] In some countries like Cambodia, land holders are either farming mined land, or are clearing the land for themselves with significant risks to themselves and others. This is because they cannot afford to wait (possibly for a decade or more) for organized de-mining teams to arrive.[Bottomley [2001]]

While land-mines and other sources of insecurity drive people away from agricultural land leaving it susceptible to erosion and degradation, inflow of population groups due to conflict leads to other kinds of land degradation issues. Land, in particular, its utilization for farming and other uses, becomes an important feature in displaced persons' survival strategies. As the general tendency is to locate refugee camps in semi-arid or ecologically fragile regions, most camps are overpopulated, resulting in rapid land degradation. [Black [2001]] observes that the resulting soil

degradation triggers overuse of resources, including cultivated fields that have to suffer shorter than usual fallow period and overgrazing by refugees' livestock. Where land is a source of contestation between refugees or IDPs and the local population, it generates heightened tension, often resulting in skirmishes or even precipitating civil war.

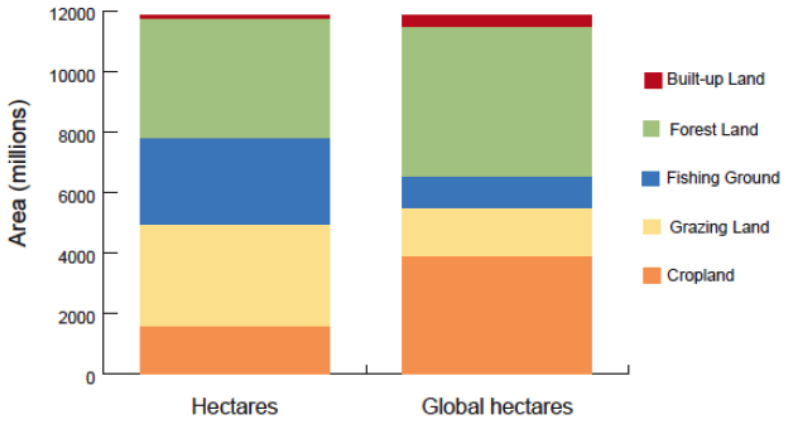

Figure 5.1: Relative Area of Land Use Type in Hectares and Global Hectares

Source: National Footprint Accounts (2008)

In this section, I will look at the impact of conflicts on agricultural land or cropland and grazing land though direct (bombing, chemical warfare) and indirect (population displacements, destruction of hydrological infrastructure, long term suspension of market supply and demand chains) means. Cropland *biocapacity* consists of the area required to grow all crop products, including livestock feeds, fish meals, oil crops and rubber. It is the most bioproductive of the land use types included in the National Footprint Accounts. In other words the number of global hectares of cropland is large compared to the number of physical hectares of cropland in the world, as shown in Figure 1. Worldwide in 2007 there were 1.55 billion hectares designated as

cropland.[FAO ResourceSTAT Statistical Database (2007)] The National Footprint Accounts calculate the footprint of cropland according to the production quantities of 164 different crop categories. The footprint of each crop type is calculated as the area of cropland that would be required to produce the harvested quantity at world-average yields.

Cropland *biocapacity* represents the combined productivity of all land devoted to growing crops, which the cropland footprint cannot exceed. As an actively managed land use type, cropland has yields of harvest equal to yields of growth by definition and thus it is not possible for the footprint of production of this land use type to exceed biocapacity within any given area.[Kitzes et al., (2009b)] Unfortunately, this problem in cropland *biocapacity* makes it difficult to establish over exploitation of cropland. Hopefully, eventual availability of more accurate data on historically sustainable crop yields will help in improving cropland *biocapacity* calculations and tracking overexploitation of agricultural land.

The grazing land *biocapacity* measures the area of grassland used in addition to crop feeds to support livestock. Grazing land comprises all grasslands used to provide feed for animals, including cultivated pastures as well as wild grasslands and prairies. According to Figure 5.1, in 2007, there were 3.38 billion hectares of land worldwide classified as grazing land.[FAO ResourceSTAT Statistical Database (2007)] Since the yield of grazing land represents the amount of above-ground primary production available in a year, and there are no significant prior stocks to draw down, overshoot is not physically possible over extended periods of time for this land use type. For this reason, a country's grazing land footprint of production is prevented from exceeding its *biocapacity* in the National Footprint Accounts. Similar to cropland *biocapacity* calculations, grazing land *biocapacity* calculations are also not very accurate at accounting for overgrazing.

From the above discussion and the nature of cropland *biocapacity* data and grazing

land *biocapacity* data I will test for some of the following key hypotheses to examine the impact of violent conflicts on cropland and grazing land.

H1: Higher intensity of total conflicts will lower the cropland *biocapacity* of a country.

H2: Higher intensity of international wars will lower the cropland *biocapacity* of a country.

H3: Higher intensity of civil wars will lower the cropland *biocapacity* of a country.

H4: Higher intensity of ethnic wars will lower the cropland *biocapacity* of a country.

H5: Increase in the refugee population in a country will increase the cropland *biocapacity* of a country.

H6: Increase in levels of democracy, per capita GDP and trade should have a positive impact on cropland *biocapacity* of a country.

H7: Higher intensity of total conflicts will lower the grazing land *biocapacity* of a country.

H8: Higher intensity of international wars will lower the grazing land *biocapacity* of a country.

H9: Higher intensity of civil wars will lower the grazing land *biocapacity* of a country.

H10: Higher intensity of ethnic wars will lower the grazing land *biocapacity* of a country.

H11: Increase in the refugee population in a country will decrease the grazing land *biocapacity* of a country.

I have analyzed the impact of violent conflicts on the *biocapacity* of cropland and grazing land using a Fixed-Effects model. For each of the disaggregated measures of *biocapacity*–cropland and grazing land, I estimate four different models–(1) Total

conflicts, (2) International Wars, (3) Civil Wars, and (4) Ethnic wars. All the independent variables are lagged by a year to account for endogeneity. The estimates are presented in Table 5.2 and Table 5.3 respectively.

The results presented in Table 5.2 here suggest that the cumulative intensity of all the conflicts that a country is involved in decreases the cropland *biocapacity* of that country. More specifically, with every one unit increase in the intensity of conflict in a country, the cropland's *biocapacity* decreases by 1.17 percent. This decrease can be quite substantial in terms of overall *biocapacity*. For example, Afghanistan's cropland *biocapacity* in 1999 is 1,07,95,400 GHa (Global Hectares) then with a single unit increase in the intensity of conflict in the country, its cropland's *biocapacity* will decline by about 1,26,307 GHa. The estimates also indicate that international wars, civil wars and ethnic wars, all have a statistically significant negative impact on a country's cropland *biocapacity*. Specifically, international conflicts decrease a country's *biocapacity* by .67 percent with every unit increase in the intensity of international conflict. With every unit increase in the intensity of civil wars a country's cropland *biocapacity* decreases by about 1.34 percent. Ethnic wars seem to have the worst impact on cropland *biocapacity* by decreasing it almost by 2 percent with every unit increase in their intensity. This is clearly in line with our earlier discussion and hypothesis stating that conflicts in general are detrimental to a country's cropland *biocapacity* through various direct and indirect ways. Ethnic wars seem to have the worst impact of agricultural land because they often lead to large scale internal displacements or even worse, death of people who are involved in farming (which is captured in the conflict intensity data). Such conflicts also tend to be more localized and protracted in nature, preventing farmers from working on their fields and disrupting food demand and supply chains.

Increase in democracy also has a positive impact on the cropland *biocapacity* of a country. According to the above estimates, a unit increase in democracy score

increases the cropland *biocapacity* of a country by .31 percent. As discussed in the previous chapters, this increase can be attributed to two factors—first, often high levels of democracy also correlate with high levels of GDP, therefore given the nature of the *biocapacity* data, increase in crop production will lead to higher agricultural biocapacity numbers and high economic growth rate can be generally indicative of higher levels of crop production and food self sufficiency. The second factor is that democracies are generally responsive to public attitude towards conservation and sustainable agricultural practices, therefore, increase in biocapacity of agricultural land with increase in levels of democracy perhaps underscores the normative importance to democracy in agricultural land conservation efforts.

Improvement in economic growth increases the agricultural biocapacity of a region. One percent increase in per capita GDP of a country increases its cropland *biocapacity* about .93 percent which is quite substantial. This increase can be attributed to the reason explained above, that high levels of economic growth in a country go hand in hand with increase in crop production and achieving food security for its people. Since the cropland *biocapacity* data equates crop production with the biocapacity of agricultural land, increase in crop yield in high income countries will result in high estimates of *cropland* biocapacity. These estimates perhaps don't account very well for use of chemical fertilizers and pesticides to increase crop yield, that lead to deterioration of the agricultural land in the long run. However, it is interesting to note that an increase in the per capita GDP does not increase the agricultural biocapacity of a country at the same rate. Which means that the increase in economic growth has diminishing return on its positive impact on agricultural biocapacity as evident from the estimates of the squared GDP per capita data. This happens when a country's population growth is stabilized and it reaches an optimum level of food production. As that point the money in the economy is diverted into other sectors. International trade does not seem to have a statistically significant impact on cropland *biocapacity*

of a country.

Population density has a positive impact of cropland *biocapacity*. More specifically, one percent increase in population density of a country leads to about .37 percent increase in its agricultural capacity. This is fairly intuitive given the nature of cropland *biocapacity* data and in line with our hypothesis. Increasing population leads to not only creating more agricultural land but also puts pressure on the existing land to increase food production. However, as mentioned earlier, the calculation of cropland *biocapacity* data does not inform at what stage does the increase in the biocapacity of the agricultural land becomes unsustainable and exploitative for the land.

Refugee population does not seem to have any impact of the bioproductivity of the land. This could be due to the fact that the refugee data weighs more on refugees of cross border conflicts who are better cared for by international organizations and human rights groups. This translates into better aid in terms of food and less dependency on cultivating their own crops. However, increase in the refugees in countries that are already experiencing ethnic conflicts tends to have a negative impact on the agricultural biocapacity by perhaps exacerbating existing conflicts and underutilization of agricultural land.

The results presented in Table 5.3 here suggest that one unit increase in the intensity of total conflicts decreases the biocapacity of grazing land by about .04 percent. International wars have the biggest impact on grazing land with one unit increase in their intensity decreasing the grazing land *biocapacity* by almost .07 percent. This can be explained by the loss of grazing land due to aerial bombing and other kinds of direct impact on soil quality due to warfare. A unit increase in the intensity of civil war decreases the biocapacity of grazing land by about .4 percent. Increase in the levels of democracy increases the grazing land *biocapacity* in a statistically significant way. Increase in one unit level of democracy scores raises the capacity of

grazing land by .03 percent. This can again be attributed to high income levels of democracies and practice of large scale animal rearing activities in developed countries for food production. This is also evident by the statistically positive impact of per capita GDP on grazing land *biocapacity*. According to the estimates, one precent increase in per capita GDP leads to about .2 percent increase in the capacity of grazing land. This trend again exhibits a diminishing effect because in high income countries as population stabilizes, and animal husbandry practices reach an optimal level, national income is diverted to other sectors. Increase of one percent in population density increases biocapacity of grazing land by .13 percent. Also increase in the refugee population of a country puts pressure on the pastures of the host country and increases in biocapacity by .13 percent.

5.2 Impact on Forest Cover

Forest cover is affected by conflict through many direct and indirect mechanisms. Firstly, forests can be destroyed during warfare through aerial bombing, or use of chemicals. This destruction by combatants is either on purpose–to clear out hiding cover for 'guerilla' forces or a collateral during bombardment. Incendiary bombing of forests made its debut in the early 1920s in the context of French efforts to defeat an anti-colonial struggle for independence in northern Morocco, the Rif War (1921-26). The aerial use of napalm began in the final stages of the Greek Civil War (1944-49), in which a communist insurgency used the forests of the northern mountains as its redoubt. Both sides burned forests for tactical advantage, but the Greek nationalists, with napalm and American help, did it more widely, trying to minimize the forest cover that afforded refuge to their enemies. Perhaps the most outstanding example of this kind is Vietnam, where the US forces cleared 325,000 ha of land and sprayed 72,400 m^3 of herbicides in the name of security.[Westing (1982)] The impact on biodiversity was severe; spreading herbicides on 10 percent of the country (including 50

percent of the mangroves) led to growth of low-diversity grasslands replacing high-diversity forests, mudflats instead of highly productive mangroves. Apart from this, forests have often been cleared to ease troop movements in wartime or in preparation for war.

Secondly, forests have been a source of war material and funding. For millennia the world's armies and navies had depended on the world's forests, and a reliable supply of good timber; be it for the construction of wooden fortresses in ancient China, Japan or Rome or for the construction of naval ships by great sea powers like Britain, France, Spain or Netherlands. Even after bronze, iron ore or other metals became important for active warfare, wood was still used for smelting to make weapons and canons. By the end of the 19th century, warships increasingly came to be made of metal, and the metals were now smelted with coal. Wood had lost some of its strategic significance as a source of war materiel, but it was still important. In a protracted war of attrition, such as the WWI, timber supplies became significant. In Great Britain, for example, which had come to rely almost completely upon North American and Baltic forests for wood in the late 19th century, U-boat warfare interrupted supplies in 1915. Britain's own woodlands were scant and not managed for timber production. But the military needed timber for trenches, barracks, telegraph poles at the front, and the munitions industry and coal mines needed plenty more. From 1916 to 1918 Britain felled half of its productive forests to meet the needs of the war. Similar urgency inspired similar assaults on forests in other combatant countries. Roughly the same thing happened during the WWII. Japan, for example, felled 15 percent of its forests from1941 to 1945, and clear-cut 50 square miles a week by 1945.

However, technological developments have almost eliminated the use of timber in warfare and the relationship of forests to warfare has experienced a drastic shift. Now, timber works as a crucial resource for rebel forces or the state to be sold for money to buy arms and ammunition. Timber's characteristics–its bulk, low value for

weight (compared to other, more lootable, commodities, such as precious metals or rough diamonds), and relatively high extractions costs, both technical and financial– does make it difficult to smuggle. However, if the warring factions are able to control territory rich in forests and the transportation routes necessary to export the timber, then the exploitation of timber can, and indeed does, fuel conflict as it has been done in Liberia, Cambodia, DRC, Ivory Coast and other heavily forested countries.

Thirdly, forest conservation efforts experience a major set-back during and after war. During the time of war, most international workers involved in forest and wildlife conservation projects leave because of threat to their survival. Times of violent conflict also mean changes in priorities, which means that whatever domestic and international funds are allocated towards post-war recovery are primarily targeted on humanitarian relief efforts. Given the constant threat of war in many politically unstable states, few incentives encourage long-term conservation or management of resources.

Lastly, refugees and displaced persons exert impact on forestry and other vegetation which in turn can also impact local communities. Their engagement in deforestation is due to two main reasons–to meet their own survival needs for lumber to build shelter or for firewood, and to earn money through selling wood and charcoal in the local markets, also known as relief economy.[Languy (1995), quoted in Kalpers (2001)] This problem is related to the scale of the camps and to the standard of aid provision for displaced populations. Indeed, the level of assistance that displaced people receive in temporary settlements varies greatly. International refugees automatically qualify for assistance from UNHCR, while many IDPs do not. The assistance provided can include food aid, a water supply, basic sanitation facilities, tented accommodation or simply cover sheets and some basic household items. What is virtually never provided is a source of energy for cooking food, boiling water or heating. In addition, when no formal accommodation is supplied, timber is needed to

construct temporary dwellings. As a result, people living in camps and settlements are forced to find timber and fuelwood in the surrounding area.

In Sudan, for example, deforestation is clearly visible around all major camp locations and can easily be detected by satellite in regions with otherwise good forest cover. In Nimule county on the border with Uganda, for instance, the illicit felling of trees for firewood and to clear land for slash-and-burn agriculture on the outskirts of a local IDP camp has resulted in the deforestation of a large area surrounding the camp. In drier regions, the effects are more difficult to detect but even more damaging. Much of northern and central Sudan is relatively dry, with low woodland density and slow growth rates. Tree cover is particularly sparse in Northern Darfur and northern parts of Kassala, two regions that host large displaced populations. Besides, the majority of settlements have been established in locations that were already occupied, and where the existing burden on forest resources may or may not have been sustainable. In eastern Sudan, camp-related deforestation has been occurring for at least twenty years. Corrective measures (prohibitions) were put into place by UNHCR and the Forests National Corporation (FNC) to prevent refugees from cutting down trees for fuel, but as their ongoing energy needs were not addressed, these were not effective. In Darfur, fuelwood collection is effectively uncontrolled. Camp residents reported journeying up to 15 km to find timber, and UNEP fieldwork inspections revealed extensive deforestation extending as far as 10 kms from the camps. This has contributed to a major security issue, as displaced women and girls are often at risk of rape, harassment and other forms of violence when they leave the camps to collect wood. This risk, however, is one they often have no choice but to take, since there are few other sources of cooking fuel or income available to them.

A similar situation obtained in the Gambela region of Ethiopia which witnessed massive deforestation at the hands of 200,000 settlers and refugees form Sudan.[Kurimoto (2005)] A UNEP rapid assessment of the impacts of refugees on the environment in

Guinea, through interviews, field visits and available reviewed materials reported over-exploitation and consequent degradation of natural resources and the disruption of traditional practices in refugee-hosting areas, with the depleted vegetation cover used for the housing construction, firewood and charcoal, both for domestic use and cash generation.[UNEP (2000)] A study of the Senegal River Valley found changes in vegetation and land cover, which depicted declining stands of vegetation in all ecological zones along the river.[Black and Sessay (1996: 61-64)] Fuel wood for energy and heating, which is a consequence of deforestation and degradation of land cover, is one area in which refugees and IDPs exert a negative impact. In western Tanzania, unhealthy competition between refugees and local hosts impacted adversely on the firewood usage: refugees used more firewood than their local hosts, they rarely put out fires between meals for lack of matches and their food was cooked for a much longer time because dried food rations took longer to cook than fresh crops.[Whitaker (1999)]

Worldwide in 2007 there were 3.94 billion hectares of forest land area in the world.[FAO ResourceSTAT Statistical Database (2007)] The forest land *biocapacity* measures the capacity of this forest land area to supply fuelwood, timber and other forest products. The current Ecological Footprint data methodology also counts forest land as carbon uptake land and a measure of biodiversity reserve. Although, many different ecosystem types have the capacity for long-term storage of CO_2, including the land use types considered in the National Footprint Accounts such as cropland or grassland, most terrestrial carbon uptake in the biosphere occurs in forests. For this reason it is considered to be a subcategory of forest land. The National Footprint Accounts calculate the yield of forest land according to the production quantities of 13 primary timber products and three wood fuel products. Timber productivity data from the UNEC and FAO Forest Resource Assessment and the FAO Global Fiber Supply are utilized to calculate the world average yield of 1.81 m^3 of harvestable

wood per hectare per year.[UNEP (2000), FAO (2000b), FAO (1998)]

In the light of the above discussion here are some of the key hypotheses we will test to examine the relationship between forests and violent conflicts:

H13: Higher intensity of total conflicts will lower the forest land *biocapacity* of a country.

H14: Higher intensity of international wars will lower the forest land *biocapacity* of a country.

H15: Higher intensity of civil wars will lower the forest land *biocapacity* of a country.

H16: Higher intensity of ethnic wars will lower the forest land *biocapacity* of a country.

H17: Increase in the refugee population in a country will decrease the forest land *biocapacity* of a country.

I have analyzed the impact of violent conflicts on the *biocapacity* of forests using a Fixed-Effects model. Again, I have estimated four different models–(1) Total conflicts, (2) International Wars, (3) Civil Wars, and (4) Ethnic wars, to analyze their individual impact on the forest cover of a country. All the independent variables are lagged by a year to account for endogeneity. The estimates are presented in Table 5.4 below.

The results confirm some of the above hypothesis about the relationship between forest cover and conflicts. The increase in intensity of the overall conflict has a very significantly negative impact on the forest cover of a country. To be more specific, according to the model estimates, an increase of one unit in the overall intensity of conflict decreases the forest *biocapacity* of a country by about 4.26 percent. An increase in the intensity of international wars by one unit decreases a country's forest *biocapacity* by about 5.44 percent. This is in line with our hypothesis and points

to the fact that modern day warfare over all is more detrimental to forest cover as opposed to some older claims that have argued that conflicts lead to development of "no man's land," such as the Green Corridor between East and West Europe or the DMZ in along 38th parallel in the Korean peninsula, creating protected forested and wildlife areas. According to the above estimates, international wars have a more detrimental impact on forest *biocapacity* than civil wars because while a unit increase in the intensity of international wars decreases the forest *biocapacity* by 5.44 percent, a one unit increase in the intensity of civil wars in a country decreases the capacity of its forests by 2.63 percent. This indicates that aerial warfare, that has become a staple in international intervention and international warfare, has an extremely damaging effect on forest resources. This is much worse than exploitation of forest resources like timber to fund intra-state conflicts. Ethnic wars do not seem to have a statistically significant impact on forest *biocapacity* according to this analysis.

Democracy has a negative impact on the forest *biocapacity* with every unit increase in democracy scores leading to a .47 percent decline in forest *biocapacity*. Again, this could be explained by democracies generally being more industrialized and extractive in nature which negatively affects *biocapacity*. However, this relationship begs more exploration in the future, because strong democracies also tend to be more organized towards environmental protection and conservation.

GDP does not have a statistically significant impact on forest *biocapacity* here. However, increase in one percent of trade decreases the forest *biocapacity* of a country by about .06 percent. This is a significant decline and attests towards the exploitative impact of international trade on natural resources, especially forests.

Population density has a statistically significant negative impact on forest *biocapacity* with one percent increase in population density decreasing the forest *biocapacity* by about .2 percent. This direction of the relationship is fairly intuitive since growing population puts more pressure on forest resources. As the population grows, forests

are often cleared to develop agricultural land and for other commercial purposes like housing, timber, and so on. Presence of refugees does not have a statistically significant impact on forest *bicapacity*. However, the estimates here suggest that refugees do have a detrimental impact on forest *biocapacity* if the country is already experiencing with ethnic conflicts. This could certainly lead to exacerbation of the existing ethnic conflicts.

5.3 Impact on Water

Armed conflict and related activities can degrade water resources in a number of ways. Direct action against facilities supporting military activities can release harmful contaminants into the environment. During the Kosovo War, for example, NATO forces targeted a major industrial complex in Pancevo, which included a petrochemical plant, a fertilizer plant, and a major oil refinery. Hazardous substances were released into the environment as a result of the strike and the ensuing fires. Smoke from the fires produced "black rain," threatening air, food, and water safety in Pancevo, as well as in downstream and downwind countries, particularly Bulgaria and Romania (UNEP and UNCHS 1999). Bombs, missiles, and other explosives can create craters, compact soil, and contribute to erosion, all of which can degrade water quality.[Linden et al. (2004)] The disposal of human causalities can also threaten water quality. During the Rwandan genocide, for example, bodies washed or were thrown into water systems, affecting the water quality of the entire Great Lakes region.[Tesi (2000)]

Damage to utilities' infrastructure can have indirect impacts on the water system. Physical infrastructure to maintain clean water supply is especially vulnerable to intentional or unintentional impacts from armed conflict and related activities. For example, in the Occupied Palestinian Territories, Israeli defense forces in Jenin intentionally destroyed or damaged booster pumps, water lines, and valves. Other system components were damaged unintentionally by tank traffic and the construction of

a trench designed to restrict Palestinian movement.[Zeitoun (2005)] In general, centralized water systems are more vulnerable to conflict than decentralized systems, as relatively less damage can disrupt supply to a greater number of people. Systems that rely on a single source of water are also especially vulnerable.[Zeitoun (2005)] During times of conflict, delicate water sharing systems between countries and groups also come to a stand-still. For example, the recent upheaval in the Libya has halted the incredibly important process of managing and conserving the Nubian Aquifer System (a fossil water aquifer), which is the largest source of freshwater in the region, also providing water to Sudan, Chad and Egypt.

Displaced persons also have a major impact on surface and ground water bodies, water being a necessity in human life. As relief camps are constructed under emergency conditions where haste rather than careful planning matters, wells are dug before the capacity of the aquifer feeding them is assessed, resulting in rapid depletion rates and/or decline in water quality.[Hoerz (1995a), quoted in Jacobsen (1997, p. 25)]. There have been instances where refugees competed for scarce water resources, depleting the water sources and forcing the diversion of river courses to the camps, away from the villages.[Whitaker (1999, p. 6)]

In this study, in order to measure the quality of marine and freshwater eco-systems, we use the National Footprint Accounts data on fishing grounds. This is because any detrimental impact on the aquatic systems due to war would affect its *biocapacity* (measured in terms of fish yield). Oil spills and leakage or massive localized air and soil pollution which occur as a result of warfare affect the aquatic systems in terms of their high biological productivity; provision of nutrients, feeding, breeding or nesting areas for marine and other animals; areas particularly rich in species; and areas important for sustaining populations of species at some or all phases of their life cycle. This is especially true in the case of international conflicts, where the scale of weapon systems, tactics and ariel bombardment can wreak an indiscriminate damage

to delicate aquatic ecosystems. In civil conflicts, the impact on marine and freshwater ecosystems is more likely to come from a breakdown of conservation infrastructure and water-sharing arrangements. *Biocpacity* of fishing grounds also indicates towards the ability of certain population groups that are primarily dependent upon fishing, to sustain their lives. Destruction of fishing grounds due to conflict can lead to loss of income for such fishing communities and breed further discontentment.

The National Footprints Accounts estimate the marine yields using data on annually available primary production of the sustainable annual harvests of 19 different aquatic species groups.[Gulland (1971)] The fishing grounds calculation is one of the most complex in the National Footprint Accounts and significant improvements have taken place over the past seven years; including revision of many fish extraction rates, inclusion of aquaculture production, and inclusion of crops used in aquafeeds.[Ewing et. al (2010)] The FAO FishSTAT database does not report trade in fish commodities prior to 1976. In the NFA 2008, trade in fish commodities prior to 1976 was simply omitted. In both the 2009 and 2010 Editions of the NFA, COMTRADE data were used to extrapolate these trade flows back to the start of their time series (1961). In the 2010 Edition of the NFA the list of fish species considered in the *biocapacity* of production calculation has been expanded, as the number of reported species has grown, and estimates of average trophic level have been collected for more species. The exports yield for each fish commodity is now calculated as the weighted average of domestic catch and imports. The catch intensity for each commodity is now based on the effective trophic level across a countryÕs catch of several species, rather than global constants based on the trophic levels of individual species. Moreover, fishmeal and fish oil production and trade, and of aquaculture, were included in the 2010 Edition and the fish commodity extraction rates were revised to include species-specific extraction rates for all species.

Some of the main hypotheses based on the above discussion on the impact of

violent conflicts on water (measured in terms of fishing *biocapacity*) are presented below:

H18: Higher intensity of total conflicts will lower the fishing grounds *biocapacity* of a country.

H19: Higher intensity of international wars will lower the fishing grounds *biocapacity* of a country.

H20: Higher intensity of civil wars will lower the fishing grounds *biocapacity* of a country.

H21: Higher intensity of ethnic wars will lower the fishing grounds *biocapacity* of a country.

I have analyzed the impact of violent conflicts on the *biocapacity* of fishing-grounds using a Fixed-Effects model. Again, I have estimated four different models–(1) Total conflicts, (2) International Wars, (3) Civil Wars, and (4) Ethnic wars, to analyze their individual impact on the fishing grounds in a country. All the independent variables are lagged by a year to account for endogeneity. The estimates are presented in Table 5.5 below.

The estimates in the table above suggest that violent conflicts have a statistically significant negative impact of the fishing grounds *biocapacity*. A single unit increase in the overall intensity of conflicts decreases fishing ground *biocapacity* by .15 percent. International wars have a larger negative impact on the fishing ground *biocapacity* with every one unit increase in the intensity of international wars significantly decreasing the fishing ground *biocapacity* by .45 percent, whereas a single unit increase in the intensity of civil wars decreases the *biocapacity* of fishing grounds by .11 percent.

Every single unit increase in democracy increases the fishing *biocapacity* by .13 percent indicating that democracies are indeed more vigilant about sustainable fishing practices, at least around their own country. GDP levels don't seem to have a statistically significant impact on fishing *biocapacity*, however every percent increase in international trade decreases biocapacity of fishing grounds by .01 percent. With one percent increase in population density, the fishing grounds *biocpacity* declines by .05 percent indicating that population increase does put pressure of fishing grounds and compromises sustainable fishing practices.

Refugee population does not seem to affect the biocapacity of fishing grounds in any statistically significant manner.

5.4 Discussion

The analysis in chapter provides a more detailed account of how different types of conflicts affect different aspects of the environment. While the impact of different types of wars on disaggregated measures of *biocapacity* is mostly in the expected directions, the magnitude varies. However, the estimated results for other political, economic and demographic variables tell a mixed story about their impact on different aspects of the environment. Based on the estimated coefficients presented in the above models, Table 5.6 below summarizes the percentage change in disaggregated measures of *biocapacity*—cropland, grazing land, forest land and fishing grounds, as a result of one unit increase in the intensity of different conflict types. The percentage change in disaggregated *biocapacity* measures is the percentage change in the total global hectare *biocapacity* of the four environmental resource categories.

The percentage change numbers presented above indicate that different types of conflicts affect a country's environmental sources differently. On an average, international wars tend to be most devastating for the three out of the four environmental resources analyzed here. This clearly indicates that with use the of chemical weapons,

carpet bombing and strategic aerial attacks on essential infrastructure, as part of the modern international warfare strategy, wreak havoc with a country's environment. This devastating impact on the environment also highlights the environmental injustice of many international wars that are being increasingly undertaken for the sake of "humanitarian intervention." This is because the intervening parties' mode of conducting warfare is often not only impersonal but also physically distant, absolving themselves of any environmental damages.

While internal wars are extremely devastating for the forest resource of a country, ethnic wars and civil wars are more destructive for crop production. This is because civil wars and ethnically motivated wars, especially as part of protracted conflict between social groups, completely disrupt the domestic supply and demand chain for agricultural produce. Violence at a localized level prevents farmers from working on their fields, and stalls transportation and sale of agricultural goods. Cropland *biocapacity* is an extremely critical environmental service that lends a source of sustained livelihood to people. Therefore, a decline in cropland *biocapacity* means possible large scale unemployment and social disruption. While laying out my plan for this project in the earlier chapters, I had stresed on the importance of studying the relationship between conflict and environmental degradation as a reinforcing feedback loop. When thinking about such vicious cycles of conflict and environmental degradation, a decline in cropland *biocapacity* during the time of intra-state warfare is asignificant factor in predicting further continuation and escalation of conflict.

Unfortunately, at this time the National Footprint Accounts data does not distinguish between high yield and unsustainable agricultural practices to calculate cropland and grazing land *biocapacity*. This means that an increase in the *biocapacity* of cropland and grazing land could also be indicating better and more sustainable agricultural practices that can be potentially associated with democracies due to a high levels of political participation by environmental organizations and an increased

awareness in the population about environmental issues. Also advanced democracies tend to be richer and can afford "green" technology to a greater degree. However, an increase in the *biocapacity* of cropland and grazing land can simply mean more yield which can be obtained through overuse of chemical fertilizers, pesticides and genetically modified crop variety which are harmful to the environment in the long-run. Therefore, it is hard to untangle the positive impact of GDP and trade on cropland and grazing land *biocapacity* from their exploitative impact on the environment with in the scope of this study.

However, the impact of conflicts on the environment is clear. Conflicts are bad for the environment and some type of conflicts are worse than others with their impact on certain environmental services. Also, high levels of decline in cropland *biocapacity* due to internal conflicts forebode an environment and conflict degradation spiral.

Table 5.2: Estimates Measuring the Impact of Different Types of Conflicts on Cropland *Biocapacity*

	(1) Total	(2) International	(3) Civil	(4) Ethnic
Lagged Total Conflicts	-0.0117***			
	(0.0026)			
Lagged POLITY Score	0.0031***	0.0046***	0.0039***	0.0054***
	(0.0008)	(0.0014)	(0.0009)	(0.0011)
Lagged *ln*(Per Capita GDP)	0.9322***	0.9493***	0.9325***	0.9594***
	(0.0514)	(0.0508)	(0.0513)	(0.0512)
Lagged *ln*(Per Capita GDP Sq)	-0.0678***	-0.0688***	-0.0678***	-0.0693***
	(0.0034)	(0.0034)	(0.0034)	(0.0034)
Lagged *ln*(Trade Openness)	0.0536	0.0578	0.0534	0.0559
	(0.0119)	(0.0119)	(0.0119)	(0.0119)
Lagged *ln*(Pop Density)	0.3767***	0.3682***	0.3790***	0.3750***
	(0.0132)	(0.0131)	(0.0133)	(0.0132)
Lagged *ln*(Refugee Pop)	0.4027	0.4326	0.3786	0.3791
	(0.2932)	(0.3089)	(0.2679)	(0.2526)
Total Conflicts X RefugeePop	-0.0003			
	(0.0004)			
Lagged International Wars		-0.0066**		
		(0.0028)		
International Wars X Refugee Pop		0.0007		
		(0.0010)		
Lagged Civil Wars			-0.0134***	
			(0.0029)	
Civil WarsXRefugee Pop			-0.0004	
			(0.0004)	
Lagged Ethnic Wars				-0.0198***
				(0.0047)
Ethnic WarsXRefugee Pop				-0.0013*
				(0.0006)
N	4912	3678	3867	3906
r2	0.5370	0.5341	0.5372	0.5371
F	210.9850	207.5536	211.1906	211.0939

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5.3: Estimates Measuring the Impact of Diffrent Types of Conflicts on Grazing Land Biocapacity

	(1) Total	(2) International	(3) Civil	(4) Ethnic
Lagged Total Conflicts	-0.0042***			
	(0.0013)			
Lagged POLITY Score	0.0032***	0.0032***	0.0033***	0.0032***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Lagged *ln*(Per Capita GDP)	0.2694***	0.2732***	0.2741***	0.2751***
	(0.0258)	(0.0254)	(0.0257)	(0.0257)
Lagged *ln*(Per Capita GDP Sq)	-0.0149***	-0.0152***	-0.0152***	-0.0152***
	(0.0018)	(0.0017)	(0.0018)	(0.0017)
Lagged *ln*(Trade Openness)	0.0304***	0.0321***	0.0309***	0.0318***
	(0.0059)	(0.0059)	(0.0059)	(0.0059)
Lagged *ln*(Pop Density)	0.1352***	0.1317***	0.1354***	0.1318***
	(0.0065)	(0.0064)	(0.0065)	(0.0065)
Lagged *ln*(Refugee Pop)	0.1352***	0.1317***	0.1354***	0.1318***
	(0.0065)	(0.0064)	(0.0065)	(0.0065)
Total ConflictsXRefugee Pop	-0.0003			
	(0.0002)			
Lagged International Wars		-0.0077*		
		(0.0034)		
International WarsXRefugee Pop		0.0010*		
		(0.0005)		
Lagged Civil Wars			-0.0038**	
			(0.0014)	
Civil WarsXRefugee Pop			-0.0002	
			(0.0002)	
Lagged Ethnic Wars				0.0010
				(0.0023)
Ethnic WarsXRefugeePop				0.0004
				(0.0003)
N	4870	4268	4356	3261
r2	0.2223	0.2226	0.2217	0.2207
F	192.4530	192.7369	191.7903	190.6483

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5.4: Estimates Measuring the Impact of Diffrent Types of Conflicts on Forest Land Biocapacity

	(1) Total	(2) International	(3) Civil	(4) Ethnic
Lagged Total Conflicts	-0.0426***			
	(0.0091)			
Lagged POLITY Score	-0.0047***	-0.0045***	-0.0046***	-0.0032***
	(0.0003)	(0.0003)	(0.0003)	(0.0009)
Lagged *ln*(Per Capita GDP)	0.0036	0.0073	0.0073	-0.0015
	(0.0227)	(0.0224)	(0.0226)	(0.0226)
Lagged *ln*(Per Capita GDP Sq)	0.0026	0.0023	0.0024	0.0029
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
Lagged *ln*(Trade Openness)	-0.0583***	-0.0576***	-0.0579***	-0.0588***
	(0.0053)	(0.0053)	(0.0053)	(0.0053)
Lagged *ln*(Pop Density)	-0.2151***	-0.2155***	-0.2156***	-0.2158***
	(0.0061)	(0.0060)	(0.0061)	(0.0060)
Lagged *ln*(Refugee Pop)	0.0563	0.0562	0.0498	0.0562
	(0.0265)	(0.0264)	(0.0265)	(0.0265)
Total ConflictsXRefugee Pop	0.0003			
	(0.0002)			
Lagged International Wars		-0.0544***		
		(0.0097)		
International WarsXRefugee Pop		0.0007		
		(0.0004)		
Lagged Civil Wars			0.0263***	
			(0.0082)	
Civil WarsXRefugee Pop			0.0002	
			(0.0002)	
Lagged Ethnic Wars				-0.0010
				(0.0020)
Ethnic WarsXRefugee Pop				0.0009***
				(0.0002)
N	4688	4367	4120	3990
r2	0.3640	0.3643	0.3637	0.3651
F	370.9754	371.4857	370.5403	372.7658

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5.5: Estimates Measuring the Impact of Diffrent Types of Conflicts on Fishing Ground Biocapacity

	(1) Total	(2) International	(3) Civil	(4) Ethnic
Lagged Total Conflicts	-0.0015***			
	(0.0002)			
Lagged POLITY Score	0.0013***	0.0014***	0.0014***	0.0014***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Lagged *ln*(Per Capita GDP)	-0.0536	-0.0512	-0.0520	-0.0490
	(0.0646)	(0.0645)	(0.0546)	(0.0543)
Lagged *ln*(Per Capita GDP Sq)	0.0039	0.0037	0.0038	0.0036
	(0.0093)	(0.0093)	(0.0099)	(0.0098)
Lagged *ln*(Trade Openness)	-0.0108***	-0.0114***	-0.0110***	-0.0115***
	(0.0011)	(0.0010)	(0.0011)	(0.0011)
Lagged *ln*(Pop Density)	-0.0513***	-0.0499***	-0.0511***	-0.0502***
	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Lagged *ln*(Refugee Pop)	0.0089	0.0091	0.0087	0.0092
	(0.0074)	(0.0076)	(0.0078)	(0.0075)
Total ConflictsXRefugee Pop	0.0000			
	(0.0000)			
Lagged International Wars		-0.0045***		
		(0.0006)		
International WarsXRefugee Pop		0.0001		
		(0.0001)		
Lagged Civil Wars			-0.0011***	
			(0.0003)	
Civil WarsXRefugee Pop			-0.0000	
			(0.0000)	
Lagged Ethnic Wars				0.0003
				(0.0004)
Ethnic WarsXRefugee Pop				-0.0000
				(0.0001)
N	4781	4567	4672	3980
r2	0.5174	0.5189	0.5144	0.5124
F	708.6192	712.8844	700.3386	694.7196

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5.6: Percentage Change in Disaggregated *Biocapacity* Measures (in GHa) due to One Unit Increase in Conflict Intensity

Conflict Type	Cropland	Grazing Land	Forest Land	Fishing Ground
Total Conflicts	-1.17	-.04	-4.26	-.15
International Wars	-.67	-.08	-5.44	-.45
Civil Wars	-1.34	-.04	- 2.63	-.11
Ethnic Wars	-1.98	Inconclusive	Inconclusive	Inconclusive

Chapter 6

Protecting the Environment from Conflict

In Chapters 4 and 5, I examined the extent of damage to a country's environmental capacity due to violent conflict. I also assessed how different types of conflicts affect different aspects of a country's environmental capacity like agricultural land, forests, and water, potentially leaving it more susceptible to further conflict. The results in the previous chapters highlight yet another cost of conflict–the environment. Even though conflicts often produce very stark and obvious images of environmental destruction, like the nuclear attack on Japan or the burning oil wells during the Gulf War, it is often difficult to translate those dramatic images into actual long-term impact. Therefore, environmental degradation is difficult to measure, often occurs over long-term, and is unfortunately politically not as compelling as other casualties of war such as the economy or health. This study is attempting to measure the environmental cost of conflict and that realization should make the decision to go to war more prohibitive for leaders and policy-makers. However, if wars do occur, then the international society and domestic institutions have a responsibility to protect the environment during and after wartime, just like it is the international community's moral obligation to prevent human rights abuses, or to provide monetary assistance towards health, education and economic development after wars.

After presenting the long term impact of conflicts on countries' environmental biocapacity in the previous chapters, I now assess the international provisions available so far to protect the environment during wartime. Since displaced populations and refugees are an important part of the natural resources and conflict dynamic, I

will also analyze the international regime pertaining to displaced population groups and its affect on environmental extraction. In this chapter, I argue that the international regimes designed to protect the environment during wartime need to undergo a *norm-shift*. Most of such international regimes, especially the ones that are designed as part of international humanitarian law are normatively constructed under the doctrine of '*military necessity*' and not '*environmental preservation*'. This means that even though there are international provisions to protect the environment during war-time, any military compulsion allows those environmental concerns to be compromised.

6.1 International Regime to Protect the Environment during Wartime

After much debate on their definition, Steven Krasner characterized International Regimes as: "Implicit or explicit principles, norms, rules and decision-making procedures around which actors' expectations converge in a given area of international relations."[**?**] Oran Young claimed that regimes are "more specialized arrangements that pertain to well-defined activities, resources, or geographical areas and often involve only some subset of the members of international society." IR scholars have also been debating about the role of regimes from being mere tools in the hands of powerful actors to all pervasive standards of behavior that all states try to comply with.Milner [1992], Young [1982], Puchala and Hopkins [1982] [1]

The international regime for protecting the environment during and after wartime is an amalgamation of international organizations and agencies like the World Wildlife Fund (WWF) and the United Nations Environment Program (UNEP). The

[1]The literature on international and multilateral regimes is extremely vast and unfortunately it is beyond the scope of this project to discuss it in detail. For additional information refer to some of these seminal works on international and multilateral regimes like Snidal [1985], Keeley [1990], Haas [1980], Keohane [1982], Haggard and Simmons [1987], Ruggie [1982], Krasner [1983a,b].

regime also includes the International Humanitarian Law (IHL) and the International Environmental Law (IEL) that make specific provisions to protect the environment during wartime and form the basis of punishing the violators. Given the results of this research presented in the previous two chapters about environmental impact of wars due to a hold on land use, and, the indirect role of Internally Displaced Populations (IDPs) and Refugees, I believe that the various treaties on land-mines and the international law regarding IDPs and Refugees, should also be considered an important part of the international regime to protect the environment from the effects of war.

International Humanitarian Law

In the early 1970s, when the international community began addressing environmental protection generally, it also started making a serious attempt to remedy the deficiencies of legal protection for victims of armed conflict. Environmental disasters like oil spills and scientific assessments about ozone depletion had already galvanized public opinion towards environmental protection and conservation. However, the Vietnam War, the protection of human rights in occupied territories (specifically in Palestine), and the armed conflicts that occurred during decolonization brought forth the issue of environmental and public health effects of wars. However, lawmaking in the international environmental field left the issue of protecting the environment during wartime at the margins. Therefore, the issue was directly addressed by the international conferences dealing with armed conflict and humanitarian law–perhaps to the great dismay of those defending military interests. These conferences included the United Nations Committee of the Conference on Disarmament (CCD) and the Diplomatic Conference on the Reaffirmation and Development of International Humanitarian Law (CDDH, Geneva, 1974-1977). While these conventions made giant strides in introducing some legal recourse to protecting the environment during wartime, sev-

eral gaping holes in these provisions continued to exist which were, arguably, never meant to be fixed.

The "Threshold" Issue

In 1976, the CCD adopted the Convention on the *Prohibition of Military or Any Hostile Use of Environmental Modification Techniques (ENMOD)*. This treaty regulates the use of environmental modification techniques as a means to cause harm to the enemy. ENMOD specifically prohibits "environmental modification techniques having *widespread, long-lasting or severe effects* as the means of destruction."[2] Around the same time CCDH adopted two important provisions in what became Additional Protocol I to the Geneva Conventions.[3] First, *Article 35*, paragraph 3, states that "[i]t is prohibited to employ methods and means of warfare which are intended, or may be expected, to cause *widespread, long-term and severe damage* to the natural environment." Second, *Article 55* of Additional Protocol I states that "[c]are shall be taken in warfare to protect the natural environment against *widespread, long-term and severe damage*." It further specifies that this protection "includes a prohibition of the use of methods and means of warfare which are intended or may be expected to cause such damage to the environment and thereby to prejudice the health or survival of the population."

Right from the outset, it is clear that the ENMOD and the provisions in the Additional Protocols have adopted different standards of prohibition of environmental damage during war-time. The three adjectives–"widespread", "long-lasting", and "severe",–limiting the scope of prohibited damage are alternatives (joined by "or") in ENMOD and cumulative (joined by "and") in the Additional Protocol. Legal

[2]Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD), 10 December 1976, 1108 UNTS 151, Art. 1.

[3]Protocol additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I) of 8 June 1977, Arts 35(3) and 55(1).

scholars have called it a *threshold* problem. Additionally, the CCD defined "long-lasting" as "lasting for a period of months or approximately a season."[4] On the other hand discussion on the Additional Protocols established the time-frame to establish damage to the environment to be twenty or thirty years.

Clearly ENMOD tried to set up a fairly stringent limit to establish environmental damage during war-time whereas the Additional Protocol I negated that limit by setting up a more permissible scope and time-frame of environmental damage and thereby creating a *threshold* problem in this legal framework. This was done to make sure that the battlefield damage incidental to conventional warfare would not normally be proscribed by international legal provisions. This also leaves room for application to biological and chemical warfare. As to nuclear warfare, however, most NATO countries claim that Additional Protocol I does not apply thereto, and at least the United States and the United Kingdom contest that these two provisions constitute customary law.[5] Therefore the legal situation pertaining to the protection of the environment during war-time is highly unsatisfactory. First, the cumulative conditions of environmental damage attached to the prohibition of Articles 35 and 55 of Additional Protocol I are excessively restrictive, making the prohibition much too narrow from an environmental point of view. Second, the exact scope and time-span of this prohibition remains uncertain, and thus difficult to implement or enforce.

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[4]See Understanding annexed to the text of ENMOD, contained in the report of the UN Committee of the Conference on Disarmament to the General Assembly, Official Records of the General Assembly, 31st Session, Supplement No. 27 (A/31/27).

[5]United States, declaration made on signature: "It is the understanding of the United States of America that the rules established by this protocol were not intended to have any effect on and do not regulate or prohibit the use of nuclear weapons." United Kingdom, declaration made on ratification: "It continues to be the understanding of the United Kingdom that the rules introduced by the Protocol apply exclusively to conventional weapons without prejudice to any other rules of international law applicable to other types of weapons. In particular, the rules so introduced do not have any effect on and do not regulate or prohibit the use of nuclear weapons."

Environment as a "Civilian Subject" or "Military Target"?

Another environmentally critical provision of the Additional Protocol I, Article 51(5)(b), prohibits attacks that cause "excessive" collateral damage to civilians or civilian objects. Similar to Article 51(5)(b), the Rome Statute, while establishing the International Criminal Court, contained a provision to protect the environment in times of international armed conflict:

> "Intentionally launching an attack in the knowledge that such attack will cause incidental loss of life or injury to civilians or damage to civilian objects or widespread, long-term and severe damage to the natural environment which would be clearly excessive in relation to the concrete and direct overall military advantage anticipated."[6]

Legal scholars argue that in order to by-pass the restrictive conditions of Article 35 and 55 of the Additional Protocol I, one could use Article 51 and the Rome Statute (Article 8) to safeguard environment as a civilian subject during war-time. After all, elements of the environment are most often civilian objects. However, this argument becomes shaky when environmental elements become military objectives. Once armed forces are located in a protected area, the area may contribute effectively to military action and its neutralization may offer a definite military advantage. Thus, it becomes a military objective. In the case of herbicide use in Vietnam, the trees provided cover for the enemy. Their defoliation constituted a definite military advantage, and the trees–more precisely their leaves–became a military objective. There are some weak legal recourses available (Articles 59 and 60 of the Additional Protocol I) to protect environmentally sensitive regions from becoming military targets by establishing them as de-militarized zones or non-defended localities. But that would require a prior agreement between the warring parties (possibly mediated by a third party like the UN or the Red Cross) to recognize certain regions as demilitarized zones and out of

[6]Art. 8(2)(b)(iv), Rome Statute of the International Criminal Court (ICC) of 17 July 1998.

bounds for combat. This is certainly a tall order to achieve between two countries internationally, let alone between two factions in a domestic civil war.

The *"Proportionality Issue"* and the *"Precautionary Principle"*

In 2005, the International Committee for Red Cross (ICRC) published a crucial study on the Customary International Humanitarian Law, that tried to simplify the "threshold" issue discussed above.[7] The study declares a simplified version of the provisions of Additional Protocol I and of ENMOD to constitute customary law, stating that the "use of methods and means of warfare that are intended, or may be expected, to cause widespread, long-term and severe damage to the natural environment is prohibited. Destruction of the natural environment may not be used as a weapon."[8]

A real step forward was accomplished via another rule articulated in the study. Rule 44 states that:

> ....[m]ethods and means of warfare must be employed with *due regard* to the protection and preservation of the natural environment. In the conduct of military operations, all feasible precautions must be taken to avoid, and in any event to minimize, incidental damage to the environment.....[l]ack of scientific certainty as to the effects on the environment of certain military operations does not absolve a party to the conflict from taking such *precautions*.[9]

The above rules of customary international humanitarian law, by using the words *"due regard"* and *"precaution"* argue that recognition of the precautionary principle, as exists in customary international environmental law, must be reflected in the law of armed conflict. The study, however, quotes limited state practice to support this rule.

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[7] For references, see Jean-Marie Henckaerts and Louise Doswald-Beck, *Customary International Humanitarian Law*, International Committee of the Red Cross and Cambridge University Press, Cambridge, 2005, Vol. I, pp. 153ff.

[8] *Ibid.*, Rule 45.

[9] *Ibid.*, Rule 44.

The majority of the support cited is the reading of two decisions of the International Court of Justice (ICJ), namely the 1995 Nuclear Tests case order and the 1996 Nuclear Weapons advisory opinion.[10] Additionally, two private, yet semi-official, restatements of the relevant rules also give credence to the precautionary principle. First, the San Remo Manual on International Law Applicable to Armed Conflict at Sea (1994) states that "[m]ethods and means of warfare should be employed with *due regard* for the natural environment...."[11] and second, the HPCR Manual on International Law Applicable to Air and Missile Warfare (2009) states that the "destruction of the natural environment carried out *wantonly* is prohibited." It also urges that "[w]hen planning and conducting air and missile operations, due regard ought to be given to the natural environment."[12]

These rules of customary international humanitarian law provide a more favorable and flexible approach to protecting the environment during war-time that the provisions of the Additional Protocol I by stressing upon the notion of proportionality (by using the words 'wanton' and 'due regard') and precaution when it comes to treating the environment during conflict. However, as mentioned before, the state practice to establish strong customary laws in this regard are very limited.

International Environmental Law

Another body of international law that can be evoked to protect the environment during conflict is the International Environmental Law (IEL). Multilateral environmental

[10]ICJ, Request for an Examination of the Situation in Accordance with Paragraph 63 of the CourtÕs Judgment of 20 December 1974 in the Nuclear Tests (New Zealand v. France) Case, Order of 22 September 1995, ICJ Reports, 1995; ICJ, Legality of the Threat or Use of Nuclear Weapons, Advisory Opinion of 8 July 1996, ICJ Reports, 1996.

[11]San Remo Manual on International Law Applicable to Armed Conflict at Sea, reproduced in Dietrich Schindler and Jiri Toman (eds), *The Laws of Armed Conflict*, 4th edition, Leiden and Boston, 2004, p. 1153, Rule 44.

[12]Harvard University, Program on Humanitarian Policy and Conflict Research (HPCR), *Manual on International Law Applicable to Air and Missile Warfare*, Bern, 2009, Rule 88.

agreements like the United Nations Convention on the Law of the Seas (UNCLOS) or Convention for the Protection of Biological Diversity (CBD) or the World Heritage Convention, are all examples of multilateral agreements that have been designed to protect the environment by the member states. The catch, however, is that these conventions are not explicitly made to work during wartime. For example, if while targeting a particular infrastructure facility during war, an oil pipeline is destroyed, what should the international response be? During the Israel-Lebanon conflict in 2006, the Israeli Air Force bombed the Jiyeh thermal power-station in Lebanon. The air strikes also destroyed the heavy fuel storage reservoir that lead to about 30,000 tons of oil being leaked into the Mediterranean. The UN estimated the cost of clean up and the cost of the spill for the Lebanese economy to be more than 203 million dollars, however, Israel claimed immunity from damage payments stating that it was a collateral of strategic warfare and that Hezbollah, based in Lebanon, started the war. The UN did set up a fund (based on volunteered donations) to pay for the damages, but the money has been insufficient and it might take more that 10 years for the affected region to recover environmentally. On the other hand, in the event of a similar occurrence during peacetime, such as the Exxon Valdez oil spill or the BP oil spill, the oil companies or the states controlling the oil companies can be made liable according to the international and domestic environmental laws.

International Environmental Law is still developing and the international community and legal scholars have only recently started looking into the application of IEL during an armed conflict. Since the 1990s, there has been a noticeable shift in the historic belief that laws applicable during war and peace were mutually exclusive. Contemporary perspectives are increasingly trying to bridge the two bodies of law, applying peacetime international law during armed conflict to varying degrees. Where both bodies of law apply concurrently, however, the question of their relationship also has to be answered. This development is clearly documented in the work of

the International Law Commission (ILC). In 2004, the General Assembly approved the ILC's proposal to include work on the 'effects of armed conflict on treaties' in its long-term program. In 2008, that work resulted in a set of draft articles that attempt to regulate the applicability of treaties during armed conflicts.[13] The draft articles state that the onset of armed conflict 'does not necessarily terminate or suspend the operation of treaties' between belligerents or belligerents and neutral parties.[14] Rather, this is determined by a complex body of different considerations: express provisions and subject matter of the treaty, treaty interpretation according to Articles 31 and 32 of the Vienna Convention on the Law of Treaties (VCLT) of 23 May 1969, the nature and extent of the armed conflict, and the effect of the armed conflict on the treaty.[15] This means in practice has to be ascertained on a case-by-case basis.

Multilateral Environmental Agreements During Armed Conflict

With regard to the question of whether and to what extent multilateral environmental agreements (MEAs) continue to protect the environment in times of armed conflict, a basic distinction has to be made, which is also a basic problem. As a rule, the law applicable in times of peace applies between belligerents and neutral states (more generally, states not parties to an armed conflict). This means that, at least as a matter of principle, an MEA must continue to apply during an armed conflict at least in the relation between the parties to the conflict and the states that are not parties. From this perspective, the continued application of an MEA during an

[13]International Law Commission (ILC), *Report of the International Law Commission*, 59th Session, 7 MayÐ5 June and 9 JulyÐ10 August 2007, paras. 266Ð324, UNGA Supp. A/62/10; ILC, *Effects of Armed Conflicts on Treaties*, UN Doc. A/CN.4/L.727/Rev.1, 6 June 2008; ILC, *Effects of Armed Conflicts on Treaties, Addendum*, UN Doc. A/CN.4/L.727/Rev.1/Add.1, 11 July 2008. The draft articles were provisionally adopted and circulated to states for comment and observation, to be submitted by January 2010: ILC, *Report of the International Law Commission*, 60th Session, 5 MayÐ6 June and 7 JulyÐ8 August 2008, para. 14, UNGA Supp. A/63/10.

[14]ILC, *Effects of Armed Conflicts on Treaties*, 6 June 2008, Art. 3.

[15]*Ibid.*, Art. 4

armed conflict only constitutes a problem in the relationship between belligerents. In addition, and in line with this logic, the existence of a non-international armed conflict arising on the territory of a party to an MEA does not affect the application of the treaty. Herein lies the conundrum of the intra-state conflicts, just as in the case of International Humanitarian Law, where the international environmental regime is least effective in protecting the environment.

While the basic distinction between the relationship between belligerents and the one between belligerents and non-belligerents has to be maintained, a closer look at the scope of that distinction is necessary, taking into account the basic content of relevant MEAs. How instruments of IEL address their applicability during times of armed conflict varies substantially and can be broadly classified under three categories. The first kind are the MEAs that directly or indirectly provide for their continued application during hostilities, the second kind state that they are automatically suspended, terminated, or inapplicable once armed conflict has begun, the third kind are the ones that remain silent on the issue. Unfortunately, most MEAs fall into the third category, and there is substantial amount of uncertainty regarding their applicability during war-time.

For example, under the World Heritage Convention, the World Heritage Committee establishes and updates a World Heritage List of cultural heritage and natural heritage properties with "outstanding universal value."[16] Inclusion on the list requires the concerned state's consent. In addition, the Committee maintains a list of "World Heritage in Danger" that includes sites that require 'major operations' to conserve, for which assistance has been requested, and that are "threatened by serious and specific dangers." These serious and specific dangers may include "the outbreak or the threat of an armed conflict."[17] Another example of MEAs that directly or indi-

[16]World Heritage Convention, Art. 11(2).

[17]*Ibid.*, Art. 11(4).

rectly provide protection for the environment during an armed conflict is the Ramsar Convention, which establishes a list of wetlands of international importance.[18] The Convention does not expressly state whether it applies to belligerents; however, intent may be inferred from the Convention's language that a party to the agreement has the right, "because of its urgent national interests, to delete or restrict the boundaries of wetlands already included by it on the List."[19] Although a little vague, scholars argue that 'urgent national interests' may include armed conflict.**?**Austin and Bruch [2000][20] Similarly, the UN Convention on the Law of the Sea (UNCLOS) requires states party "to protect and preserve the marine environment', as well as to take measures to prevent, reduce, and control marine pollution."[21] Although the standards applied to military as opposed to non-military vessels and aircraft vary,[22] legal experts argue that since UNCLOS creates an "objective regime" and intends to serve the interests of the state community as a whole, regardless of any political context, it may continue to apply during armed conflict.**?**Vöneky [2000] As discussed previously, more specific requirements for protecting the marine environment during wartime are are formulated in the San Remo Manual on International Law Applicable to Armed Conflicts at Sea. Article 44 of the Manual states that when hostile actions are undertaken within the exclusive economic zone of a neutral state, belligerents shall "have due regard for the rights and duties of the coastal State, inter alia, for Éthe protection

[18]The Ramsar Convention or The Convention on Wetlands of International Importance, Art. 2.

[19]*Ibid.*, Art. 3. Article 4 of the Ramsar Convention then requires that, when urgent national interests cause a party to make such a deletion or restriction, they should attempt to compensate for that loss of wetlands.

[20]It is notable that urgent national interests do not allow a party to restrict the protective measures of a listed wetland, only to amend its boundaries. The question then arises whether a military use of the area constitutes a violation of the duties of protection established by the Convention.

[21]United Nations Convention on the Law of the Sea (UNCLOS), 10 December 1982, 1833 UNTS 3. Arts. 192 and 194; also see Arts. 207Ð208 and 212.

[22]*Ibid.*, Art. 236.

and preservation of the marine environment."[23]

In contrast, the second type of MEAs explicitly suspend, derogate, or terminate the agreement between belligerents during armed conflict. For example, the Convention on Third Party Liability in the Field of Nuclear Energy (1960) exempts operators for damage directly resulting from armed conflict or similar activities.[24] This is equivalent to the established principle of insurance law that insurance against losses does not cover war damages. Seen in this light, the rule would apply not only to the relationship between belligerents but also to that between belligerents and non-belligerents. However, Austria and Germany objected to this provision and explicitly declared their right to hold operators liable for such damage.

Most of the MEAs contain no reference to their applicability during armed conflict. A few examples of such kind are the Convention on Biological Diversity (1992), the UN Convention to Combat Desertification (1994), and the Convention on the Conservation of Migratory Species of Wild Animals (1979). The effect of their silence, and whether it varies by type of convention, is uncertain. For example, commentary has posited that the Convention on Biological Diversity applies to belligerent parties, as it is analogous to human rights treaties that do not automatically terminate upon hostilities.[25] This uncertainty raises questions about how parties should proceed, such as whether belligerents should agree on sites to be placed off limits, or if military entities should be instructed on the principles of the MEAs and charged to abide by them to the extent possible. Table 6.1 provides a categorical list of some of the most important international environmental conventions and treaties according

[23]Art. 34. of the San Remo Manual. Additionally, Art. 35 states that if mines are laid within a neutral state's exclusive economic zone, the belligerent must notify the neutral state and give "[d]ue regard É to the protection and preservation of the marine environment."

[24]Convention on Third Party Liability in the Field of Nuclear Energy, Art. 9, 29 July 1960, amended 28 January 1964, 956 UNTS 264.

[25]Convention on Biological Diversity, 5 June 1992, 1760 UNTS 79; United Nations Convention to Combat Desertification, 17 June 1994, 1954 UNTS 3; Convention on the Conservation of Migratory Species of Wild Animals, 23 June 1979, 1651 UNTS 333.

to their applicability during war-time.

Customary International Environmental Law and Soft Law

Going back to our discussion on the relationship between the belligerent states and belligerent and non-belligerent states during an armed conflict, Customary International Environmental Law provides clearer guidelines for establishing liability between belligerent and neutral parties. For example, the Trail Smelter principle may afford protection to non-belligerent, neutral territories by establishing state responsibility for environmental damage caused outside the state where the acts or events entailing such damage occur.[26] Even though, several legal experts suggest that such allocation might not apply if belligerent interests outweigh the victim state's harm.**?** When damage is caused in neutral territory, this thesis is in contradiction with the general principle of the law of neutrality that the neutral territory is inviolable and that the neutral state, as a matter of principle, may not be affected by the armed conflict. There is no basis in state practice for the suggested exception to this customary rule of international law. The frequent reiteration of the Trail Smelter principle indeed indicates the rapid emergence of a state's right to environmental protection as customary IEL even during an armed conflict.

That still leaves the environmental protection of parties to the conflict an open question. Certain soft-law instruments of IEL explicitly refer to armed conflict. Other IEL principles and soft-law instruments may apply, although they do not address armed conflict directly. Soft-law instruments are not binding and can only inform

[26] *Trail Smelter Case (United States v. Canada)*, 16 April 1938 and 11 March 1941, Reports of International Arbitral Awards (R.I.A.A.), Vol. III, p. 1905. The Trail Smelter principle arose from an arbitral decision resolving a dispute between the United States and Canada regarding trans-boundary air pollution in which a Canadian smelter harmed US crops and forests downwind of it. The Trail Smelter arbitral panel held that Canada had a responsibility to prevent harmful trans-boundary air emissions from the smelter, and was liable for the damages that such emissions incurred. The decision was based on a fundamental responsibility to use one's territory so as not to cause harm to that of another. It must nowadays be considered as a rule of customary international law.

Table 6.1: Applicability of MEAs During Armed Conflict

EXPLICIT PROVISIONS
1) UN Convention on the Law of the Sea (UNCLOS) (1982) 2) International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL) (1954) 3) International Convention for the Prevention of Pollution from Ships (MARPOL) (1973/1978) 4) Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and its Protocols (Barcelona Convention) (1976/1995) 5) Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) (1971) 6) Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention) (1972) 7) Convention on Long-Range Transboundary Air Pollution (LRTAP) (1979) 8) African Convention on the Conservation of Nature and Natural Resources (Revised) (2003) 9) Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) (1972) 10) UN Convention on the Law of the Non-Navigational Uses of International Watercourses (1997)
SUSPENDED OR TERMINATED
1) Convention on Civil Liability for Damage Resulting from Activities Dangerous to the Environment (1993) 2) Convention on Third Party Liability in the Field of Nuclear Energy (1960) 3) Vienna Convention on Civil Liability for Nuclear Damage (1963) 4) International Convention on Civil Liability for Oil Pollution Damage (1971)
NO PROVISION
1) Convention on Early Notification of a Nuclear Accident (1986) 2) Convention on Biological Diversity (1992) 3) Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention) (1989) 4) UN Convention to Combat Desertification (1994) 5) Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973) 6) Vienna Convention for the Protection of the Ozone Layer (1985) 7) Montreal Protocol on Substances that Deplete the Ozone Layer (1987) 8) United Nations Framework Convention on Climate Change (1992) 9) Stockholm Convention on Persistent Organic Pollutants (2001) 10) Convention on the Conservation of Migratory Species of Wild Animals (CMS) (1979) 11) Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998)

Source: UNEP

the interpretation and application of international law unless they rise to the level of customary IEL. For example legal scholars are still arguing whether the 'precautionary principle' and the right to a healthy environment constitute–or are emerging–customary IEL. A few examples of these soft laws are the Declaration of the United Nations Conference on the Human Environment or the Stockholm Declaration of 1972 that articulated an overarching principle that may bear on IEL applicability during armed conflict.[27] Principle 21 of the Declaration provides that "States have É the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction." Two decades later, adopting the language in the Program of Action or Sustainable Development (Agenda 21),[28] The Declaration on Environment and Development (Rio Declaration) of 1992 stated in Principle 24 that "Warfare is inherently destructive of sustainable development. States shall therefore respect international law providing protection for the environment in times of armed conflict and cooperate in its further development, as necessary." [29]. In 1993, the UN General Assembly adopted resolution 47/37, urging states to take measures for complying with international law protecting the environment during armed conflict. In all of the above soft law measures, the intent to protect the environment is clear, the provision's precise meaning is less so; it may mean that IEL applies during conflict, or it may simply reiterate required state adherence to relevant IHL provisions.

[27]Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration), 16 June 1972, UN Doc. A/CONF.48/14/Rev. 1 (1973).

[28]See Art. 39(6) of Agenda 21: Program of Action for Sustainable Development, UN GAOR, 46th Session, Agenda Item 21, UN Doc. A/Conf.151/26, 14 June 1992.

[29]Rio Declaration on Environment and Development, 13 June 1992, UN Doc. A/CONF.151/26, Vol. I

6.2 Commentary

The above discussion on the International Humanitarian Law and the International Environmental law, embodying several conventions and treaties that make up the environmental protection regimes during war-time, highlights the fact that the doctrine of military necessity overshadows environmental concerns during wartime. The "threshold problem" in the IHL signifies the lack of will in the international community to protect the environment during conflicts. As the findings in the previous chapters suggest, conflicts do inflict a long term damage on the environment in many indirect ways even though we might assume that the environmental damage was contained. The IHL stipulations clearly have a very narrow view of environmental damage in-terms of its time and scope which has led to a very myopic regime, giving a significant advantage to military operations over environmental concerns. Similarly, treating environment as a military target trumps environmental concerns for the sake of military strategy. Even though customary international humanitarian law tries to rectify some of these problems, there aren't enough international case law precedents to strengthen customary law in this sphere.

Similarly, International Environmental Law, which includes conventions and treaties to primarily protect and conserve the environment is often silent when it comes to warfare. Except for a few treaties that explicitly offer guidelines during conflicts, most environmental laws are either silent on the issue of warfare or are suspended during conflict. This underscores the need to explicitly include regulations for states not only at the times of peace but also during the times of conflict. Also, these regulations should not only apply towards parties and non parties to conflict but also between parties to conflict.

Another critical issue that faces environmental regime during war-time is intra-state wars. Both IHL and IEL are extremely weak when it comes to dealing with environmental degradation during civil wars. As made clear in the previous chapters,

civil wars are as destructive for the environment as international wars, therefore, to not have significants regulations about the treatment of the environment during wars with in state borders is a serious gap in this international regime. One could potentially apply International Criminal Law or International Human Rights Law to deal with environmental abuses during civil war. For example, the case against Sudan's President, Omar Al-Bashir, in the International Criminal Court (ICC) has explored using environmental damages as an underlying act of an international crime. The prosecutors argued that the Militia/Janjaweed and the Armed Forces repeatedly destroyed, polluted or poisoned these wells so as to deprive the villagers of water needed for survival and thus invited the judges to recognize that environmental degradation in Darfur constituted an underlying act of genocide. However, such case precedents are far and few and have not been prosecuted successfully. Also, prosecution in such cases is based upon endangering human lives and not on damaging the environment, which limits the regime to human security and not comprehensive environmental security.

6.3 Land-mines and the International Law

As discussed in the previous chapters, both international and civil wars have an extremely detrimental impact on agricultural capacity. A large part of this loss can be attributed to direct and indirect effects of both anti-personnel and anti-tank land-mines. Land-mines not only release toxic chemicals into the soil, they also render large parts of the land useless by preventing people from utilizing the land. Given the extent of their usage even till today and the enormous harm that they perpetrate on the environment, it is important to look at the international mechanisms designed to deal with land-mines as part of international regime protecting the environment during war-time.

Land-mines were traditionally used by state-militaries for the purposes of defensive

warfare–to protect strategic locations or to channel enemy troops into specific combat areas. Due to this restricted manner of use, casualties of land-mines were limited to military personnel during combat or related activity. However, since the Vietnam war, land-mines have come to be increasingly used by weaker military or semi-trained militia to carry out more offensive warfare. This certainly does not mean that larger and more organized military did not use land-mines for combat, but the strategic use of land-mines moved from defense to offense. Most of the wars in the last few decades have been long-drawn, low-intensity, internal, and have been carried out by cash strapped parties. This changed nature of warfare has made land-mines, that are cheap and extremely destructive, an attractive weapon of choice. In wars today, mines are frequently placed in areas of high civilian concentration rather than being confined to limited battlefields of discreet size. This has resulted in increased level of destructiveness and fatalities in civilian communities. For example, internal wars in Afghanistan, Cambodia, and Uganda saw all the parties involved using land-mines to perpetrate economic and social destabilization or to prevent the return of refugees. Similarly, in Bosnia during 1993-94, Bosnian, Croatian and Serbian forces used mines to discourage the return of refugees by other ethnic groups.

Even though the US has been resistant to signing any treaty banning the use of land-mines, the U.S. State Department estimates that about 59 to 69 million land-mines were deployed worldwide in the early 1990s, making them one of the most toxic and widespread pollution facing mankind.[30] The State Department report also states that apart from inflicting heavy civilian casualties, (killing over twenty-four thousand people each year), land-mines exacerbate regional conflicts, hinder post-conflict reconstruction, seriously undermine infrastructure, and deny land-to-civilian use, thereby leading to overuse of existing land.

[30]U.S. Department of State, *Hidden Killers: The Global Landmine Crisis*, Pub. no. 10225, December 1994,1.

Over the last four decades two treaties have emerged as part of the International Humanitarian Law to restrict or ban the use of land-mines by both state and non-state actors. The first one is the Convention on Certain Conventional Weapons (CCW or CCWC), concluded at Geneva on October 10, 1980 and entered into force in December 1983, legislates on the use of excessively injurious and indiscriminate conventional weapons. The Additional Protocol II (AP-II) of CCW "prohibits or restricts the use of mines, booby traps and other devices." The AP-II aims to restrict the use of not only anti-personnel mines but also anti-vehicle mines and over the years the AP-II has been amended to expand its scope. Designed on the lines of arms control treaties, this protocol has been heavily criticized for prioritizing military necessity over humanitarian concerns. This is because the Protocol restricts the use of land-mines in stead of completely eliminating them. It also does not take into account the temporal aspect of land-mine use, which means that land-mines often have an impact on unsuspecting civilian population long after they are deployed.

The Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction, also known as the Mine Ban Treaty, which came into effect in March 1999 sought to rectify the loopholes of the AP-II. The Treaty is designed to completely eliminate Anti-Personnel land-mines around the world. The treaty also heavily emphasizes on the process of de-mining in all the signatory parties. Even though the Mine Ban Treaty does not enjoy the membership of some of the most militarized countries like the United States, China, India, Israel, Iran and so on, it does embody a different normative principle of regime building from AP-II which is the primacy of humanitarian and environmental concern over military necessity. This shift in international norms of regime construction which accords importance to humanitarian and environmental concerns over the doctrine of military necessity is the key to building stronger and more effective international regimes to protect the environment.

6.4 International Laws regarding IDPs and Refugees

Previous chapters show the impact of forced migration on environmental resources. Both outflow and inflow of population can lead to environmental degradation. Exit of large groups of people, especially from agrarian communities, leads to degradation of agricultural and grazing land. On the other hand, arrival of large population groups in an area leads to greater pressure on the local environmental resources like fresh water, land, forests and wildlife. Forced migrants settling on a new area can be primarily categorized as Refugees and Internally Displaced Populations (IDPs).[31]

When IDP data were first gathered in 1982, the ratio of refugees to IDPs was 10:1 (Cohen and Deng 1998a, 3); however, by 1990, the ratio was reversed to 1:1.45, with 14.7 million refugees and 21.3 million IDPs. More recently, the reversed ratio has increased to 1:3.08 in 2009 (UNHCR 2010c). The reasons for this reversal are both demographic and political. While internal wars, developmental projects and environmental disasters in the last few decades, have led to much more displacement of population groups within state borders, the limited definition of "refugees" as per the the international law precludes these groups from being counted as refugees. Refugees are recognized by the 1951 Convention Relating to the Status of Refugees, and IDPs are not. Defining or labeling categories of forced migration changes the lives of a potentially very large number of people. People who fall into the refugee category are more likely to have the opportunities to be safe; otherwise, they are often ignored and their lives become more endangered they are similarly in desperate need of help **??**.

Most internal displacements in the last decade were caused by internal armed con-

[31]In the contemporary research on forced migration, the most frequently cited definition of forced migration, which has been adopted and promoted by the International Association for the Study of Forced Migration and Forced Migration Online, is: "a general term that refers to the movements of refugees and internally displaced people (those displaced by conflicts) as well as people displaced by natural or environmental disasters, chemical or nuclear disasters, famine, or development projects."(Refugee Study Center N.d.)

flicts rather than international or internationalized conflicts [**?**]. Sudan, DRC, and Iraq are major countries that consistently produced refugees and IDPs. In these countries, although the non-displaced population maybe exposed to the same abuses and barriers, the fact that IDPs have been displaced within their countries tends to further keep IDPs from access to physical security, the basic necessities of life, and other rights. In the worst case, these people are often not acknowledged by national authorities. Governments often deny situations of internal displacement caused by conflict, generalized violence, or human rights violations. According to IDMC [**?**], the governments of Ethiopia, Indonesia, Israel, Myanmar, Sudan, Turkmenistan, Uzbekistan, and Zimbabwe did not acknowledge the existence of internal displacement during 2008. Thus, it is difficult to profile a forcibly displaced but hidden population along with their suspected outstanding needs. In these cases, the influence of international humanitarian actions on IDPs becomes marginal, especially when those governments reject international humanitarian assistance. Notably, no international institution has been given the mandate to protect or assist conflict-induced IDPs.

As an outcome of wars, these groups can be further divided as–1) Refugees of International Wars, 2) Refugees of Civil Wars, 3) Internally Displaced Population (IDPs) of International War, and 4) IDPs of Civil Wars. Given the nature of the international refugee regime, Pathak and Song (2012) find that the level of environmental extraction varies by different migrant groups depending on the financial and humanitarian assistance by the international community for those groups. This is primarily due to the design of international regimes pertaining to refugees and IDPs.

Institutional Definition of Refugees

Traditionally, academic and policy concerns with forced migration have concentrated on refugees. The 1951 Convention codifies the rights of refugees and lays down basic minimum standards for the treatment of refugees. It defines a refugee as a person

who:

> "... owing to well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable or, ... is unwilling to avail himself of the protection of that country; or who, not having a nationality and being outside the country of his former habitual residence as a result of such events, is unable or, ... is unwilling to return to it ..." (Article 1.A.(2)). [32]

Most importantly, refugees have to be *outside* their countries of origin. The well founded fear has to result from persecution, and refugees have to be unwilling or unable to seek the protection of their country. The definition in the 1951 Convention is often applied to cover people displaced by natural disasters or economic development projects; however, those groups are not recognized by the international refugee law.[33]

Developing countries host 8.3 million refugees, which is 80 percent of the global refugee population. Statistics from UNHCR show that most refugees remain in their region of origin and flee to bordered countries. The major refugee generating regions host on average between 76 percent and 91percent of the refugees within their regions. At the end of 2009, only 17 percent of the total 10.4 million refugees lived outside their region of origin (UNHCR 2010c). This pattern remains consistent over the period between 2001 and 2009. During these years, the minimum percentage of refugees who stayed in their region of origin was recorded at 71 percent in Europe in 2004, and the maximum percentage was 94 percent in Latin America in 2004. This obviously puts a tremendous amount of pressure on the neighboring countries' environmental resources sometimes leading to further violence between local and refugee populations.

[32]The 1967 Protocol Relating to Refugee Status and the 1969 OAU Convention Governing the Specific Aspects of Refugee Problems in Africa also recognize this individual as a refugee.

[33]The term "Refugees" should not be confused with "economic migrants," who can leave their countries of origin by voluntary and conscious choice and may return to their countries of origin without any problems. The UNHCR statistics also do not include 4.2 million Palestinian refugees from 2000 to 2009. They fall under the responsibility of the United Nations Relief and Works Agency of Palestine Refugees in the Near East (UNRWA).

The situation is complicated by the fact that most of the countries facing an influx of refugees are themselves strapped in terms of money and infrastructure to provide adequate support for the incoming population groups. However, the international law and agencies pertaining to refugees are relatively organized and well funded to offer help.

Institutional Definition of IDPs

During the past three decades there has been a growing recognition that a great number of people are in refugee-like situations within their own countries with the same level of special needs that refugees have. Since IDPs relocate themselves to a different part of their own country, international assistance to and the protection of IDPs are politically controversial issues in international relations. Nevertheless, the international community has developed an international IDP regime since the mid-1990s.

The Guiding Principles on Internal Displacement in 1997 (UN OCHA N.d.) defines IDPs as follows:

> "... persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or man-made disasters, and who have not crossed an internationally recognized state border (para.2)."

Three core elements of this definition are the coercive and involuntary character of movement, movement within national borders, and citizens or foreigners with habitual residence. Unlike refugees, IDPs do not have a specific legal status; yet, they are in as much desperate need as refugees are. In contemporary forced migration crises, governments reluctantly but increasingly allow humanitarian agencies to launch humanitarian operations within their territories. Thus, it is necessary to restate more

detailed legal provisions responding to the specific needs of IDPs induced by conflict as well as other causes. At the end of 2009, the number of conflict-generated IDPs was estimated at 27.1 million (IDMC 2010a). UNHCR does not have a mandate to assist or protect these people, but it increasingly engages in field operations for IDPs. In 2009, for instance, 5.6 million IDPs benefited from UNHCR-involved operations. However, the majority of IDPs worldwide live in protracted displacement in which the processes of finding durable solutions have stalled and/or IDPs are marginalized as a consequence of violations or a lack of protection of human rights, including economic, social, and cultural rights (IDMC 2009, 14). In this situation, it is difficult to assess their number, particularly in countries with both protracted and new displacements. For example, in the August 2008 conflict between Russian and Georgian forces, the situation of people displaced since the 1990s was overlooked in favor of the people affected by the new displacement crisis.

Different categories of forced migrants vary in their power of choice and the accessibility to international assistance and protection. In general, refugees are considered to exercise more power of choice and get more assistance and protection than IDPs. In international conflict, neighboring countries and the international community often become promptly involved in assisting and protecting those who have already crossed international borders. Due to the binding demand of the international refugee regime, refugees enjoy a higher level of accessibility to international support than IDPs. The range of their freedom of choice in international conflict becomes wider than that of refugees motivated by domestic violence.

IDPs in an international conflict can also have a wider range of power of choice than IDPs in a domestic conflict, but by staying inside the country of origin in which a conflict occurs, they often have little access to international assistance and protection. On the other hand, in the case of an internal conflict, the probability that both refugees and IDPs will be assisted and protected by the international community is

lower than in the case of an international conflict. Since the international refugee regime was established to address humanitarian consequences of interstate wars, it does not bind governments and humanitarian agencies together to assist displaced people in internal conflicts. Therefore, forced migrants in civil wars and other internal conflicts are likely to remain within their countries of origin and face harsher circumstances. Without binding rules for the international community to be involved in domestic affairs, the number of refugees is expected to be smaller than that created by international conflict. IDPs are assisted or protected by the international community in varying degrees. Depending on the willingness and capability of governments and the international community, some IDPs have better opportunities for safety than others. In general, being entitled to refugee status increases the probability that displaced people can be safe and can get assistance.

To sum it up the above argument, in terms for humanitarian and financial assistance, refugees of international wars benefit the most from the international refugee regime followed by refugees of civil wars followed by the IDPs of international war and the groups that benefits the least are IDPs of civil wars as follows: refugees in international wars >refugees of civil wars >IDPs of international wars >IDPs of civil wars. This order of benefits perhaps indicates the group that would engage in most environmental extraction to compensate for any the lack of assistance from the international community. Therefore, the need of the hour is to strengthen the IDP regime so that internally displaced groups rely less on environmental extraction from their surrounding areas.

6.5 Discussion

A regime's norm forms its core that determines its objectives and effectiveness. The above discussion indicates that the international regime to protect the environment during wartime accords primacy to military necessity over environmental security.

Even when International Human Rights Law, International Criminal Law or the International Humanitarian Law prescribe measures for environmental protection during wartime, that concern often stems with in the context of human security and not necessarily environmental security (which should mean securing the environment for the sake of environment itself and not necessarily for the sake of human beings). For a more comprehensive and effective regime to wards environmental protection during wartime, the norm of the international community needs to experience a shift towards environmental protection.

One example of how norm-shifting can help the effectiveness of a regime is the international whaling regime. The International Convention for the Regulation of Whaling which regulates and monitors whaling activities around the world has seen significant changes in its norms since 1940s. The regime was initially designed for sustainable whaling and embodied a "consumptionist" norm. This meant that the aim of the member states was to establish fixed quotas for the catch be able to carry on whaling for commercial purposes in a sustainable manner. Due to an upsurge of environmental movements in the 1960s and new research by the scientific community, the "consumptionist" norm of the whaling regime shifted to "conservation." This shift in the regime norm led the International Whaling Commission (IWC) to establish zero catch limits for commercial whaling in 1986. This provision is still in place today, although the Commission continues to set catch limits for aboriginal subsistence whaling and research related whaling. Various environmental groups have been fighting for complete "preservation," which means an absolute ban on whaling. So far, the IWC has resisted a shift to the "preservation" norm but the earlier shift from a "consumptionist" norm to a "conservationist" norm in the whaling regime made significant improvements in the whale population and the effectiveness of the whaling regime.

A similar shift in the international norm–from that of "military necessity" to

"environmental preservation"–has to occur so that the international regime towards protecting the environment during wartime can be strengthened.

Chapter 7

Conclusion

The traditional notion of security focuses on the security of states and their ability to guard their territorial sovereignty against any external threat. At the international level this implies that the world is secure if individual states can protect their borders and national interests. However, with the end of Cold War, the notion of security underwent a paradigm shift. With the great power politics suspended, scholars and policy practitioners of security began to shift their gaze from the security of states on to the security of human beings. This new paradigm of human security demanded absence of wars, population health, human rights, social developments, and protection from environmental hazards. The expansion of the notion of state security to human security was a result of changing dimension of the international context such as the emergence of an arguably multipolar world, growth of non governmental organizations, international terrorism, and globalization. Now, once again we are at a critical juncture in international politics where the world has to think about security in terms of environmental challenges and this calls for another reorientation of our perspective of security.

Earlier, the idea of environmental security was subsumed under the paradigm of human security. This involved and reflected the ability of an entity, whether a nation or a society, to withstand environmental asset scarcity, environmental risks or adverse changes, or environment related tensions or conflicts. Such a conception of environmental security has been very prevalent in the field of international relations and international development. In international politics, scholars and policy-practitioners,

concerned about conflict, have looked at how altered resource availability such as food shortage or loss of land, leads to political disputes and civil unrest. Such resource scarcity could lead to creation of new power blocs and much bigger international conflicts. Scholars of international development worry about environmental security in terms of access to drinking water, food, and environmental sustainability to ensure continuous economic development. However, as more and more scientific evidence of anthropogenic impact on the environment is coming forward, we must question our objective of environmental security.

As mentioned repeatedly in this research, an anthropocentric vision of environmental security is not only presumptuous, it also weakens the construction and effectiveness of environmental regimes. Also, given how human civilization has exploited Earth's "resources," for centuries now, it is the environment that needs to be secured from us and not vice-versa. Both states, (as emphasized by the Neo-realist security paradigm) and individuals, (as epitomized by the Human Security paradigm) have contributed towards compromising the environment for developmental gains. As the landscape of international politics is shifting again, it is important to not subsume environmental security under other security paradigms but reframe it as an independent paradigm that prioritizes the security of the environment.

The Millennium Project, an independent think tank initiated by the United States EPA, UNDP, and UNESCO, did a global assessment of the definitions of environmental security and created a synthesis definition: Environmental Security is environmental viability for life support, with three sub-elements–1) preventing or repairing military damage to the environment, 2) preventing or responding to environmentally caused conflicts, and 3) protecting the environment due to its inherent moral value. This definition, although anthropocentric, does underscore the importance of securing the environment due to moral imperatives above all else. This understanding of environmental security also recognizes that environment is greatly susceptible to wars

and needs to be protected from military activities.

In line with the above understanding of environmental security, this study has examined some important aspects of the relationship between armed conflict and the environment. Whereas most studies of conflict focus on determinants of war, I examine the consequences of war for the environment. Environmental security should not mean securing the environment *for* us, rather it should be about securing the environment *from* us. This includes protecting the environment from militarized and violent conflicts notwithstanding any doctrine of military necessity. In this concluding chapter, I revisit the question of why the relationship between conflict and environment matters to students of international security. In the next section, I briefly discuss the importance of securing the environment in a global context, followed by some significant aspects of conflict-environment relationship that might be useful directions for future research.

7.1 Environment and Environmental Security as a Global Issue

Although the Earth's climate has gone through natural changes through its inception due to natural climatic cycles, variations in the Earth's orbit and inclination to the Sun, changes in sea currents, and other natural phenomena such as volcanoes and sunspots, the scientific community concurs that the changes in Earth's climate since the 20th century have outpaced all other natural changes of the past recorded by humans. Scientists have attributed this unusual pace of change in Earth's climate, which includes an overall rise in global temperatures, to anthropogenic activities.

Since the industrial revolution, human activity has increased the amount of greenhouse gases such as carbon-dioxide, methane, nitrous-dioxide, and chlorofluorocarbons, in the atmosphere. The increased amount of gases which absorb heat, has directly lead to more heat being retained in the atmosphere and thus an increase in global average surface temperatures. The increase in temperature also leads to change

in rainfall patters, hurricanes, glacial melting, and other effects on the climate system.

Land-use changes, such as cutting down forests to create farmland, have led to changes in the amount of sunlight reflected from the ground back into space, a phenomenon known as the surface albedo. The World Meteorological Organization estimates that this phenomenon is responsible for at least one-fifth of the changes in the global climate due to changes in emissions of greenhouse gases. About half of the land use changes are estimated to have occurred during the industrial era, much of it due to replacement of forests by agricultural cropping and grazing lands over Eurasia and North America. Other significant changes in the land surface resulting from human activities include tropical deforestation which changes evapotranspiration rates (the amount of water vapor put into the atmosphere through evaporation and transpiration from trees), desertification, which increases surface albedo, and the general effects of agriculture on soil moisture characteristics.

Given the state of affairs and the inability of the Kyoto Protocol to achieve a global mandate, the international community is now aiming to come up with a binding universal agreement to cut greenhouse gas emissions by the year 2015. Fervent international negotiations are underway as part of the Bali Action Plan to come up with a viable and effective agreement to protect the environment from anthropogenic activities. Two primary reasons why the Kyoto Protocol failed to achieve a universal mandate were a strong reluctance from developed countries like the United States and Australia to accept a "differentiated responsibility" for cutting down emissions, and a refusal from developing countries like India and China to accept any binding cuts on their emissions and compromise their economic growth. The reservations from both sides are predicated upon prioritizing economic security and development of states and individuals over environment. However, the inability to reduce the anthropogenic emissions into the Earth's atmosphere, coupled with massive deforestation and other pollution, will lead to catastrophic effects for the planet. Therefore, we have come

to a precipice of environmental degradation where we need to change our priorities and secure our environment above all. This is also true in the realm of violent conflict where no military necessity or national security should justify environmental degradation.

7.2 Violent Conflict and Environmental Security

In this study, I have evaluated certain aspects of the relationship between conflict and the environment within an altered environmental security framework. I have presented the environment at the center of my analysis and have argued that environment must be protected during war-time as a moral imperative. Wars affect the environment through a myriad of complex mechanisms, and a number or direct or indirect consequences of violent conflict can lead to deterioration of the environment. My analyses demonstrate some important linkages among conflict, socio-political factors, and environmental indicators.

I find that conflicts have a very detrimental impact on the environment which may not become apparent in the short-run but can lead to a significant loss of biocapacity of a country in the long-run. My analysis also suggests that different type of conflicts can have different impact on a country's environment, for instance, international and ethnic conflicts have a more detrimental impact on a country's environment in a the long-run but in the short-run only international conflicts seem to impact the environment. My analysis also finds a significant relationship between democracies and the long-run environmental management after conflicts. Apart from political factors, economic factors also have a significant impact on the environmental capacity of a country in both short-term and long-term. By using a standardized measure of environmental quality such as *national biocapacity*, I can compare the impact of different types of wars on different types of environmental services or indicators. For example, I find that while internal wars are extremely devastating for the forest resource of a

country, ethnic wars and civil wars are more destructive for crop production. On an average, international wars tend to be more devastating for most of the environmental indicators analyzed in this study.

These are important conclusions regarding a significant consequence of war, and are relevant to policy decisions regarding conflict initiation, intervention, and international regime building. As mentioned earlier in the dissertation, this study only claims to be the "first-cut" in assessing the impact of conflicts on the environment in a large-scale and systematic manner. I expect this type of research to become more nuanced and accurate as we develop better data for measuring the environment in a more comprehensive manner and not just the productive capacity of the environment (which is a completely anthropocentric measure of the environment). A more nuanced analysis of this relationship (between violent conflict and the environment) would also involve looking at feedback loops where environment and conflict could impact each other in temporally sequential manner. This means that violent conflicts can lead to environmental degradation, which in turn can lead to further conflict, which could lead to further environmental degradation and so on.

Another path for this analysis would be to look at the spatial diffusion of environmental degradation due to conflict. Since, both environment and conflict spread across territorial boundaries, this relationship often diffuses across national borders. Therefore, the next natural step for this research would be to undertake a spatial analysis to understand how environmental impact of conflict spreads into neighboring countries.

There are some additional aspects to the impact of violent conflicts on the environment that have not been empirically tested in this study but warrant a brief discussion here as appropriate directions for continued exploration of the conflict-environment relationship. Internal displacement of population, international aid and domestic budget allocation, environmental justice, and conflict cycles are some of the

factors that need to be looked into when we look at the relationship between conflict and environment.

Allocation of Resources Between Environment and Military Expenditure

Wars cost money, and for states and warring factions, the expenditure on war often comes at the expense of social welfare. Societies all over the world have had to divert divert resources from other use, including environmental provisions, to fund war efforts. Both developing and developed countries make critical decisions about defense spending, particularly in times of conflict. Between 1960 and 1990, military expenditure increased about four times in developing countries, but began to decline after 1990. Even though there has been an overall decline of military expenditures by developing countries since the 90s, their per-capita expenditure on defense spending has doubled in recent years. This means that developing states cultivate a higher defense spending burden as a proportion of their GDPs as compared to developed countries that obviously outspend the developing countries in absolute amounts.

This is a classic guns verses butter debate where due to states' limited economic capacity there is budgetary tradeoff between military expenditure and welfare spending. In this research I have talked about the indirect impact of wars on the environment, this kind of monetary trade-off that takes away resources from spending on environmental protection is a very important economic consequence of conflicts for the environment.

There are three important ways in which conflict affect the environment through economic channels. Firstly, wars lead to diversion of resources away from environmental protection. This trade-off has a much more harmful impact on developing countries that developed countries. Wars put tremendous strain on a country's infrastructure and social services, this includes environmental infrastructure such as

irrigation structures, conservation personnel, refineries, mines and so on. Developing countries, where such infrastructure might be underdeveloped and under-protected to begin with, often pay a much heavier price if whatever infrastructure that exists, is destroyed. Also, during and after wars, economically disadvantaged countries might not be able afford reconstruction of critical environmental services and the impact of destruction is then prolonged. This is because, given a limited supply of economic aid and resources, other human services like food, shelter, and health take priority over environmental conservation efforts in times of crisis. Having said that, such budgetary trade-offs are also experienced in societies of developed and industrialized states. For example, the Cold War witnessed a significant resource allocation of resources from welfare to war preparation both in the United States and the Soviet Union. Military spending by developed states also affects financial aid allotted to developing countries. [Levy and Sidel (2002)]

Secondly, in addition to diversion of resources from welfare to warfare, states that are involved in conflict–particularly longer conflicts–experience a decrease in their overall income level. According to the United Nations Children's Fund (UNICEF) estimates, by 1986 Mozambique's GDP per capita was 50 percent less than what it would have been without the war. Mozambique's GDP per capita fell from 185 USD in 1980 to 87 USD in 1992, and Mozambique became the poorest state in the world. This loss of income not only affects human services, it also affects a Mozambique's ability to spend on conservation efforts and protect its precious Mangrove forests and coral reefs. Other countries in Africa, such as Niger, Sierra Leone, and Liberia, have also been expanding their defense spending at the expense of other economic sectors. [Rahim and Akinroye (2002)]

The third way in which conflicts indirectly affect the environment through economic mechanisms is in trade involving environmental resources to generate the income needed to buy arms. Extraction of minerals and diamonds, and illegal logging

have funded brutal wars in Liberia, Sierra Leone, Angola, Democratic Republic of Congo and CŹte dÕIvoire that have resulted in the death and displacement of millions of people. According to recent reports, revenues from diamond mining companies operating in the Marange area in Zimbabwe have funded abusive security forces loyal to the ruling Zanu-PF. Revenue from the diamond sector could fund further violence in the 2013 elections. In Democratic Republic of Congo (DRC), fighting that has continued over 15 years, has been driven by the trade in valuable minerals like cassiterite (the ore for tin), coltan (the ore for a rare metal called tantalum), wolframite (tungsten ore), and gold. Interestingly, the electronics industry based in developed countries is one of the main destinations for these metals, which end up in mobile phones, laptops, and other consumer products.

Untangling these complex economic connections between conflicts and environment is a crucial task which will not only highlight the inadequacy of funding towards environmental conservation but also underscore the need for financial aid and international concern towards combating environmental impact of conflicts.

Subnational Environmental Impact of Conflicts

This study has looked at the impact of warfare on a country's environmental capacity. Due to the nature of *national biocapacity* data, this research has been confined to a country level analysis of environmental degradation. However, "environment" is not confined by political boundaries, and states often experience different levels of environmental degradation within their territories as a consequence of conflict. This is because the ecological vulnerability of the environment varies within countries. Also environmental infrastructure such as dams varies in different parts of a country which can determine what areas are targeted during wartime.

For example, according to UNEP reports, the southern part of Sudan and the northern part of South Sudan were the worst affect regions environmentally during

the civil war in Sudan. This region falls in the Sahel belt and is environmentally one of the most vulnerable regions of the world. Also, this region was the epicenter of the Darfur conflict hence it experienced the maximum amount of population displacement in the country. Similarly, in larger countries like India, intra-state wars in specific regions such as Kashmir or Assam or Punjab lead to environmental deterioration within a localized area that is not effectively captured by *national biocapacity* data. Also, due to data limitations, this research only focuses on the impact on a country's environmental biocapacity due to hosting international refugees. However, as mentioned before, given the increase in the number of intra-state wars in the last thirty years the number of internally displaced population is much higher that international refugees. These groups of IDPs that locate themselves in different parts within the same country also put pressure on environmental resources that needs to be accounted for.

Refugee camps and IDP camps put an immense amount of pressure on local environmental resources. It is often hard to find large swaths of land to establish refugee camps and IDP camps, hence, national parks and wildlife reserves often become the *de facto* choice for setting up these camps. As mentioned before in this research, this leads to logging, poaching and hunting of wild animals, pollution of water resources. Such environmental degradation is often limited around the area of rehabilitation camps and might be difficult to capture in a national level environmental data. Therefore, it is important to develop similar studies that look at the environmental impact of conflicts at a more subnational level. This will not only increase the accuracy of the analysis, it will also help in making more specific policy prescriptions designed for localized regions.

Environmental Justice

This study highlights the devastating impact of international warfare and how overall, international wars are more detrimental to the environment that civil wars. This is because, modern international wars use advanced weaponry, carpet bombing and strategic aerial attacks that wreak havoc with a country's environment. This devastating impact on the environment also highlights the environmental injustice of many international wars that are increasingly being undertaken for the sake of "humanitarian intervention." Because the intervening parties' mode of conducting warfare is often not only impersonal but also physically distant, absolving them of any environmental damages.

The notion of environmental justice emerged in the United States in the 1980s a part of a larger environmental movement. The concept of environmental justice focuses on a fair distribution of environmental benefits and burdens. Environmental justice advocates are concerned with what is termed "social ecology" or "human welfare ecology." Their primary concern is the impact of institutional systemic flaws which are the natural result of a progression of historical events resulting in decisions which establish unjust living conditions upon one group of people due to a lack of organization, power and prominence. Environmental justice advocates contend that instances of environmental injustice are not simply arbitrary realities which occur in varying contexts. Rather, instances of environmental injustice are the outcome of an institutional oppression and isolation which have set up an inevitable framework of the powerful oppressing the powerless. The victims, through a significant occurrence of historical and social realities, have been cut off from the power required even to challenge the causes of environmental injustice.

Even-though the environmental justice movement primarily emerged in the United States within the context of racial and class politics, its scope has now been expanded to international circumstances. The idea of "differential responsibility" in the politics

of climate change and the financial and technological aid demanded by the global South, stems from the idea of environmental justice. The environmental exploitation of the global south is symptomatic of systemic injustice that has been perpetrated from the times of mercantilism to colonialism to the present era of globalization.

Since the development of aerial warfare, the notion of environmental injustice has become relevant for militarized conflicts also where the environmental burden of war is born unequally. From the atomic bombing of Japan during the Second World War by the United States to the NATO intervention in Libya in 2011, developed countries have been able to successfully distance themselves from the environmental catastrophes of war. Every time, the United States has undertaken military operations in Iraq, or when Britain launched an attack over Falkland Islands with Argentina, or when NATO bombed Yugoslavia, it was the country at the receiving end that experienced environmental devastation. Such inequality in experiencing the environmental impact of war can make the powerful and more developed countries oblivious of the environmental cost of war. However, such thinking can be misguided because in the long-run, if not sooner, the environmental impact of wars if felt by other countries due to the interconnectedness of environmental systems and a global dependence of environmental resources.

7.3 Directions for Future Research

Environmental security if treated as means for human security will dilute our focus on protecting and conserving the environment. As mentioned previously, this research only claims to be the beginning of looking at the relationship between environment and conflict from an altered perspective of environmental security. Most research exploring this issue has looked at the environmental factors as exogenous determinants of violent conflicts. These studies argue that scarcity or abundance of resources or environmental disasters lead to conflict. I, on the other hand, have argued here that

the relationship between environment and conflict is not unidirectional. In stead environment and social conflicts affects each other in complex feedback loops and looking at the environmental impact of conflict is only examining one part of this complex relationship. My research also shows how conflicts degrade some of socially critical environmental resources such as cropland, fisheries, and forests, that could lead to more social conflict. The difficulty in clearly explicating this feedback type of relationship between conflict and environment arises from the complexities of relevant linkages, the challenge of identifying influential intervening factors, lack of data, and the sheer number of actors involved. It is therefore necessary to continue examining the environmental consequences of conflict and their larger relationship.

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