AY 2014-2015

ORIENTING THE MILITARY TO THE THREAT OF CLIMATE CHANGE

INDEPENDENT STUDY RESEARCH PAPER

LIEUTENANT COLONEL JESSE A. KEMP
UNITED STATES MARINE CORPS

GREG FOSTER, ISRP ADVISOR
MARK FOULON, PRIMARY FACULTY ADVISOR

The Dwight D. Eisenhower School
for National Security and Resource Strategy
National Defense University
Fort McNair, Washington, D.C. 20319-5062

Climate change has become one of the most politically divisive issues of our time. Fierce debates frequently abound about whether our planet is warming, at what pace and whether or not this phenomenon is caused by human-induced carbon emissions. Yet while politicians are staunchly divided over how climate change should impact budget considerations and public policy, the United States military has quietly begun to focus on climate change as a strategic priority. As events like tsunamis in the Asia-Pacific, the Ebola crisis in West Africa and the earthquake in Nepal continue to illustrate, the U.S. military will inevitably be called on during humanitarian crises and environmental calamites. This is why climate change is such an important issue for the military. Many believe that climate change is a dangerous catalyst on top of an already fragile, resource-strained planet that could lead to humanitarian disasters on a scale and scope unseen in modern times.

Analyzing security threats through such a non-standard lens as climate change is not a new concept. There is a mature and robust body of literature on "environmental security", and to a related extent, "human security", with a central argument that core security is derived from humans and their relationship with the environment. However, the emerging threat of climate change has rapidly brought the concept of environmental security into mainstream debate circles, with many convinced it is now the most serious threat to global security and stability we face. Admittedly, this is a hard concept for most "traditionalists" to grasp. For starters, climate change is incredibly difficult to perceive—both literally and conceptually. Second, conventional wisdom on climate change assumes its effects will manifest slowly and linearly over a period of decades or even centuries, making it an easy threat to put off. Yet many scientists warn that climate change could just as easily produce sudden, violent shifts in environmental conditions with especially dire consequences for politically weak or conflict-prone regions.[1] Furthermore,

worst-case climate change scenarios suggest the possibility of enormous destabilization that threatens to undermine security on a truly global scale—especially given the interdependent nature of the modern globalized world. Failing to consider these types of scenarios and the full range of risks climate change poses is not a sound basis for security planning.[2] Such a potential threat requires the *prioritized* focus of all instruments of national power—including the military. This will not be easy. Even though military strategists have begun to consider climate change threats as an influencer of military operations, in practice the U.S. military is neither structurally nor culturally aligned towards serious consideration of environmental security threats. Yet as this paper will argue, prevailing conditions and emerging trends indicate that environmental *insecurity* could define a new era of scarcity exacerbated by climactic change. As a result, the military must begin to better orient itself toward addressing these risks. This orientation begins with developing environmental intelligence capabilities which will allow regional combatant commanders to realistically incorporate environmental threat scenarios into operational plans. A serious commitment to this challenge also provides renewed opportunities to leverage the often sought-after but perpetually illusive "whole of nation" approach by integrating strategies and coordinating operations with both inter-agency partners and civil society-based organizations.

Understanding Climate Change:

A slow-moving, nearly imperceptible menace, climate change is difficult to perceive—both literally and conceptually. Rising temperatures and sea levels, changing precipitation patterns and an increased frequency of severe weather all characterize the direct impacts of climate change. While polarizing political debate surrounds the root causes of climate change, few disagree that there is mounting, tangible evidence of changing climactic conditions compared to historical norms. For example, NASA's Earth Sciences Division reports that the

earth's mean temperature has risen by 1.4 degrees Fahrenheit since 1880,[3] while the National Oceanographic and Atmospheric Administration (NOAA) reports that sea levels have been steadily rising at a rate of 0.04 to 0.1 inches per year since 1900, with almost no observed sea level rise prior to that.[4] NASA satellite measurements also indicate that the Greenland and Antarctic ice sheets have lost up to a combined 72 cubic miles of mass between 2002 and 2006.[5] At the North Pole, the extent and thickness of Arctic sea ice is declining at a rate of 13.3 percent per decade.[6] Assessing future trends, the United Nations' Intergovernmental Panel on Climate Change (IPCC)—widely recognized as the world's unbiased authority on climate change science—recently issued its 5th Assessment Report in November 2014. The report warns it is "very likely" that the earth's surface and atmospheric temperatures will continue to increase, causing more intense heat waves while oceans will continue to warm, rise and become more acidic, placing already fragile ecosystems in jeopardy.[7] Additionally, researchers have observed a 70 percent increase in the destructive power of Pacific and Atlantic-based tropical storms over the last 30 years, reinforcing a belief that rising ocean temperatures may also be linked to greater intensity of tropical cyclones and hurricanes.[8] Summarizing future threats in its 5th Assessment Synthesis Report designed for policy makers, the IPCC emphasized with "very high confidence" that the impacts of climate-related extremes already observed reveal fundamental vulnerabilities within ecosystems and human systems to further climate variability.[9] In other words, the IPCC believes the threat of future humanitarian crises brought on by environmental calamites is very high.

While climate change is a global phenomenon, its impacts will not be distributed equally. Not surprisingly, developing nations face the greatest risk as their inherent weaknesses will only be exacerbated by the effects of climate change. Without the infrastructure or capacity to provide

basic services, many countries face the challenges of unstable populations that already push the limits of sustainability. This existing tension is felt both internally, as governments engage in a constant hand-to-mouth struggle to provide food, clean water and basic services to their people, and externally as international food supply chains operate with little excess capacity. Any anomaly in the system such as floods, droughts or heat-waves, could trigger a cascading series of events with the potential to quickly destabilize underlying security conditions. Evidence of such environmental fragility in many countries and regions around the world is increasing and is becoming a widely recognized risk.

A Case Study of Bangladesh:

In 2008 riots broke out on the streets of Dhaka, the capital of Bangladesh, over the soaring price of rice. An estimated 20,000 Bangladeshis, made up primarily of striking garment industry workers, clashed with police while demanding higher wages to compensate for the price spikes. The protesters were eventually dispersed but not without the aid of the military, which was rapidly mobilized to assist overwhelmed police. At the time, garment workers supporting Bangladesh's number one export industry earned less than $1 per day. Even before the price spikes the average family of four in Bangladesh spent roughly half their income on food yet through the early months of 2008, rapidly rising prices had driven food costs to almost 75% of household income.[10,11] A staple across the entire country, Bangladeshis count on rice for 75% of their diet meaning there were few substitutes available to offset high rice prices—particularly in urban markets.[12]

Leading up to the Dhaka riots of 2008, the price of world food commodities had seen a remarkable rise over the course of a year: wheat prices increased by 130 percent, soya by 87

percent and rice 74 percent.[13] Besides inciting riots in Bangladesh, these food price spikes caused similar public unrest across the developing world including in Egypt, Indonesia, Ivory Coast, Mauritania, Mozambique, Senegal and Cameroon. [14] While the factors that contributed to global food shortages were complex, a primary cause was attributed to decisions by the United States and other grain exporting countries to subsidize domestic agriculture for biofuel production—an issue championed by environmentalists at the time as a means to develop clean, renewable energy sources.[15] Yet in an ironic twist of unintended consequences, the biggest impact of diverting grain crops for biofuel was to exacerbate already-strained global food supplies.

Under normal conditions, Bangladesh would not have been subjected to global food commodity price perturbations. Occupying the world's largest delta at the confluence of the Jamuna, Padma (Ganges) and Meghna rivers, over 60 percent of Bangladesh is arable land which, along with use of "green revolution" technology such as irrigation, improved seeds, and fertilizer, has ensured a relative degree of agricultural self-sufficiency for the country's massive population of 156 million people. However, in November 2007, Cyclone Sidr, a category-5 tropical storm, struck the coastline of Bangladesh killing an estimated 3,500 people, destroying over 500,000 homes and displacing just under 1 million people.[16] Unfortunately the devastation did not end there. Sidr also destroyed over 3 million tons of un-harvested rice in the fields—a significant portion of the country's overall annual capacity—forcing the government to import rice to meet demand and subjecting Bangladeshis to unfavorable global markets. Ultimately, Cyclone Sidr's most lasting legacy was that it revealed an underlying fragility and lack of resiliency in the country's overall food security. Many believe it was also a harbinger of more frequent and greater challenges ahead for Bangladesh.

A New Threat Paradigm:

Bangladesh's food crisis of 2008 illustrates a form of "complex emergency" resulting from a combination of both natural and man-made causes.[17] Along with increasing signs of an environmentally-strained planet, incidences like the emergency in Bangladesh are becoming more frequent. Many believe it is an indicator of an emerging global trend. Because of the interrelated and combined effects of multiple factors, including unsustainable population growth rates, strained natural resources and a warming climate, the underlying conditions of local environments are beginning to fundamentally weaken to the point that any disruptions—such as storms, floods, or droughts—have the potential to create disproportionately large negative impacts and rapidly destabilize already politically weak or conflict-prone regions. [18] Therefore, while the crisis in Bangladesh was averted, it serves as an indicator of how future shocks may occur along with how they may affect already vulnerable areas in the form of complex crises. And while governments and civil society-based organizations tend to emphasize the need for mitigation (e.g. efforts to reduce carbon-based emissions) as a means to reverse the effects of climate change and protect natural resources, these policy issues have, so far, proven to be politically intractable. Meanwhile, as always, the military must prepare for the worst.

Given the scenarios of an increasingly vulnerable planet, militaries—and particularly the United States military—are the only institutions capable of responding to increasingly severe complex disasters and environment-induced conflict. Historically the U.S. military has proven its worth in humanitarian crises—especially during the past decade—by ably responding to a wide range of disasters from Hurricane Katrina to the West African Ebola crisis. However, the military's responses to these crises tend to be ad hoc in nature and often heavy-handed in execution. Military commanders' actions on the ground during crises have been known to

induce friction with civilian aid organizations and local governments, often for lack of shared mission priorities. These assessments should not be surprising. As mentioned previously, the U.S. military is neither structurally nor culturally aligned towards serious consideration of or preparation for environmental security threats. However, this ancillary-mission-focus may not be sufficient in the future as evidence suggests the security landscape is changing. If the threat of climate change is to be taken seriously, the military must begin to better orient itself toward addressing its risks.

Examining Climate and Security Linkages:

The convergence of climate change threats and existing environmental vulnerabilities as a major global security issue has been gaining increasing momentum among security strategists and policy analysts for many years. The Obama Administration's 2010 and 2015 National Security Strategies (NSS) repeatedly recognize environmental security issues such as damage to the environment, food insecurity, public health risks and natural disasters as significant threats to global stability.[19] Additionally, the World Economic Forum's "Global Risk 2014" report cites water crises, failure of climate change mitigation and adaptation measures, greater occurrence of extreme weather, and food crisis among the top ten risks the world now faces.[20] The focus on environment, climate, and security by a prominent economic institution like the World Economic Forum is not coincidental. Environmental security and economic prosperity are widely considered to be closely related. Increasing economic prosperity as a means to reduce environmental insecurities is the basis for the United States' and other nations' economic and developmental efforts across the world. Likewise, developmental banks such as the World Bank, International Monetary Fund and the Asian Developmental Bank share the same philosophy. But more and more debate centers on whether the threat of environmental calamity justifies the

prioritized concentration of all instruments of power. Appealing to the need for a more comprehensive, "whole of nation" approach to non-traditional security issues, the 2015 National Security Strategy also cites inherent shortcomings in existing institutions for dealing with challenges such as climate change, sustainable economic growth, food security and pandemic disease.[21] Adding weight to this premise, in a recent speech at the National Defense University, retired Coast Guard Commandant Thad Allen, the national on-scene commander for Hurricane Katrina and the Deepwater Horizon Oil Spill—arguably the two worst environmental disasters in recent U.S. history—listed climate change among a group of emerging threats whose complexity will overwhelm the capacity and doctrinal competencies of any single government or non-governmental capability. [22]

The U.S. Military and Environmental Security:

What, specifically then, does climate change imply for the military? During a public interview in March 2013, the Commander of U.S. Pacific Command, Admiral Samuel Locklear, listed climate change as the most likely threat scenario military forces will respond to in the future, adding that environmental instability has the potential to "cripple the security environment, probably more likely than the other scenarios we all often talk about.''[23] Operating within the disaster-prone Asia-Pacific region it is easy to understand how Admiral Locklear formed this opinion. That said, the degree to which the leadership within the U.S. Department of Defense (DoD) has embraced this idea is debatable. On one hand, the DoD has begun to address climate change as a specific security risk in influential strategy documents such as the 2010 and 2014 Quadrennial Defense Reviews (QDR), describing an "elevated risk" to areas of the world where stability is already fragile.[24] However, given the relatively paltry space these documents devote to describing climate change threats—compared to more traditional security threats, such

as nuclear proliferation and terrorism—one wonders whether the discussion of climate change has more to do with the fact that it's a legislative mandate than a legitimate security consideration in the eyes of DoD. Nevertheless, spurred by the QDR, the DoD took a considerable step forward in October 2014 by publishing the Climate Change Adaptation Roadmap. This document achieved two important criteria: first, it solidified the link between climate change and security and second, it—at least loosely—defined the military's role in an operating environment affected by climate change. Specifically, the Climate Change Adaptation Roadmap directs that the DoD integrate the effects of climate change into its future plans and operations by "monitoring" climate change developments in order to decide where and how to intervene based on U.S. security interests.[25]

Even with the publication of documents such as the DoD's Climate Change Adaptation Roadmap, there are many who contend that the military's focus on anything other than traditional security challenges risks diluting its primary capability—warfighting. In a 2012 assessment of DoD Humanitarian and Developmental Assistance Operations, the U.S. Government Accountability Office questioned the DoD's role in humanitarian assistance altogether given similar, often overlapping efforts performed by other U.S. agencies.[26] Indeed, many argue that the military's recent focus on climate change and other non-traditional security threats are part of a trend of "over-securitizing" issues as a means to maintain the DoD's relevance—and budgets—in the face of post-war downsizing pressures. Yet aside from the wars in Iraq and Afghanistan, nearly every operational commitment the U.S. military has responded to in the last fifteen years has been some form of environmental or humanitarian crisis. Some very notable operations during this period include the 2004 Indian Ocean tsunami, Hurricane Katrina in 2005, the Haitian earthquake of 2010, Japan's Fukushima reactor meltdown

following an earthquake and tsunami in 2010, flooding in Pakistan and Thailand in 2011, the West African Ebola crisis and most recently the earthquake in Nepal. Consider also how potential future security challenges should be prioritized—ostensibly using risk factors such as likelihood, pervasiveness, destruction potential or disaffection potential. Assuming these factors are influential, the military would be well served to prepare for many more complex and natural disasters given recent trends. Despite a four-fold rise in terrorism acts since September 11, 2001, incidences of natural and complex disasters since 2001 have proven to be far more deadly. A sampling of data from 2006 to 2013 reveals that 128,932 people died as a result of terrorist acts, yet during that same period, 641,742 people died as a result of natural and complex disasters—a difference of almost five-fold.[27] Climate scientists warn that climate change effects will continue to exacerbate environmental vulnerabilities; therefore future crises are likely to be more frequent, more complex and even more destructive. These probabilities and the fact that the U.S. military has more operational reach and logistics capacity than any other government or non-governmental capability in the world means it will continue to be called on in future environmental calamities. Further, if degraded environmental conditions lead to a collapse of peace and security, the military's role in recovery will be even more vital.

Environmental Security and "Traditional" Security Linkages:

By embracing environmental security as a core competency, starting with the development of environmental intelligence skills, the military will not only be better prepared for future disasters, these skills will arguably also enhance its ability to predict and better prepare for traditional security challenges—such as armed conflict. Indeed, evidence suggests there are many direct linkages. A comparison of Yale University's "Environmental Performance Index" (EPI) against both the Fund For Peace's "Fragile States Index" and Transparency International's

"Corruption Perception Index" suggests a strong correlation between environmental security and traditional security. Comparing the Environmental Performance Index and the Fragile States Index reveals an 83% correlation rate between the two indices (meaning 83% of those states in the top third of the Fragile States Index are simultaneously in the bottom third of the Environmental Performance Index).[28] Likewise, comparing the Environmental Performance Index to the Corruption Perception Index shows a 71% correlation rate (in other word, 71% of the top third most corrupt states also have the worst environmental performance).[29] These close relationships should not be surprising. Slow moving climactic changes and degrading environmental conditions can steadily erode stability and security. Water shortages exacerbated by drought, health crises spurred by poor sanitation, or inundation through natural disasters can lead to mass migration, placing pressures on a nation's internal capacity, particularly in urban areas, or on its borders with other countries in refugee camps. Migration can also lead to anti-migrant violence or worse, cross-border water crises. Malnourishment, rapid spread of disease or disaster-induced catastrophes can also have destabilizing impacts. All these conditions serve to reduce the legitimacy of the government in the eyes of its most adversely affected people, leading to rises in fundamental extremism, transnational criminal activity and other problems that commonly characterize fragile or failed states.

In fact, the roots of many of today's conflicts can be traced to environmental insecurity. The most recent example of this is in Yemen, where Shite-based Houthi rebels from the north of the country have overthrown the Sunni government of Abd-Rabbu Mansour Hadi. While the majority of media attention and scholarly analysis focuses on the sectarian nature of the conflict, there is perhaps a simpler answer for why Yemen is currently in political turmoil—water. Over half of the country's 24.4 million people struggle daily to find enough water for basic

subsistence.[30] Poor water management, no municipal water sources for the country's rural population and a leaky infrastructure that struggles to support less than half of those in the country's largest cities have contributed to distrust between the people and its government for decades.[31] Even more significant, over 70% of the country's population reside in rural areas where resentment towards the government is especially fierce because of a perception that all running water is prioritized for the "rich" within the capital of Sana'a. Overall there is strong evidence to conclude that environmental insecurity is at the heart of Yemen's conflict and ongoing sectarian strife.[32]

Water, Scarcity and Conflict—a Historical Constant:

While there are a multitude of potential risks in the realm of environmental security, what Yemen's conflict illustrates is that the simplest and perhaps most powerful tool for gaining critical environmental intelligence is water. The story of human civilization is, in many ways, the story of humans' relationship with water. Every era in the course of human civilization, defined by its major developments in health and wellbeing, is associated with humans' ability to overcome water challenges.[33] At the heart of these challenges has always been where to find it. The irony of life on the "water planet" is that water is scarce. Although two-thirds of the earth's surface is water, only 2.5% of the earth's water is fresh. But even that doesn't tell the entire story. Of the earth's fresh water supply, almost 69% of it is contained in its ice caps and polar glaciers while another 30% is in deep underground aquifers. Amazingly, just over 1% of the earth's fresh water supply is surface water, yet even the majority of that is inaccessible, contained in ground ice and permafrost. All told, less than three tenths of 1% of the earth's fresh water is found in lakes and rivers.[34] Nevertheless, it was from rivers' paltry share of the earth's fresh water that civilization was born.

Water and Civilization: Humans' ability to harness river water for crop irrigation—along the Tigris and Euphrates, Indus, Nile and Yellow—enabled transitions from hunter-gather status to agricultural status all over the ancient world. Yet these rivers' relative scarcity and inherent unpredictability were also a key contributing factor into the collapse of almost every ancient civilization in some way or another. The rise and fall of Egypt's three great kingdoms—Old, Middle and New established between 3150 and 1069 BC—are closely correlated to cyclic variations in the Nile's floods, with periods of low flood levels leading to food scarcity, political disharmony and ultimately the collapse of dynasties.[35] Roughly one thousand years later, the *Pax Romana* was enabled, not by Rome's land armies, but by its control of the Mediterranean Sea and the transport of grain from the Nile's fertile river valley throughout its empire, bringing a relative degree of food security to its citizens.[36] Grain from Egypt's Nile valley became so important to the stability of the Roman Empire that annual taxes rates were based on the river's flood levels. The expansion and population growth of the city of Rome corresponded directly to its ability to expand its water supply through the construction of aqueducts. Conversely, the city of Rome's demise at the hands of the Goths in the 5th Century AD came by destroying its aqueducts and cutting off its water supply.[37]

Across the world, the Chinese were the first civilization to harness river power for energy, along with crop irrigation, enabling grain processing, smithy work, and other tasks. In China, use of the rivers for irrigation and work productivity was literally synonymous with political power—the Chinese character for "politics" is derived from the root word meaning "flood control."[38] Just as in western civilization's history however, water scarcity played a key role in the rise and fall of Chinese civilizations. In 220 AD, the Han dynasty collapsed, overrun by barbarian raiders from the north, in part due to two key water related crises. First, in AD 11,

hundreds of miles of the Yellow River changed course, affecting flood canals and leading to severe famine and political disarray.[39] Ultimately, however, the Chinese' inability to maintain a sufficiently large army in its arid north—for lack of water resources—was the source of the Han dynasty's demise, allowing northern based raiders easy access for attacks on the Chines heartland.[40]

Water and Health: As humans' ability to stabilize their water source increased, civilized societies flourished all over the world. But with the growth of urban areas, water-borne diseases such as cholera became an all-too-common occurrence before sewage disposal and drinking sources were separated. The delivery of clean water in urban areas began to change that. The "Sanitation Revolution," as it is known, began in the late 19th Century and is largely credited to the pioneering work of John Snow. Snow, an English physician, was the first to link cholera to polluted water by tracing the origins of an 1854 outbreak the disease in London's Soho district to contaminated water from a public water pump.[41] Snow's hypothesis came before germ theory was understood and thus was not well received when it was published. Thus, the revolution in water sanitation may have been delayed many years had it not been for London's infamous "Great Stink" of 1858.[42] Since London's establishment as a Roman outpost, the Thames had been a dumping ground for the city's animal, human and industrial waste while also supplying its drinking water. Sweltering summer temperatures that year exposed the polluted nature of the river, creating what was described as an overwhelming stench so bad that it brought the entire citizenry—rich and poor—to its knees. As a result, legislation to refurbish the Thames and create a sewer system passed the English Parliament quickly during the year of the Great Stink. Without knowing it at the time, London had separated a major source of water-borne pathogens from its drinking water that had plagued the city for centuries.[43] Further developments in

sanitation such as filtering and treating piped water continued to improve public health in Britain and across the Western world. Ultimately, the sanitation revolution began during this period is credited for aiding the exponential improvement in life expectancy—largely due to vast reduction in infant mortality rates.[44]

Water and Economic Expansion: The final stage in humans' relationship with water brought with it the modern era. Two things fundamentally transformed humans' relationship with water—first the damming of rivers, regulating their flows and eliminating the unpredictability of floods while exponentially expanding their irrigation potential. The second was the discovery of ground water in deep aquifers that brought water to areas otherwise dependent on rain and other limited surface water sources. The Hoover Damon the Colorado River, completed in 1936, is largely credited as the beginning of a global revolution in building enormous, multi-purpose dams for irrigation, flood control and hydro-electric power.[45] Later, bigger projects such as the Grand Coulee Dam on the Columbia River and California's Central Valley Project redirecting water from the wetter north to the dryer south literally transformed the American West. By the end of the 1970's California was the nation's leading agriculture state and the most water engineered area in the world.[46] All told the 17 western states of the U.S. (otherwise arid desert) established over 4.5 million acres of agriculture land under irrigation from river dams at its peak, equaling 10% of the world's total irrigated lands.[47] The rest of the world quickly followed suit. Today, over 45,000 dams have been built worldwide, transforming agricultural production and allowing for huge population expansions in areas previously inhospitable to human life.[48] While dams have no doubt proved their economic worth to nations all over the world, they are not without downstream environmental costs. These costs, the greatest of which include reduced flow rates and increased salinity rates, create a natural disadvantage for those communities and

countries in downstream basins and river deltas.[49] This downstream phenomenon associated with modern water engineering has already contributed to transnational discord among countries sharing some of the earth's great river basins including the Colorado, Nile, Indus, Ganges and Mekong.

While just over 1% of the earth's fresh water is in lakes and rivers, over 30% of the earth's fresh water is contained in underground aquifers.[50] Discovery of this untapped resource greatly aided in the continued transformation of global societies. As one example, the Ogallala underground aquifer stretching from the Dakotas to Nebraska, Kansas, Oklahoma and parts of Texas, with a capacity equal to that of Lake Huron, fueled Midwestern agriculture and propelled the U.S. to be the world's leading food exporter.[51] Not without cost, however. Experts believe parts of the Ogallala aquifer have been extracted at rates 10 times greater than its ability to replenish itself.[52] Today, ground water extraction accounts for 25-40% of the world's drinking water and irrigates approximately 38% of the world's agricultural lands, mostly at unsustainable rates.[53]

Water and Scarcity: Humans' exploitation of the earth's fresh water sources along with vast improvements in public health, beginning with water sanitation, enabled the planet's population to expand—literally exponentially. In the 20th Century alone, the world population more than quadrupled.[54] Some, such as economist Thomas Malthus, wondered what the limits of sustainable populations could be. Throughout history, humans continually adapted to their environment as the story of water development through the eras of time illustrates. Agricultural use, which accounts for as much as 90% of the world's fresh water use, illustrates the point.[55] Global output per acre of most grain crops have increased exponentially since the mid-20th Century.[56] However, many believe we are reaching the upper limits of what the earth can

support, not for lack of innovation but simply due to water scarcity. Over the past 50 years alone global demand for water has tripled.[57] Given the food-water relationship and the fact that the United Nation's Food and Agriculture Organization predicts global food demand will grow by 50 percent by 2030, one wonders how much more resource capacity the earth has.

Thus, where water was once seen as an abundant, seemingly endless resource, the earth's freshwater resources now appear under great strain. All over the world, ground water sources are being extracted at highly unsustainable rates—particularly in the most populated countries in the world such as India, China and Pakistan—highlighting the fact that rivers and other surface water sources are inadequate or over-polluted. At the crux of this issue is a burgeoning global population of 6.9 billion people. Examples of populations outstripping their water sources are myriad. For example, at its independence from Britain, Pakistan's water availability stood at 5000 cubic meters per person; by 2004, per capita availability had fallen to 1000 cubic meters due to the country's rapid population growth.[58] And perhaps one of the defining ironies of the modern age, highlighting the threat environmental security poses, is Egypt. Once the breadbasket for the entire ancient world, Egypt now struggles to support a burgeoning population of 82 million, and as a result has one of the world's heaviest dependencies on imported grain.[59] This dependency has led to increasing tensions between the Egyptian government and its people. Indeed, there is broad consensus that water scarcities in Egypt and across the Middle East played an influencing role in the 2010 Arab Spring and the ongoing civil war in Syria.

The Middle East and Maghreb regions' water and food insecurity was exposed by global weather patterns in 2010 that many scientists attribute to climate change effects.[60] These weather patterns created "once-in-a-century" drought conditions in Russia, Ukraine and China while simultaneously influencing excessively wet conditions in Canada and Australia.[61] The net

effect of these adverse conditions was a precipitous drop in crop yield among the world's top exporters of grain and a doubling of global wheat prices between June 2010 and February 2011.[62] By the time of the Tunisian riots in late 2010—the genesis of the Arab Spring uprisings—the average Egyptian household was spending 40% of its income on food (compared to an average of only 10% in the United States and the United Kingdom) despite the Mubarak regime's heavy spending on wheat subsidies.[63] Indeed, the World Bank president Robert Zoellick along with many other experts concur that, while it was certainly not the central factor in the Arab Spring, exorbitant food prices were an "aggravating factor" in why it erupted when it did.[64,65] In all, 21 countries across North Africa and the Middle East were caught up in the Arab Spring, experiencing mass protests and civil strife. Four countries' governments were overthrown completely including Tunisia, Egypt, Yemen and Libya and an additional seven countries' governments committed to significant political reforms as a result of the protests. But by far the most consequential event of the Arab Spring was its initiation of a civil war in Syria. Five years later, Syria's civil war continues with virtually no end in sight.

Water Scarcity and the Syrian Civil War: Ironically, as the Arab Spring's populist fervor spread across almost every nation in the Arab world, many believed Syria was immune.[66] By the end of February 2011 Syria was still largely unaffected while 16 other countries had experienced significant political disruptions and protests. Soon, however, those who believed the Assad government was too stable to succumb were proven drastically wrong—by May 2011 the city of Homs was under siege and civil war had begun. Yet not everyone was surprised by Syria's "sudden" collapse. In a study done by the Center for Climate and Security, Francesco Femia and Caitlin Werrell argue that the foundations of stability had been slowly eroding for over five years, influenced by severe drought-induced water shortages. Their report summarized that from

2006 to 2011, up to 60 percent of Syria's land experienced unprecedented drought conditions, which along with water mismanagement, contributed to wide-spread crop failures.[67] These adverse conditions impacted the livelihoods of over 800,000 people, causing mass migrations from farms to cities.[68] In the area surrounding the city of Aleppo alone, it is estimated that as many as 200,000 rural dwellers migrated to urban areas over five years.[69] Beyond the direct effects on farmers, the United Nations assessed that up to 3 million Syrians were ultimately affected by Syria's drought, being driven into extreme poverty or otherwise made "food insecure."[70] While Fermia and Werrell are careful not to infer direct causation between water shortages and civil war, they provide credible evidence that environmental insecurity was at least a significant contributing factor.

A Focus on Asia:

All over the world, signs of the same underlying environmental security elements leading up to the Syrian Civil War—food insecurity and water scarcity—abound. Strained natural resources not only compete with growing populations but also rapidly-increasing consumption habits. Nowhere is this struggle more acute than in Asia, where more people reside than in the rest of the world combined. And while Asia's sheer size is directly related to its explosive economic success in the global market, its burgeoning population may ultimately be an even greater liability. Continued population growth in Asia at predicted rates will place unprecedented strains on natural resource availability, perhaps testing the very limits of the earth's carrying capacity. This balancing act that is Asia's future will largely define what has been described as the Age of Scarcity. [71]

Asian economic growth rates are among the fastest in the world, led by the unprecedented success rates of China. Future growth in Asia will bring with it an insatiable demand for resources—namely water and fuel. By the year 2030, it is estimated that the world's energy needs will increase by 50%, almost half of which will come from India and China alone.[72] As developing nations' fortunes rise, so do their consumption habits. Rapidly-changing eating habits in India and China alone have significantly increased demand for "higher-end" food such as meat, processed food, dairy and fish.[73] These types of food are costlier to make in terms of grain and—more importantly—water. As much as 90% of the water humans consume is accounted for by agriculture and ultimately the food we eat.[74] Mapping the water footprint required for beef production—one of the world's most "expensive" food items in terms of its water requirements—is illustrative of the impact changing diets will have on global water resources. Considering the grain, roughage and drinking requirements over the three year life-span of an average cow, plus water to support the farm and meat processing facilities, it is estimated that approximately 15,400 liters of water goes into every kilo of beef produced.[75]

The Paradox of Development and Sustainability:

Increasing and more expensive consumption habits are part of the normal progression process within developing societies. Any classification of this as a "problem" from the vantage point of the developed world is certainly more than a little hypocritical. Nevertheless, it highlights the paradox that lies at the intersection of development and sustainability. As Asia's fortunes collectively rise, influenced primarily by the massive forces of India and China, can the supply of resources keep pace with demand? How resilient will the global food supply chain be in 15-20 years, and how would it react to the kind of anomaly that caused the food crisis leading to the Arab Spring in 2011? Finally, what kind of geopolitical pressures would resource

shortages induce? Current trends are alarming. South and Southeast Asia, along with North Africa, are particularly vulnerable in terms of water security with high demand and relatively low availability.[76] India and China's explosive growth rates to date have depended on what many believe are unsustainable rates of ground water extraction.[77] Yet underlying this vulnerability is the fact that the Asia-Pacific region is already home to the largest number of people considered "food insecure," a number estimated at 578 million.[78] Adding context to this is the fact that the worlds undernourished are primarily concentrated in seven countries, five of which are in Asia, including Bangladesh, China, India, Indonesia and Pakistan.[79] Recognizing this as a critical threat, the National Intelligence Council's Global Trends 2030 describes a "food, water, energy nexus" where growing global demand creates critical resource shortfalls that could lead to wide-spread instability—particularly in South Asia.[80] Yet as dire as these risks are, they become even more acute when combined with the forecasted impacts of climate change. Illustrating its potential as a threat multiplier, the United Nations' Intergovernmental Panel on Climate Change (IPCC) estimates that due to increasing temperatures, global agricultural output could drop as much as 2 percent per decade while global demand for food simultaneously rises by 14 percent per decade.[81] Similarly, for every 2 degrees rise in temperature, an additional 5 percent of the world's population could be placed at risk for malaria and other vector-borne diseases.[82] And although climate change is a global phenomenon, once again, Asia is potentially the most vulnerable region in the world. A recent study characterized the 20 most at-risk cities in the world based on forecasted population growth, lack of capacity for basic services and vulnerability to climate change impacts. Of those 20 cities, 17 are in Asia.[83]

With water scarcity at the heart of Asia's environmental security challenge, governments are placing significant emphasis on water engineering projects. Once again, China's actions have

oversized influence well beyond its borders. Nine of the ten largest rivers in Asia have sources that originate in China, meaning any water redistribution project in up-stream China will create geopolitical strains among its down-stream neighbors.[84] Water engineering of the Mekong is illustrative of the transnational challenges associated with dam building. Between China, Laos, Myanmar and Vietnam, more than 100 hydropower projects are being planned in the greater Mekong basin, including the river's tributaries. The planning process for these projects has been described as ad hoc, uncoordinated and lacking transparency, the impacts of which could be devastating to one of the most diverse freshwater fisheries on the planet.[85] Fishing alone within the greater Mekong basin provides $2-3 billion per year in economic value and is the main source of animal protein for over 60 million people.[86] Meanwhile, in India, the Indus River Treaty is a remarkable feat of transnational coordination—particularly given the strained relations between India and Pakistan—but crises have a way of revealing foundational weaknesses. During the devastating floods of 2010 floods, Pakistan accused India of manipulating flows with upstream dams, exacerbating downstream flood conditions.[87]

The Asia-Pacific Rebalancing and Environmental Security:

Many prominent Asia experts indicate that Asian nations are reluctant to embrace environmental security and other non-traditional threats, particularly in lieu of focusing on traditional geopolitical security themes. It is easy to see why given the ongoing geopolitical tensions that abound in the Asia-Pacific region. Like many other issues shaping Asian politics, the rise of China as military power is central to the security dynamic in Asia. Indeed, in 2011, President Obama initiated a "rebalancing" to the Asia-Pacific, punctuated by a heavily-publicized deployment of U.S. Marines to Australia. Many in Asia interpreted this strategic messaging a means to check the growing, aggressive actions of China towards its Asian

neighbors. Disputes over territorial areas in the South and East China Seas between China and its neighbors have become increasingly contentious over the years. In particular, China's definition of international waterways and neighboring countries' territorial islands as part of its internal security zone—including Taiwan, the Senkaku/Diaoyu islands and the Spratly Islands—is a major source of friction and distrust between China and its affected neighbors.[88] Though countering Chinese territorial disputes was never a deliberate stated objective of the rebalancing initiative, it is not lost on anyone that most countries involved in territorial disputes with China are also closely allied with the U.S.

Looking back on the U.S. strategy of Pacific rebalancing and the course of events that it influenced, the relevant question to ask is, has it been effective? Disagreements abound on this issue; however, since the announcement of the "pivot", it is safe to say that U.S. and Chinese interactions have become increasingly competitive, along with rhetoric that is sometimes outright confrontational. This is a potentially dangerous political path. Continued and increasing mistrust between the U.S. and China will compel both nations to hedge against the unknown, perpetuating an arms race that the U.S. cannot afford and diplomatic strategies that attempt to isolate each other from broader coalitions. Ultimately, this is a risky long-term strategy for the United States. Any environment that is characterized by competition between the United States and China favors China in the long run—particularly within Asia where Chinese economic dominance is already becoming a reality.

Current trends reflecting both economic and diplomatic forces, suggests that continued U.S. military primacy in the Asia-Pacific may not be realistic either. A U.S. security strategy built primarily around its traditional bilateral agreements with Japan, South Korea, Australia, Philippines and Thailand will likely antagonize China, spurring an even more competitive

environment. Such a strategy may not be sustainable in a future dominated by the economic forces of globalism. The economies of Japan, Korea and Australia are much more dependent on China than they are of the U.S., which will inevitably provide China more and more leverage within Asia despite whatever resolve the U.S. may display in the face of growing Chinese power. At the same time, however, ceding control of the global commons—particularly in the Asia-Pacific—is in many ways just as risky as allowing U.S.-Sino tensions to continue to escalate under the status quo construct. Furthermore, the United States' reputation in the Asia-Pacific is also closely tied to its ability to adequately protect the countries with which it shares security alliances. In the event of hostilities between China and any U.S. ally in the region, access to forward basing in the Asia-Pacific, particularly within the first island chain around China, is still of paramount importance.

Alternately, many noteworthy policy experts agree that a strong U.S.-Chinese relationship can ensure lasting peace in Asia.[89] Ultimately, therefore, a sound strategy must move U.S.-Chinese interactions towards greater cooperation. Yet beyond their economic interdependencies, there has been very little common ground between the U.S. and China from which to base cooperative agreements—with one important exception: climate change. Three years after President Obama's announcement of the Asia pivot, another historic announcement was made—this time in a spirit of uncharacteristic cooperation between the U.S. and China. In the face of broad global consensus on the emerging threat climate change poses, both nations agreed to significant reductions in carbon emissions by 2025. This agreement is noteworthy for several reasons. First, it is an acknowledgment to the legitimacy of climate change as a global security challenge. Second, it suggests that the security landscape is indeed changing. It is proof that the emerging threat of climate change has rapidly brought the concept of environmental

security—particularly in the Asia-Pacific region—into mainstream debate circles. And while environmental security threats are a global challenge, China's willingness to commit to such aggressive climate change mitigation efforts reinforces a common belief that Asia is potentially the most environmentally vulnerable region in the world.

Above all else, however, the U.S.-Chinese accord on climate change proves that this issue can become a galvanizing "common enemy" whose threats may be the one thing capable of forging a strong sense of shared purpose between the U.S. and China as well as within multi-lateral partnerships. Indeed there are indications this is already happening. As an example, during the 2010 ASEAN "Defence Ministers' Meeting-Plus" in Hanoi, ASEAN members along with representatives from Australia, China, India, Japan New Zealand, Russia, South Korea and the United States found easy consensus in environmental security issues as a main focus. Vietnamese hosts deliberately centered discussions on non-traditional security themes such as humanitarian assistance and disaster relief, primarily because it offered common ground among a group with otherwise widely disparate geopolitical views.[90] Ultimately, what this vignette reinforces is that an American-led security construct in the Asia-Pacific built on a foundation of ensuring regional environmental security will provide the U.S. with the strategic *legitimacy* to remain forward deployed in the Asia-Pacific while simultaneously creating a shared purpose with China.

An Environmental Security Strategy for the Asia-Pacific:

While the focus of this paper is how to orient the military towards the threat of climate change, there can be little hope of applying effective military engagement towards this threat without a broader strategic focus. Meaningful strategy must, by definition, coordinate and align

all instruments of national power towards a threat and more importantly, it must dictate the ends, ways and means of translating strategic theory into operational reality. Because climate change threats are by definition, non-traditional, it goes without saying that traditional strategic initiatives are of little use. As Admiral Thad Allen indicated, solutions the complex problem of climate change must go beyond the independent capabilities of the government or civil society. Admiral Allen used a specific term for the type of solutions necessary to address highly complex challenges, referring to the need for "co-production."[91] That is, the kind of solutions that combine the capabilities of government, corporations and civil society. To this end, creative, cross-organizational solutions addressing the challenge of climate change have been proposed.

Once again, from the Center for Climate and Security, Francesco Femia and Caitlin Werrell have weighed in to the environmental security debate, this time providing the framework for a bold strategic initiative. In their 2012 document "A Marshall Plan to Combat Climate Change in the Asia-Pacific: The Missing Piece of the New U.S. Security Strategy," Femia and Werrell advocate a U.S.-led climate investment initiative aimed at helping the most vulnerable nations of the Asia-Pacific region adapt to the threat multiplier of climate change. Their comparison of this plan to the Marshall Plan is fitting. In the aftermath of World War II, the United States initiated the Economic Cooperation Act of 1948, (commonly known as the Marshall Plan) to help lift Europe out of the economic devastation wrought by years of total warfare. While primarily a strategy to get the nations of Europe back on solid economic footing, a broader goal of the Marshall Plan was to check the threat of future political turmoil and instability brought on by economic stagnation—precisely what had led to the rise of Hitler and Mussolini prior to World War II. Likewise, ensuring lasting stability in the face of the destabilizing threat of climate change is at the heart of a similar "Marshall Plan for the Asia-

Pacific." Reinforcing the region's unique vulnerability to environmental security challenges, the United Nations Development Programme assessed the Asia-Pacific as one of the most disaster-affected regions in the world. Due to its unique geography, it is permanently threatened by a variety of natural hazards, many of which will only worsen with the onset of climate change.[92] Thus, a climate investment fund would target precisely the areas that climate change threatens to affect the most by investing in building resilient infrastructure and developing methods, programs and systems for adaptation. This includes climate-proofed flood and water management systems, renewable energy sources, climate resilient food crops, other adaptation projects, and lastly, comprehensive contingency response plans.[93]

Like the original Marshall Plan, U.S. investment and leadership in a climate change resiliency strategy for the Asia-Pacific can only be successful if it engenders broad multi-national support and spurs broad commercial economic investment. These two criteria appear to be achievable. First, the UN Framework Convention on Climate Change (UNFCCC) is already established as the main conduit for prioritizing and administering climate investment funds, meeting the need for a multi-national-led execution arm. Second, the U.S. has pledged to lead the climate investment effort in generating $100 billion in a combination of public and private funds.[94] If successful, the U.S. will not only expand its influence in the region by advocating for such an important effort, it will also engender a bona fide "co-produced" solution by ensuring the private sector has a meaningful stake in the strategy and its execution.

With investment funds in place, the next step will be planning and prioritizing execution. Once again, a framework is in place. Through the UNFCCC, the most vulnerable countries in the Asia-Pacific—like Bangladesh—have already developed detailed risk mitigation strategies known as "National Adaptation Plans of Action" (NAPA). These UNFCCC-approved NAPAs

provide the detailed means for risk-based prioritization of climate investment funds. Not only that the NAPAs also provide a powerful indigenous-driven source of environmental intelligence. These documents can form the basis for accurate and detailed baseline assessments about localized inherent and future environmental risks—a critical element in preparing for climate change adaptation. This is where the military becomes critically important. Beyond all the economic investments in resiliency, adapting to climate change also means preparing for its worst effects. What, therefore, does the military's role in co-produced solutions for climate change adaptation in the Asia-Pacific look like?

In an April 3, 2015 TED Talk, Bill Gates described the 2014 West African Ebola epidemic as a backdrop for discussing the United States' lack of preparedness for the next great global catastrophe. In the video, Mr. Gates argues that today the greatest risk facing the world is probably not a nuclear war; instead it is more likely to be a highly contagious virus…"Not missiles but microbes," he proposes.[95] Using very sound reasoning he suggests that while the threat of nuclear destruction is still high, its risks are reduced through significant investments in nuclear deterrence. Conversely however, relatively little has gone into preparing for the next global health crisis. Ultimately, he argues, we're not ready for the next epidemic.[96] By analyzing the systemic failures of the Ebola crisis response, it is easy to see why. First, there was no forward reconnaissance element to collect intelligence and develop response plans. Second, there was also no medical team on standby ready to quickly deploy to the region. Third, during the height of the crisis, no centralized diagnostics capability existed that could examine best practices and hasten the most effective solutions (e.g. taking the blood of survivors and using it in plasma to treat those still ill, as one potential example Mr. Gates cited).[97]

Despite the inherent weaknesses in the global health system and the systemic failures that ensued during the Ebola crisis because of it, Mr. Gates' main theme is that we can build a very effective response system. How? Look to how the military prepares for war he argues. First, an appropriately prepared global health system needs robust health facilities in the world's threat-prone and vulnerable countries as an initial line of defense. Second, such a system needs a cadre of trained health workers ready to rapidly deploy to affected areas. Third, and most relevant to this paper, it needs to develop a strong partnership with the U.S. military—the singular global capability most able to respond quickly, move rapidly with robust logistics, and provide secure areas for operation. For such a partnership to work when needed however Mr. Gates argues rehearsal drills and simulations are needed—a partnership he coins as "germ games."[98]

While a global contagion outbreak and climate change are not the same thing, these threats do share many similarities. Ultimately, both represent two of the most challenging non-traditional security threats facing the world today. Furthermore, Mr. Gates' proposal for a co-produced strategy to address the threat of global pandemics provides a model from which to craft similar co-produced contingency-response plans for climate change-related threats.

Yet if the military is to be prepared for either scenario it must begin to orient itself toward these types of non-security issues now. And, as the axiom goes, intelligence drives operations; therefore the basis of such a reorientation is developing environmental intelligence capabilities. Thus, with a strategic rationale for the importance of environmental intelligence established, how does the military develop the means to conduct environmental intelligence gathering and analysis? As this paper has argued, establishing the linkages between climate change and traditional security issues relevant to the military is an important first step for moving forward. However, if combatant commanders are going to realistically integrate the effects of climate

change into their future plans and operations, more concrete, follow-on steps must be charted. The Climate Change Adaptation Roadmap provides a basic framework for organizing and thinking about climate change issues along with a set of broad, overarching strategic ends. Where it lacks specificity is the actual means for analyzing climate change risk or integrating climate change risk factors into operational plans. This skill set and methodology must be developed.

Water as an Organizing Principle:

The sum of environmental risks as outlined above, including the exacerbating effects of climate change, can be reduced to a single organizing principle for evaluating environmental security: *water*. Beyond the fact that water is the most basic of human needs, water is a valuable organizing principle because, as outlined in the history of human development above, it has linkages to every aspect of environmental security including food, energy, health and climate change:[99]

Water and Food: Without water there is no food. As described above, up to 90% of all humans' fresh water consumption goes to the production of food thus food and water security are inextricably linked and virtually synonymous. [100] Analyzing a given country or a region's water stress level—i.e. the amount of water availability per person—is one example of a powerful means to assess a region's baseline vulnerability.

Water and Health: Access to safe drinking water and water for sanitation is directly linked to human health. The World Health Organization estimates that over 800 million people lack access to safe water and as many as 2 billion people lack access to sanitation, leading to anywhere from 1.8-5 million deaths per year.[101] Additionally, there are direct linkages between

access to safe water and sanitation and the prevalence of undernourishment in children—a leading cause of child mortality.[102]

Water and Natural Disasters: Water-related natural disasters, such as the 2004 Indian Ocean Tsunami that killed over 230,000 people in Indonesia, Thailand and Sri Lanka, are by far the most catastrophic events on earth. Hurricanes, typhoons, flooding and drought are all water-related events.

Water and Climate Change: Water is closely correlated to every aspect of climate change including rising sea levels, changing precipitation patterns and an increased frequency of severe weather. There is even a strong link between water and global warming as increasing temperatures cause greater levels of water evaporation, not to mention the direct link between warming water temperatures and rising oceans.

Water, Peace and Security: Ultimately, as a means to evaluate and prioritize environmental security risks, water is a valuable organizing principle because of its core relationship between humans and their environment. As discussed above, the United States' National Security Strategies of 2010 and 2015 recognize the threat posed by environmental security issues such as damage the environment, food insecurity, public health risks and natural disasters.[103] Although water is not referenced directly among these non-traditional threats, the utility of water as an organizing principle is well illustrated here as it has a direct relationship to the environment, food and health.

Yet while water provides a simple, straight-forward organizing principle for intelligence-gathering, collection methods, interpretation and analysis of environmental intelligence is relatively complex. Given the highly technical and scientific nature of climate change, the

military cannot easily establish an organic capability for this type of intelligence-gathering. Instead of an inhibitor of forward progress however, this capability gap offers an opportunity to forge collaborative efforts among some critical external stake-holders. Recognizing the need for expertise outside the military's normal core competencies will not only enhance the DoD's already highly sophisticated planning techniques, it will also symbolize an important first step toward bringing the DoD, civilian agencies and civil society closer together during strategic and operational planning. Some of this collaboration has already begun. Its localized success illustrates not only the utility of this type of coordinated effort, but also the willingness of external organizations with a stake in climate change adaptation to work with the military.

Examples of Environmental Intelligence Applications:

In a 2012 article for the Intelligence and National Security Journal, Dr. Chad Briggs, a DoD Minerva Institute Fellow and Air War College faculty member, outlines a model for developing strategic and operational-level environmental intelligence as a means to identify critical risks related to environmental security challenges. Dr. Briggs describes environmental security as changes in underlying conditions that can trigger multiple impacts across complex systems—in other words, tipping points. If these systems upon which changes occur are vulnerable, they may create "surprises" for operational and strategic planners[104]—much like Syria's collapse surprised strategists in the midst of the Arab Spring. Dr. Briggs' model for evaluating environmental security, which includes potential impacts of climate change, is based on conducting scenario risk assessments through a multi-step process of applying scientific data to plot potential, abrupt environmental changes in a given geographical region. His model emphasizes a multi-dimensional analysis approach, designed to assess potential interactions between key environmental factors.[105]

As a case study, Dr. Briggs uses Central Asia—another region plagued by water scarcity challenges—to illustrate the utility of scenario-based modeling. Under the former Soviet Union, the Aral Sea (between Kazakhstan and Uzbekistan) was heavily exploited for cotton production—an extremely water-intensive crop—in Uzbekistan. As a result of its overuse for irrigation, between 1980 and 2010, the Aral Sea's surface area decreased by 90%, forcing the migration and lost livelihoods of over 100,000 people. Beyond the irreparable environmental damage already inflicted, the Central Asian republics of Uzbekistan, Kyrgyzstan and Tajikistan, depend heavily on both irrigation and hydroelectricity for their economic viability. With the loss of the Aral Sea as an irrigation source, Central Asia is now incredibly vulnerable to any further shifts in precipitation or snowcap levels[106]—a similar dilemma now beginning to confront Southern California. Adding depth to Dr. Brigg's scenario baseline, the U.S. State Department's Bureau of Oceans, Environment, and Science Affairs rates Uzbekistan as one of the most vulnerable irrigating nations in the world. [107] Due in part to its heavy reliance on the Aral Sea for irrigation, the State Department assesses that up to 60% of Uzbekistan's irrigated land has been damaged by salinization. With 4.3 million acres under irrigation, the country is the world's 10th largest irrigating nation by volume. As much as 89% of the country's total croplands depend on irrigation for their sustainability, highlighting an immense vulnerability to any environmental changes such as decreasing precipitation. Ultimately, loss of agricultural capacity in Uzbekistan would be devastating as it comprises 35% of the country's GDP and employs 45% of the country's workforce.[108] All these factors combine to establish a baseline environmental vulnerability assessment from which scenario development can commence. By analyzing the effects of scientifically-based environmental impacts (such as reduced precipitation levels

brought on by climate change) realistic event-driven scenarios and levels of associated risk can be developed.

A similar use of scenario development to evaluate environmental security issues has been produced for the U.S. Pacific Command. In a collaborative effort between the National Oceanographic and Atmospheric Administration (NOAA), the University of Hawaii's Natural Disaster Preparedness Training Center and PACOM's own Center for Excellence in Disaster Management and Humanitarian Assistance, the security risks associated with El Nino weather patterns are examined through various scenarios.[109] The model first establishes baseline weather patterns by applying scientifically-based, regional environmental impacts associated with El Nino events including warmer and drier weather in some regions accompanied with more frequent and higher intensity tropical storms in others. Depending on these regionally-based climate effects, the model then makes assumptions about potential security impacts including economic loss from drought conditions, loss of agricultural productivity, increased disease rates, increased human migration and increased instances of piracy. From scientifically-assessed probabilities of the effects of abrupt changes in climate brought on by an El Nino event, ten unique scenarios are presented including increased skiff-piracy rates due to reduced wave heights, energy crises in Northeast and Southeast Asia due to water shortages, social unrest in India due to drought-induced food insecurities, and South China Sea geopolitical conflicts based on reduced fish harvests. This particular type of climate intelligence-based modeling is particularly useful to operational planners within a geographic combatant command because it illustrates the potential for direct linkages between probable environmental events and traditional security threats.

Putting Climate Intelligence in Action—the Case of Bangladesh:

The choice of Bangladesh as case study for the application of climate intelligence is not a casual one. There is perhaps no country in the world more environmentally vulnerable than Bangladesh. Due to a uniquely flat and flood-prone geography along with an immense, poverty-stricken population, the country has effectively become "ground zero" for the looming environmental threats posed by climate change. Framing its immense vulnerability is the fact that many believe Bangladesh has reached the limits of its agricultural output capacity. The country has already employed the use of higher-yielding, climate resilient strains of rice and almost all available arable land is currently in use.[110] Indeed, soil for planting crops is in such high demand in Bangladesh that it is treated like a precious commodity—nothing is wasted or taken for granted. Soil from dry-season dredging of riverbeds and even the ground beneath dismantled houses is constantly being collected and transported to sustain already-strained crop fields.[111] These land conservation efforts are a desperate response to the ocean's slow but steady encroachment of the country's coastline and delta regions where the signs of a losing battle are everywhere. Plots of land that once supported three harvests per year now only produce one while others lay permanently fallow, poisoned by salt-water intrusion.[112] This progressive loss of the land's productivity is illustrative of the slow but devastating effects of sea-level rise where once vital food-producing land is rendered barren well before it is lost to the sea altogether.

As scenarios like this replicate themselves all over the country, subsistence-farming populations are forced from their rural homes to urban slums. In the capital city of Dhaka alone it is estimated that 1.5 million of the city's five million slum inhabitants are victims of climate-induced migration from villages and rural areas close to the Bay of Bengal.[113] And while sea level rise is a global phenomenon, scientists believe it is affecting Bangladesh at rates faster than

global averages. High-end estimates predict that by as early as 2050 up to 18% of the country's coastal areas could be under water, with the net effect of displacing 20 million people.[114] Such a scenario for a country as hemmed-in as Bangladesh—already one of the most densely populated countries in the world with an average of over 1,000 people per square kilometer[115]—is almost unfathomable. In addition to the millions of climate refugees created by these predictions, the country's per-capita food-producing capacity could drop by as much as 35% as a result of further arable land loss.[116]

By overlaying the country's environmental vulnerabilities with other political, religious and socioeconomic factors, it is easy to draw parallels between Syria's collapse and the threat potential for Bangladesh. Since gaining its independence in 1971, Bangladesh has maintained a reputation as a moderate Muslim nation with democratically-elected governments. However, beneath what some consider a facade of stability is an extremely fragile government characterized by rampant corruption and political dysfunction.[117] Frequent political upheaval accompanies elections between the country's two primary rival parties, although more recently radical Islamist parties and fringe groups with links to Al Qaeda have begun to exert influence and contribute to increasing political violence. This violence peaked between 2004 and 2005 when the capital city of Dhaka saw terrorist bombings, which were attributed to Islamist fringe groups. Illustrating what may be growing tensions between moderate Muslims and Islamic fundamentalists, Dhaka saw riots in the streets in 2008 protesting a draft government law giving equal inheritance rights to women.[118] Additionally, ties between the military and the government have, at times, been tenuous including accusations of covert military influence over caretaker governments during election periods and an outright mutiny by members of the Bangladesh Rifles in 2009. These political tensions, underlined by a population that largely lives on less than

$2 per day in one of the most environmentally vulnerable areas on earth, suggest that Bangladesh has little to no capacity to withstand a major shock, whether it is brought on by fast or slow-moving conditions. These implications are vividly highlighted in the book, *Monsoon: The Indian Ocean and the Future of American Power*—endorsed by the Commandant of the Marine Corps as required regional studies reading. In it, author Robert Kaplan states, "The U.S. Navy may be destined for a grand power balancing game with China in the Indian and Pacific Oceans, but it is more likely to be deployed on account of an environmental emergency, which is what makes Bangladesh and its problems so urgent."[119]

This baseline vulnerability assessment of Bangladesh provides the background and context for meaningful follow-on analysis. From it, scientifically-supported, probability-based impacts can be applied and analyzed. For example, the impact of weather events can be examined in detail. Weather related threats can generally be plotted on a two-dimensional scale measuring event duration combined with geographic scale (or the size of the impacted area). Events such as flash floods, landslides and wildfires are relatively short in duration and impact a relatively minor geographic area. Other events, such as snow-cap melt, down-river flooding, tropical cyclones and heat waves are longer in duration and have a larger geographic impact area. Still other events such as droughts, El Nino and La Nina effects have even longer durations and considerably larger geographic impacts. [120] El Nino events, in particular (as described above), produce highly predictable warmer and drier weather in some regions along with more frequent and higher intensity tropical storms in others. [121] Combined with the relative probabilities of certain weather events for varying regions—the work of meteorology—the impacts of these events can be measured on existing baseline environments such as described above for Bangladesh. Scenarios played out by analyzing the impacts of varying weather events can

inform the development of contingency response plans—particularly for Bangladesh and other highly vulnerable and threat-prone areas. If done in a truly collaborative manner, such as combined with the UNFCCC's National Adaptation Plans of Action, scenario development could determine where local government and external civilian-based capacities may become overwhelmed, allowing contingency plans to match military capabilities with specified gaps. This type of intelligence-based modeling represents the envisioned ideal. Given that, how close do combatant commands and the DoD in general come to conducting environmental security planning in this manner? While there are certainly examples of good coordination between the DoD and its inter-agency partners in development and disaster preparedness operations, broader indications are this is an area where significant improvement is needed.

Current DoD Environmental Security Operations:

The DoD currently executes two Congressionally-mandated programs that can loosely be considered environmental security operations: the Overseas Humanitarian, Disaster, and Civic Aid (OHDACA) program and the Humanitarian and Civic Assistance (HCA) program. Between 2005 and 2010, the DoD obligated just over $400 million for both programs conducting operations involving sanitation and drinking water projects, repairing/building infrastructure and providing medical, dental, surgical and veterinary care (including education, training, and technical assistance) in foreign countries (excluding Iraq and Afghanistan).[122] The mission of these programs is to improve DoD's visibility, access and influence internationally while building and reinforcing regional stability and security. Additionally, the funds are intended to provide disaster mitigation and training and bolster host nation capacity to avert humanitarian crises.[123] While these programs do not operate under the specific mandate of climate change adaptation, their focus on disaster mitigation and capacity building are, in effect, contributing to

foreign nations' ability to adapt to the future impacts of climate change. More importantly, they serve as an indicator of how various combatant commands currently interact with their inter-agency partners and NGOs when planning environmental security operations.

By all accounts, the OHDACA and HCA operations implemented across DoD's geographic combatant commands provide immense value to affected populations while also meeting DoD strategic goals. However, in a February 2012 report to Congress, the U.S. Government Accountability Office (GAO) found significant shortfalls in how these programs are planned, executed and evaluated. Among other things, the GAO reported that DoD's ODHACA and HCA programs suffer from a lack of strategic guidance, particularly above the geographic combatant command level. In particular, DoD's programs overlap with U.S. Agency for International Development (USAID) efforts abroad in the areas of health, education, infrastructure and disaster preparation. And while many geographic combatant commands coordinate their operations with USAID liaisons and State Department country teams within host nations, GAO found that the DoD's ODHACA and HCA initiatives do not necessarily compliment broader State Department and USAID strategic initiatives. Ironically the GAO recommended that DoD adopt a risk-based approach to evaluating requirements for humanitarian and development projects. Additionally, GAO stressed that DoD should make efforts to better nest its planning with USAID strategic initiatives.[124] Combined with the Climate Change Adaptation Roadmap's mandate to integrate climate change impacts into DoD strategic and operational-level planning, this assessment only reinforces the need to develop collaborative-based environmental intelligence capabilities starting at the combatant command level.

Conclusion:

Ultimately success is achievable. Among other things, the GAO had high praise for planning integration between DoD, Department of State and USAID at the country team level. Likewise, at the highest departmental levels, the DoD, State and USAID have established the "Diplomacy, Development and Defense" (3D) Planning Group which aims to align the organizations' admittedly disparate strategic planning efforts. These efforts will undoubtedly increase information-sharing and ultimately align strategic aims. Like most things with immediate operational implications, however, the regionally-based combatant commands wield the most influence and department-wide leverage. Even here, progress has begun. U.S. Central Command recently produced a "CENTCOM Climate Change Assessment," providing insight on how heat waves, wildfires, floods, tropical storms and sea level rise will affect specific regions within the CENCOM area of operations—precisely the sort of baseline probability assessment outlined above that can form the foundation of meaningful scenario development and ultimately contingency planning.[125] For now, such analysis represents the rare exception among the Combatant Commands. Reporting on the U.S. government's collective research and literature on climate change, the Wilson Center's environmental security blog, *The New Security Beat*, stated "[USCENCOM's production of a climate change assessment] makes sense—Central Command coordinates U.S. military assets for the Middle East, North Africa, and Central Asia, an already drought-prone and resource-scarce region—but it's also unusual to see such a report coming from one of the Combatant Commands, which rarely produce research."[126] Yet this example along with the U.S. Pacific Command's ongoing partnership the University of Hawaii's National Disaster Preparedness Training Center in the area of climate change research is promising. What they show is that if the appropriate priorities are placed on environmental security at this level,

positive forward progress is inevitable. But these efforts remain on the fringe of the regional combatant commanders' focus. Ultimately, meaningful, fundamental change will not be easy in the military's warfighting-dominated culture. Some contend that prioritizing environmental security, thereby making it the purview of operations and intelligence rather than adhering to the status quo of relegating such matters to the realm of engineering and logistics, simply may not be within the military's ethos.[127] Yet this is exactly where the emphasis must shift if operational plans are to incorporate the means to address climate change threats in the emerging era of environmental insecurity.

[1] Maybe, Nick, Gulledge, Jay, Finel, Bernard, Silverthorne, Katherine. "A Clear and Present Danger: How Climate Change Impacts Security." In *Degrees of Risk: Defining a Risk Management Framework for Climate Security*. London: E3G, 2011.

[2] Ibid

[3]"Global Climate Change: Evidence." Climate Change: Vital Signs of the Planet. Accessed January 26, 2015. http://climate.nasa.gov/evidence/.

[4] "Is Sea Level Rising?" National Ocean Service: Ocean Facts. Accessed January 18, 2015. http://oceanservice.noaa.gov/facts/sealevel.html.

[5] "Global Climate Change: Evidence." Climate Change: Vital Signs of the Planet. Accessed January 26, 2015. http://climate.nasa.gov/evidence/.

[6] Ibid

[7] Intergovernmental Panel on Climate Change. *Climate Change 2014 Synthesis Report: Summary for Policymakers*. Ed. Rajndra K. Pachauri and Leo Meyer. N.p., Oct. 2014. Web. 26 Jan. 2015. <http://www.ipcc.ch/report/ar5/wg2/>.

[8] Ekwurzel, Brenda. "Hurricanes and Climate Change." Union of Concerned Scientists. Accessed January 18, 2015. http://www.ucsusa.org/global_warming/science_and_impacts/impacts/hurricanes-and-climate-change.html#.VLvU0Gl0zIU.

[9] Rajndra K. et al.

[10] Ramesh, Randeep. "Bangladeshi Garment Workers Strike over Food Prices." The Guardian. April 15, 2008. Accessed January 16, 2015. http://www.theguardian.com/world/2008/apr/15/bangladesh.

[11] Dorosh, Paul; Rashid, Shahidur, "Bangladesh Rice Trade and Price Stabilization: Implications of the 2007/08 Experience for Public Stocks", IFPRI Discussion Paper 01209, International Food Policy Research Institute, September 2012, Accessed January 16, 2015.

[12] Vaughn, Bruce *Bangladesh: Political and Strategic Developments and U.S. Interests* Congressional Research Service Report, April 2010 Washington D.C.

[13] McKie, Robin, and Heather Stewat. "Hunger. Strikes. Riots. The Food Crisis Bites." The Guardian. April 12, 2008. Accessed January 17, 2015. http://www.theguardian.com/environment/2008/apr/13/food.climatechange.

[14] Ibid

[15] Ibid

[16] Khan, Aneire, Wei Xun, Habibul Ahsan, and Paolo Vineis. "Climate Change, Sea-Level Rise, & Health Impacts in Bangladesh." *Environmental Magazine*, September, 2011, 18-33. EBSCO*host* (Accessed October 20, 2014).

[17] "Complex/manmade Hazards: Complex Emergencies." International Federation of the Red Cross and Red Crescent Societies. Accessed May 25, 2015. https://www.ifrc.org/en/what-we-do/disaster-management/about-disasters/definition-of-hazard/complex-emergencies/.

[18] Maybe, Nick, Gulledge, Jay, Finel, Bernard, Silverthorne, Katherine. "A Clear and Present Danger: How Climate Change Impacts Security." In *Degrees of Risk: Defining a Risk Management Framework for Climate Security*. London: E3G, 2011.

[19] Obama, Barack. United States National Security Strategy. Washington D.C., 2010. Obama, Barack. United States National Security Strategy. Washington D.C., 2015.

[20] "Part 1: Global Risks 2014: Understanding Systemic Risks in a Changing Global Environment." In *Global Risks 2014 Ninth Edition*. Geneva: World Economic Forum, 2014.

[21] Obama, Barrack

[22] Allen, Thad. Lecture, Commandant's Lecture Series from Dwight D. Eisenhower School for National Security and Resource Strategy, Washington D.C., January 7, 2015.

[23] Bender, Bryan. "Chief of US Pacific Forces Calls Climate Biggest Worry; Says Warming, Rising Sea Levels Threaten Security." *The Boston Globe*, March 9, 2013. Accessed January 19, 2015. http://www.highbeam.com/doc/1P2-34372486.html

[24] "Quadrennial Defense Review 2014." U.S. Department of Defense. January 1, 2014. Accessed September 30, 2014. http://www.defense.gov/pubs/2014_Quadrennial_Defense_Review.pdf.

[25] United States. Department of Defense. *Department of Defense 2014 Climate Change Adaptation Roadmap*. Washington D.C. 2014

[26] United States. Government Accountability Office. *Humanitarian and Development Assistance: Project Evaluations and Better Information Sharing Needed to Manage the Military's Efforts*. GAO Contact: John H. Pendleton. GAO-12-359. Washington D.C.: GAO, 2012.

[27] Data compiled using the following sources: "Information on Over 125,000 Terrorist Attacks." Global Terrorism Database. Accessed January 28, 2015. http://www.start.umd.edu/gtd/. "The International Disaster Database." EM-DAT. Accessed January 28, 2015. http://www.emdat.be/.

[28] Comparison made using the Environmental Performance Index. http://epi.yale.edu/epi/data-explorer. and the Fragile States Index http://fsi.fundforpeace.org/.

[29] Comparison made using the Environmental Performance Index. http://epi.yale.edu/epi/data-explorer. and the Corruption Perception Index. http://www.transparency.org/cpi2014

[30] Whitehead, Frederika. "Water, Scarcity in Yemen: The Country's Forgotten Conflict." *The Guardian*, April 2, 2015. http://www.theguardian.com/global-development-professionals-network/2015/apr/02/water-scarcity-yemen-conflict

[31] Ibid

[32] Ibid

[33] Solomon, Steven. "Prologue." In *Water: The Epic Struggle for Wealth, Power, and Civilization*, 1-5. 1st ed. New York: Harper, 2010.

[34] "The World's Water." Where Is Earth's Water? USGS Water-Science School. Accessed December 29, 2014. http://water.usgs.gov/edu/earthwherewater.html.

[35] Solomon, Steven. "Rivers, Irrigation, and the Earliest Empires." In *Water: The Epic Struggle for Wealth, Power, and Civilization*, 27. 1st ed. New York: Harper, 2010.

[36] Solomon, Steven. "Seafaring, Trade, and the Making of the Mediterranean World." In *Water: The Epic Struggle for Wealth, Power, and Civilization*, 91-93. 1st ed. New York: Harper, 2010.

[37] Ibid

[38] Solomon, Steven. "The Grand Canal and the Flourishing of Chinese Civilization." In *Water: The Epic Struggle for Wealth, Power, and Civilization*, 100-107. 1st ed. New York: Harper, 2010.

[39] Ibid.

[40] Ibid

[41] "Summary of John Snow's Life in Encyclopedia Britannica." Summary of John Snow's Life in Encyclopedia Britannica. Accessed December 30, 2014. http://www.ph.ucla.edu/epi/snow/encyclopediasummaryfrerichs.html.

[42] "The Great Stink." The City of Westminster Archives: The Great Stink. Accessed December 29, 2014. http://www.choleraandthethames.co.uk/cholera-in-london/the-great-stink/.

[43] Ibid.

[44] Dye, Christopher. 2010. "200 years in the history of longevity." *Biologist* 57, no. 3: 127-130. *Academic Search Premier*, EBSCO*host* (accessed December 22, 2014).

[45] Solomon, Steven. "Giant Dams, Water Abundance, and the Rise of Global Society." In *Water: The Epic Struggle for Wealth, Power, and Civilization*, 342-358. 1st ed. New York: Harper, 2010.

[46] Ibid

[47] Ibid

[48] Ibid

[49] Reisner, Marc. "Introduction." In *Cadillac Desert: The American West and Its Disappearing Water*. New York, N.Y., U.S.A.: Viking, 1986.

[50] "The World's Water." Where Is Earth's Water? USGS Water-Science School. Accessed December 29, 2014. http://water.usgs.gov/edu/earthwherewater.html.

[51] Solomon, Steven. "Giant Dams, Water Abundance, and the Rise of Global Society." In *Water: The Epic Struggle for Wealth, Power, and Civilization*, 342-358. 1st ed. New York: Harper, 2010.

[52] Ibid

[53] "Facts About Global Groundwater Usage." National Groundwater Association. September 1, 2013. Accessed December 30, 2014. http://www.ngwa.org/Fundamentals/use/Documents/global-groundwater-use-fact-sheet.pdf.

[54] "Current World Population." World Population Clock: 7 Billion People (2014). Accessed December 30, 2014. http://www.worldometers.info/world-population/.

[55] "Virtual Water." - Discover How Much WATER We EAT Everyday. Accessed December 12, 2014. http://www.angelamorelli.com/water/.

[56] "Agricultural Productivity." International Food Policy Research Institute: Agricultural Productivity. Accessed May 25, 2015. http://www.ifpri.org/gfpr/2012/agricultural-productivity.

[57] United Nations Educational, Scientific and Cultural Organization. "Global Water Resources under Increasing Pressure from Rapidly Growing Demands and Climate Change, According to New UN World Water Development Report", March 14, 2012. Accessed May 22, 2015. http://www.unesco.org/new/en/media-services/single-view/news/global_water_resources_under_increasing_pressure_from_rapidly_growing_demands_and_climate_change_according_to_new_un_world_water_development_report/#.VV9cfDYcSUk.

[58] "Pakistan." In *Asian Transnational Security Challenges: Emerging Trends, Regional Visions*, edited by Caroline Dickens, 29-45. Australia: Macquarie University, Centre for Policing, Intelligence and Counter Terrorism (PICT) [in Association With] The Council for Asian Transnational Threat Research (CATR), 2010.

[59] Werrell, Caitlin E., and Francesco Femia. 2013. *The arab spring and climate change: A climate and security correlations* series, Center for American Progress, https://climateandsecurity.files.wordpress.com/2012/04/climatechangearabspring-ccs-cap-stimson.pdf

[60] Ibid

[61] Ibid

[62] Ibid

[63] Ibid

[64] Larry Elliot, "World Bank Warns of Soaring Food Price Dangers," *The Guardian*, February 15, 2011

[65] Werrel, Caitlin and Femia, Francesco

[66] Ibid

[67] Ibid

[68] Ibid

[69] Ibid

[70] Ibid

[71] Solomon, Steven. "From Have to Have-Not: Mounting Water Distress in Asia's Rising Giants." In *Water: The Epic Struggle for Wealth, Power, and Civilization*, 417-447. 1st ed. New York: Harper, 2010.

[72] United States. Government Accountability Office. *Humanitarian and Development Assistance: Project Evluations and Better Information Sharing Needed to Manage the Military's Efforts*. GAO Contact: John H. Pendleton. GAO-12-359. Washington D.C.: GAO, 2012.

[73] Ashok Swain. "Achieving Food Security" in *Understanding Emerging Security Challenges: Threats and Opportunities*, Routledge Press, New York, 2013

[74] "Virtual Water." - Discover How Much WATER We EAT Everyday. Accessed December 12, 2014. http://www.angelamorelli.com/water/.

[75] Ibid

[76] Zakar, Muhammad, and Rubeena Zakar. "Climate Change-Induced Water Scarcity: A Threat to Human Health." *South Asian Studies* Vol 27, No. 2 (July-December 2012): 293-312. EBSCO*host* (accessed December 12, 2014).

[77] Kenneth Pomeranz, "Drought, Climate Change, and the Political Economy of Himalayan Dam Building" in *New Security Challenges in Asia* edited by Michael Wills and Robert Hathaway, Woodrow Wilson Center Press, Washington D.C. 2013.

[78] Ashok Swain.

[79] Ibid.

[80] "Global Trends 2030: Alternate Worlds." Global Trends 2030. Accessed November 29, 2014. http://gt2030.com/tag/nic/.

[81] "WORKING GROUP III." IPCC WGIII Fifth Assessment Report. Accessed November 29, 2014. http://mitigation2014.org/.

[82] Burkle, Frederick, Gerald Martone, and P. Greenough. "The Changing Face of Humanitarian Crises." *Brown Journal of World Affairs* XX, no. II (2014): 25-42.

[83] Ibid

[84] Ibid.

[85] Zbicz, Dorothy, "Asia's Future: Critical Thinking for a Changing Environment" *Woodrow Wilson International Center for Scholars*, Washington D.C. September 2009.

[86] Ibid

[87] Ibid.

[88] Parker, Lauren. 2014. "China: Growth Rates and Domestic Allies Concern American Security." *Global Security Studies* 5, no. 2: 45-59. *International Security & Counter Terrorism Reference Center*, EBSCO*host* (accessed September 21, 2014).

[89] Kaplan, Robert, "The Guns of August in the East China Sea" Foreign Policy March 17 2014

[90] Hathaway, Robert M. and Michael Wills, "Introduction: New Security Challenges for a New Century" in *New Security Challenges in Asia* edited by Michael Wills and Robert Hathaway, Woodrow Wilson Center Press, Washington D.C. 2013.

[91] Allen, Thad.

[92] Werrell, Caitlin E., and Francesco Femia. 2013. *A Marshall Plan to Combat Climate Change in the Asia-Pacific: The Missing Piece of the New U.S. Security Strategy.* Center for Climate and Security, http://climateandsecurity.org/2012/02/08/a-marshall-plan-to-combat-climate-change-in-the-asia-pacific-the-missing-piece-of-the-new-u-s-security-strategy/

[93] Ibid

[94] Ibid

[95] Gates, Bill. "The next Outbreak? We're Not Ready." April 3, 2015. Accessed May 22, 2015. http://www.ted.com/talks/bill_gates_the_next_disaster_we_re_not_ready?language=en.

[96] Ibid.

[97] Ibid

[98] Ibid

[99] The use of water as an organizing principle along with each individual linkage: water and food, water and health, water and natural disasters, water and climate change, and water, peace and security, come from Dr. Alan Salzburg, the Special Coordinator for Water Resources at the U.S. Department of State

[100] "Virtual Water." - Discover How Much WATER We EAT Everyday. Accessed December 12, 2014. http://www.angelamorelli.com/water/.

[101] Salzberg, Arron. "International Water Issues: An Overview." Lecture, Environment Industry Study Guest Lecture Series from Dwight D. Eisenhower School for National Security and Resource Strategy, Washington D.C., November 24, 2014.

[102] Ibid

[103] Obama, Barak

[104] Briggs, Chad. "Developing Strategic and Operational Environmental Intelligence Capabilities." *Intelligence and National Security* Vol 27, No. 5 (October 2012): 653-668. EBSCO*host* (accessed November 3, 2014).

[105] Ibid

[106] Ibid

[107] Salzberg, Arron.

[108] Ibid

[109] Choy, Barry, Owen Sheih, and Imes Chieu. "EL NIÑO: POTENTIAL ASIA PACIFIC IMPACTS." *White Paper for U.S. Pacific Command*, August 1, 2014.

[110] Vaughn, Bruce

[111] Kaplan, Robert D. "Bangladesh: The Existential Challenge." In *Monsoon: The Indian Ocean and the Future of American Power*. New York: Random House, 2010.

[112] Harri, Gardiner. "Borowed Time on Disappearing Land." *New York Times*, March 28, 2014. Accessed December 20, 2014. http://www.nytimes.com/2014/03/29/world/asia/facing-rising-seas-bangladesh-confronts-the-consequences-of-climate-change.html?_r=0.

[113] Ibid

[114] Vaughn, Bruce

[115] Shamim, Choudhury. "Alternative Views of Environmental Security in a Less Developed Country: The Case of Bangladesh." *Journal of Third World Studies* XXV, no. 1 (2008): 253-72. EBSCO*host* (Accessed January 6, 2015).

[116] Khan, Aneire, Wei Xun, Habibul Ahsan, and Paolo Vineis. "Climate Change, Sea-Level Rise, & Health Impacts in Bangladesh." *Environmental Magazine*, September, 2011, 18-33. EBSCO*host* (Accessed October 20, 2014).

[117] Vaughn, Bruce

[118] Ibid

[119] Ibid

[120] Sheih, Owen. "Climate Change Overview." Lecture, Asia-Pacific Regional Strategies for Health and Security Symposium, Honolulu, January 15, 2015.

[121] Choy, Barry et al.

[122] United Sates. Government Accountability Office et al.

[123] Ibid

[124] Ibid

[125] United States Central Command, "USCENTCOM Climate Change Assessment", 2014.

[126] "Obama Highlights Long-Term Climate Security Threats, Releases Review of Federal Resources | New Security Beat." New Security Beat Obama Highlights Long Term Climate Security Threats Releases Review of Federal Resources Comments. May 20, 2015. Accessed May 21, 2015. http://www.newsecuritybeat.org/2015/05/obama-highlights-climate-security-threats-releases-review-federal-resources/.

[127] Foster, Gregory. "A New Security Paradigm." *World Watch* 18, no. 1 (Jan/Feb 2005): 36-46.