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Human Security

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Key Findings

Fossil Fuels and Human Security

- As the world has grown more prosperous, threats to human security have become less common. The prosperity that fossil fuels make possible, including helping produce sufficient food for a growing global population, is a major reason the world is safer than ever before.
- Prosperity is closely correlated with democracy, and democracies have lower rates of violence and go to war less frequently than any other form of government. Because fossil fuels make the spread of democracy possible, they contribute to human security.
- The cost of wars fought in the Middle East is not properly counted as one of the "social costs of carbon" as those conflicts have origins and justifications unrelated to oil.

Citation: Avery, D., Idso, C.D., and Stover, A. 2019. Human Security. In: *Climate Change Reconsidered II: Fossil Fuels.* Nongovernmental International Panel on Climate Change. Arlington Heights, IL: The Heartland Institute.

- Limiting access to affordable energy threatens to prolong and exacerbate poverty in developing countries, increasing the likelihood of domestic violence, state failure, and regional conflict.

Climate Change

- The IPCC claims global warming threatens "the vital core of human lives" in multiple ways, many of them unquantifiable, unproven, and uncertain. The narrative in Chapter 12 of the Fifth Assessment Report illustrates the IPCC's misuse of language to hide uncertainty and exaggerate risks.

- Real-world data offer little support for predictions that CO_2-induced global warming will increase either the frequency or intensity of extreme weather events.

- Little real-world evidence supports the claim that global sea level is currently affected by atmospheric CO_2 concentrations, and there is little reason to believe future impacts would be distinguishable from local changes in sea level due to non-climate related factors.

- Alleged threats to agriculture and food security are contradicted by biological science and empirical data regarding crop yields and human hunger.

- Alleged threats to human capital – human health, education, and longevity – are almost entirely speculative and undocumented. There is no evidence climate change has eroded or will erode livelihoods or human progress.

Violent Conflict

- Empirical research shows no direct association between climate change and violent conflicts.

- The climate-conflict hypothesis is a series of arguments linked together in a chain, so if any one of the links is disproven, the hypothesis is invalidated. The academic literature on the relationship between climate and social conflict reveals at least six methodological problems that affect efforts to connect the two.

- There is little evidence that climate change intensifies alleged sources of violent conflict including abrupt climate changes, access to water, famine, resource scarcity, and refugee flows.

- Climate change does not pose a military threat to the United States. President Donald Trump was right to remove it from the Pentagon's list of threats to national security.

- Predictions that climate change will lead directly or indirectly to violent conflict presume mediating institutions and human capital will not resolve conflicts before they escalate to violence.

Human History

- Extensive historical research in China reveals a close and positive relationship between a warmer climate and peace and prosperity, and between a cooler climate and war and poverty.

- The IPCC relies on second- or third-hand information with little empirical backing when commenting on the implications of climate change for conflict.

Introduction

The United Nations' Intergovernmental Panel on Climate Change (IPCC) refers to damages caused by climate change as "threats to human security," hence the title of this chapter. Among the topics addressed in this chapter are the role played by fossil fuels in prosperity, democracy, and wars in the Middle East, and the possible harms caused by climate change including more frequent or severe extreme weather events, sea-level rise, and damage to agriculture. The possible link between climate change and violent conflict is given particularly close attention. The final section of this chapter reviews academic literature on the role of climate in human history.

Most of the IPCC's discussion of this topic appears in Chapter 12 of the Working Group II

contribution to the Fifth Assessment Report (AR5) (IPCC, 2014a, p. 759), where human security "in the context of climate change" is defined as "a condition that exists when the vital core of human lives is protected, and when people have the freedom and the capacity to live with dignity. In this assessment, the vital core of human lives includes the universal and culturally specific, material and non-material elements necessary for people to act on behalf of their interests." "The concept [of human security] was developed in parallel by UN institutions, and by scholars and advocates in every region of the world," the IPCC reports, citing many conference and committee reports and edited books.

One supposes the definition of "human security" was carefully chosen by a task force of "scholars and advocates," but all of the words in it seem derived from philosophy, ethics, and perhaps anthropology, sociology, and law, but not science or economics. While not meaningless, the standard nevertheless is incapable of quantification. As Gleditsch and Nordås (2014) comment, "the definition in the Human Security chapter is too wide to allow serious attempts to assess the secular trend. … There is a real danger that any kind of social change disliked by some group becomes a threat to someone's human security" (pp. 85–86).

The IPCC alleges, "Climate change threatens human security because it undermines livelihoods, compromises culture and individual identity, increases migration that people would rather have avoided, and because it can undermine the ability of states to provide the conditions necessary for human security. Changes in climate may influence some or all of the factors at the same time. Situations of acute insecurity, such as famine, conflict, and sociopolitical instability, almost always emerge from the interaction of multiple factors. For many populations that are already socially marginalized, resource dependent, and have limited capital assets, human security will be progressively undermined as the climate changes (IPCC, 2014a, FAQ 12.1, p. 762).

In its *Summary for Policymakers* (SPM) for the Working Group II contribution to AR5, the IPCC claims,

> Climate change indirectly increases risks from violent conflict in the form of civil war, inter-group violence, and violent protests by exacerbating well-established drivers of these conflicts such as poverty and economic shocks (*medium confidence*). Statistical studies show that climate variability is significantly related to these forms of conflict. … Climate change over the 21st century will lead to new challenges to states and will increasingly shape national security policies (*medium evidence, medium agreement*) (IPCC, 2014b, p. 12).

As emphatic as these declarations seem to be, the IPCC is nevertheless deeply conflicted over whether global warming contributes to violence and other kinds of social conflicts. In Chapter 18 of the same report, on "Detection and Attribution of Observed Impacts," the IPCC found,

> … both the detection of a climate change effect [on social conflict] and an assessment of the importance of its role can be made only with *low confidence* owing to limitations on both historical understanding and data. Some studies have suggested that levels of warfare in Europe and Asia were relatively high during the Little Ice Age (Parker, 2008; Brook, 2010; Tol and Wagner, 2010; White, 2011; Zhang *et al*., 2011), but for the same reasons the detection of the effect of climate change and an assessment of its importance can be made only with *low confidence*. There is no evidence of a climate change effect on interstate conflict in the post-World War II period (IPCC, 2014a, p. 1001).

That this dramatic admission of uncertainty did not make it into the SPM of the Fifth Assessment Report is one of many examples of how the IPCC's editorial process, described in Chapter 2, Section 2.3.3, ensures its widely cited SPMs exaggerate the possible dangers posed by climate change, whether natural or man-made, while uncertainties and even contradictory evidence are hidden deep in its almost impenetrable tomes (Stavins, 2014; Tol, 2014).

Citing the IPCC's AR5 and its preceding Fourth Assessment Report as his scientific basis, U.S. President Barack Obama deemed climate change to be an immediate threat to the security of the United States and the entire world. Two *National Security Strategies* (White House, 2010, 2015) made that case, and two *Quadrennial Defense Reviews* (Department of Defense, 2010, 2014) discussed how the U.S. military would need to change to address the new alleged threats. When releasing the 2015 *National Security Strategy*, Obama said, "Today, there is no

greater threat to our planet than climate change" (Obama, 2015).

The United States national government quickly and dramatically changed course following the election of President Donald Trump. Climate change no longer appears in the list of national security threats facing the United States (White House, 2017). In March 2017, Trump signed an executive order scrapping the Obama administration's "social cost of carbon" calculations (Trump, 2017a) and in June 2017 he announced his intention to withdraw the United States from the Paris Accord (Trump, 2017b).

Who is right, IPCC (Chapter 12) and Barack Obama, or IPCC (Chapter 18) and Donald Trump? As this chapter will show, it is not a close call. IPCC (Chapter 18) correctly describes the lack of scientific evidence supporting claims that global warming causes violence and other threats to human security and President Donald Trump was right to remove climate change from the list of threats to national security.

Similar to previous chapters, this chapter first examines the direct impact of the use of fossil fuels, in this case on human security, and then the hypothetical indirect impact of fossil fuels if they are contributing to climate change. Parts of this chapter originally appeared in reports published by the George C. Marshall Institute titled *Climate and National Security: Exploring the Connection* (Kueter, 2012) and by The Heartland Institute titled *Climate Change, Energy Policy, and National Power* (Hayward *et al.*, 2014) and *Critique of "Climate Change Adaptation: DOD Can Improve Infrastructure Planning and Processes to Better Account for Potential Impacts"* (Smith, 2015). Those reports have been extensively revised with the authors' and publishers' approval.

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7.1. Fossil Fuels

Sections 7.1.1 and 7.1.2 show how the use of fossil fuels has contributed to human security, as defined by the IPCC, in two principal ways: by making possible the immense rise in human prosperity that resulted from the Industrial Revolution and by supporting the spread of democracy to many parts of the world. Since it is often argued that the developed nations' reliance on oil from the Middle East threatens human security by fomenting war and a huge investment in troops and arms sent to the region (e.g., Lovins, 2011, p. 5), Section 7.1.3 shows how those wars and battles for at least the past four decades, and perhaps in the more distant past, were not fought over oil but had their origins and justifications in matters unrelated to fossil fuels.

7.1.1 Prosperity

> *As the world has grown more prosperous, threats to human security have become less common. The prosperity that fossil fuels make possible, including helping produce sufficient food for a growing global population, is a major reason the world is safer than ever before.*

Fossil fuels, as documented in Chapters 3 and 4, have unquestionably made humanity more prosperous and healthier. They have even benefited nature, as documented in Chapter 5. History reveals that cold temperatures are more dangerous to our societies than warm temperatures. The Holocene Optimum from 9000 to 6000 years ago was significantly warmer than today and humans flourished. Siberia was 3°C to 9°C warmer then than it is today, and the seas around the Great Barrier Reef were warmer by about 1°C. The Minoan, Roman, and Medieval Warmings were also warmer than today and human societies flourished during those periods as well. In contrast, during the Last Glacial Maximum, temperatures frequently dipped below minus 40°C. The latest Cambridge studies say the desperate Ice Age cold left only about 100,000 human survivors scattered in tiny refuges worldwide when the warming before the Younger Dryas Event began perhaps 14,000 years ago (Davies and Gollop, 2003).

The Dark Ages and Little Ice Age saw huge proportions of their human populations die, mostly in famines because the weather was too cold and chaotic for farmers to feed their cities. Growing seasons were shorter, colder, and cloudier with chaotic events such as killing frosts in mid-summer. The "little ice ages" also suffered centuries-long droughts, massive floods, hunger-driven combat, and hunger-related disease epidemics. Vast storms lashed the seas and lands. Northern Europe became too wet for grains, southern Europe too dry, and the vast Eurasian steppes were abandoned to drought. Their nomadic herders attacked neighboring sedentary peoples in all directions, seeking more grass for their herds. The Eastern Mediterranean nations were essentially depopulated, over and over, by extended droughts. China was ravaged by droughts, floods, wars, rebellions, and dynastic collapses during each of its cold, chaotic weather periods (Fagan, 2000).

In North America, the vegetation underwent nine major transformations in 14,000 years (Viau *et al.*, 2002). Trees, grasses, berries, and roots shifted their ranges in the cold and chaotic weather, forcing the hunter-gatherers to shift their patterns, and often their habitats too. Archaeology from North America's Little Ice Age tells us warfare was the constant and inevitable result (Rice, 2009, pp. 136–60). This pattern of cold-climate human failure continued until the seventeenth century. Then, in the continuing cold of the Little Ice Age, human technology made possible by the use of fossil fuels became effective enough to feed larger populations despite that awful weather.

Global temperatures have risen since the Little Ice Age, a warming that began before the human use of fossil fuels could have been responsible and may be continuing in the modern era. Even in today's relative warmth and with our advanced technologies and wealth, though, far more humans die during cold events than during heat events (see Gasparrini *et al.,* 2015, and the many references in Chapter 4, Section 4.2). Since a low and falling mortality rate is of fundamental importance to human security, however that term is defined, it can hardly be doubted that a warmer world would be a net improvement for the human condition. Nevertheless, some scholars worry

about the possible negative "side-effects" of prosperity. Friedman (2006) writes,

> We are also increasingly aware that economic development – industrialization in particular, and more recently globalization – often brings undesirable side effects, like damage to the environment or the homogenization of what used to be distinctive cultures, and we have come to regard these matters, too, in moral terms. On both counts, we therefore think of economic growth in terms of material considerations versus moral ones: Do we have the right to burden future generations, or even other species, for our own material advantage? (p. 15)

But Friedman goes on to say, "I believe this thinking is seriously, in some circumstances dangerously, incomplete." He writes,

> The value of a rising standard of living lies not just in the concrete improvements it brings to how individuals live but in how it shapes the social, political and, ultimately, the moral character of a people. Economic growth – meaning a rising standard of living for the clear majority of citizens – *more often than not fosters greater opportunity, tolerance of diversity, social mobility, commitment to fairness, and dedication to democracy*. Ever since the Enlightenment, Western thinking has regarded each of these tendencies positively, and in explicitly moral terms (*Ibid.*, italics added).

In *The Moral Consequences of Economic Growth* (2005), Friedman showed from international studies that periods of higher economic growth tend to be accompanied historically by more tolerance, optimism, and egalitarian perspectives, while periods of declining economic growth are characterized by pessimism, nostalgia, xenophobia, and violence.

Similarly, LeBlanc and Register (2003) asked, "Has 'progress' – that escalating desire to be bigger, better, faster, stronger – totally extinguished our ancestral instincts to grow everything we consume and hunt only what we need to sustain us? Many view the march of civilization not as a blessing but as a curse, bringing with it escalating warfare and spiraling environmental destruction unlike anything in our human past" (p. xii). But also like Friedman, LeBlanc and Register say this popular point of view is wrong: "Contrary to exceedingly popular opinion, and as bad as our problems may be today, none of this is true. The common notion of humankind's blissful past, populated with noble savages living in a pristine and peaceful world, is held by those who do not understand our past and who have failed to see the course of human history for what it is."

As the world has grown more prosperous, deaths from wars have plummeted. See Figure 7.1.1.

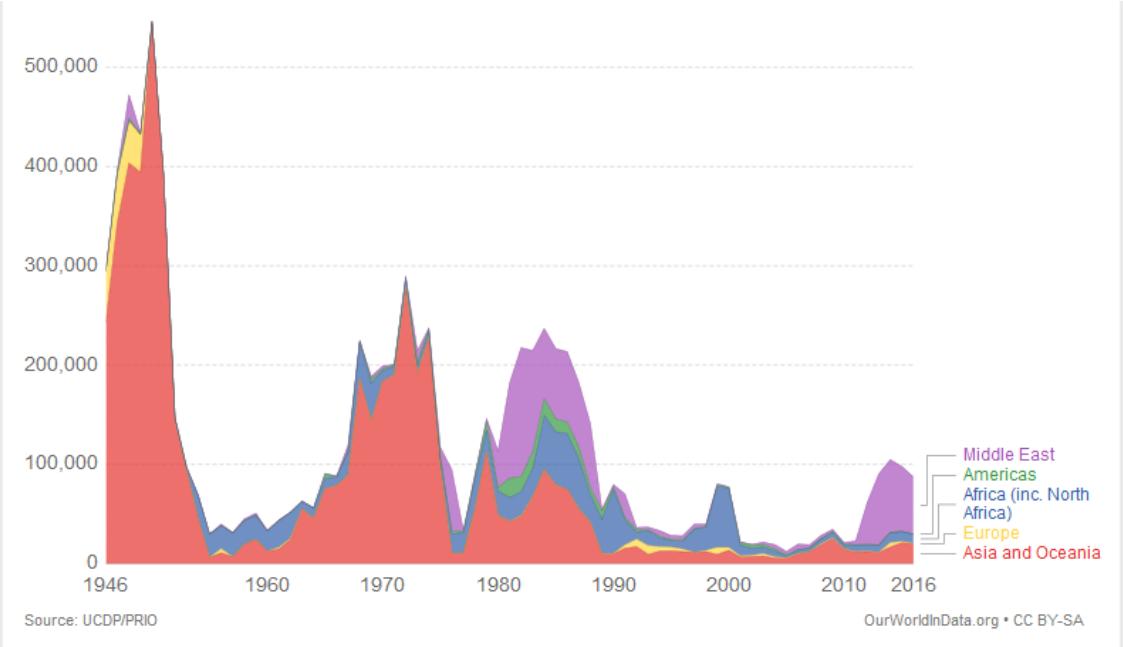
According to Gleditsch and Nordås (2004), "Globally, in the first decade after World War II, an average of some 300,000 people per year died in battle-related violence. In the first decade in the new Millennium the figure had shrunk to around 44,000" (p. 82). If prosperity fueled rather than discouraged war, these figures would be difficult to explain.

Focusing specifically on the threat to human security posed by civil wars, Hegre and Sambanis (2006) report, "there is now consensus that the risk of war decreases as average income increases and the size of a country's population decreases" (pp. 508–9). Revealing the distance between the explanatory power of these two variables and all others, the authors add, "Beyond these two results, however, there is little agreement."

Hegre and Sambanis conducted an empirical analysis of the role played by prosperity and other factors in the incidence of civil war, isolating causation "by using the same definition of civil war and analyzing the same time period while systematically exploring the sensitivity of 88 variables used to explain civil war in the literature." They used both the PRIO [Peace Research Institute Oslo] definition of "internal armed conflict" and their own definition of civil wars as "an armed conflict between an internationally recognized state and (mainly) domestic challengers able to mount an organized military opposition to the state. The war must have caused more than 1,000 deaths in total and in at least a three-year period" (p. 523). They included per-capita income as a variable because other researchers reasoned that higher incomes raise the opportunity cost of civil wars, citing Fearon and Laitin (2003).

For both definitions of civil war, Hegre and Sambanis found "robust" relationships between the onset of civil wars and low income levels as well as low rates of economic growth (p. 508). They found "decreasing income by one standard deviation increases the risk of civil war by 65%," and "income is substantially more important than population" (p. 524).

Figure 7.1.1
Battle-related deaths in state-based conflicts since 1946, by world region



Source: Our World in Data, n.d.

Other researchers have arrived at similar conclusions (see Collier and Hoeffler, 2004 for citations).

Driving much of this movement toward world peace is the rising abundance of food and other necessities made possible by the use of fossil fuels. Fagan (2000) described a world *without* fossil fuels in a book titled *The Little Ice Age*. He wrote,

> Wine harvests were generally late between 1687 and 1703, when cold, wet springs and summers were commonplace. These were barren years, with cold summer temperatures that would not be equaled for the next century. The depressing weather continued as the Nine Years War engulfed the Spanish Netherlands and the Palatinate and Louis XIV's armies battled the League of Augsburg. The campaigning armies of both sides consumed grain stocks that might have fed the poor. As always, taxes were increased to pay for the war, so the peasants had little money to buy seed when they could not produce enough of their own in poor harvest years (p. 132).

As Fagan's description shows, bad weather was enough to cause starvation and wars over limited supplies of food. Armies were raised to commandeer the meager output of low-productivity peasants, which further increased social unrest. Fagan notes "there was little excess food in Europe" during the Irish famine in 1740–1741 because of poor harvests and the War of Austrian Succession. Instead, he observes, quoting Austin Bourke, help came from Britain's peaceful and prosperous North American colonies: "large supplies of provisions arrived from America" (*Ibid.*, p. 183).

Conflicts within nations can likewise arise over scarcity, especially food shortages. Noting "it is implausible to suppose that famines and massive dislocations of poor populations will be unaccompanied by civil unrest and disobedience," Fagan documents such an occurrence in sixteenth century England: "The 1520s produced five exceptional English harvests in a row, when people adapted readily to greater plenty. A spike of sudden cold weather in 1527 brought immediate threats of social unrest. In that year, the mayor's register at Norwich in eastern England noted "there was so great

scarceness of corne that aboute Christmas the commons of the cyttye were ready to rise upon the ryche men" (*Ibid.*, p. 84).

As these and countless other examples attest, in centuries past, natural changes in weather as well as climate continuously pushed people into conflict with one another in the pursuit of scarce resources. Reducing this dependency on fair weather is one of the keystones of the development of civilization and the reduction of conflict among peoples. Goklany (2012) noted,

> Until the last quarter of a millennium, mankind depended on living nature for all its food and clothing, most of its energy, and much of its material and medicines. She dictated mankind's numbers, well-being, and living standards. But she has never been constant. She would smile on some, but not on others. Her smiles, always temporary, would inevitably be replaced by frowns. Her Malthusian checks – hunger, famine, disease, or conflict – ensured that there was little or no progress in the human condition. Many people did not even survive into their 20s, populations grew very slowly, and living standards were generally constrained to subsistence levels.
>
> Gradually, with the accumulation of human capital, exchange of ideas, and hard work, mankind started to commandeer more land to meet its needs and develop technologies that, in some cases, amplified Nature's bounty but, in other cases, bypassed her altogether. These led to higher food production, better health, longer lifespans, and larger populations with better living standards, which then reinforced human capital and the exchange of ideas, which begat yet more and better technologies. Thus was the cycle of progress born and set in motion (p. 26).

Fossil fuels, Goklany notes, made possible this cycle of prosperity and progress. Fossil fuels are responsible for at least 60% of mankind's food, and they provide 81% of our energy supply (with nature contributing only 10%). Worldwide, 60% of the fiber used for clothing and other textiles is synthetic, produced mainly from fossil fuels such as petroleum. Even the production of so-called natural fibers, which constitute 30% of the clothing and textile supply, relies heavily on the use of fossil fuel-based fertilizers and pesticides.

Fossil fuels and the technologies they make possible, Goklany notes, lower our reliance on "living nature," thus reducing the effect of "the whims of nature" on human well-being and reducing the amount of land converted to human use. The reduction of "mankind's footprint on the world" makes land – and hence political sovereignty over increasing amounts of it – less important even as populations increase. A critical element of that progress was the huge increase in crop yields achieved in the twentieth century, a story told in some detail in Chapters 3, 4, and 5.

In addition to nitrogen fertilizer – mass-produced through the use of fossil fuels and delivered efficiently by fossil-fuel-powered vehicles – irrigation and pesticides have further increased crop yields, with fossil fuels playing critical roles in the production and transportation of these goods. In addition, fossil-fuel-powered transportation plays a central role in increasing the availability of food and other necessities of life. Again Goklany reports:

> Beyond increasing yields on the farm, fossil fuels have increased food availability in other ways. The food and agricultural system depends on trade within and between countries to move agricultural inputs to farms and farm outputs to markets. In particular, trade allows food surpluses to be moved to areas experiencing food deficits. But transporting these inputs and outputs in the quantities needed and with the speed necessary for such trade to be an integral part of the global food system depends on relatively cheap fossil fuels (p. 10).

Fagan also noted the importance of transportation in reducing the vulnerability of Europe to crop failures in the fourteenth century: "Vulnerability was a reality of daily life: however adaptable farmers were, Europe still lacked an effective infrastructure for moving large quantities of grain and other commodities at short notice" (Fagan, 2000, p. 80). The Industrial Revolution and rapid increase in the use of fossil fuels have eliminated that technological constraint and spread wealth across the face of the Earth.

Also critical in reducing conflict within and between nations is international trade. Greaves (1995) reported that when Britain repealed its tariffs on imported grain in the nineteenth century (known

as the Corn Laws), "Free trade lowered the price of bread and improved the diet of the poor. Living standards improved. With more to eat, people lived longer and healthier lives" (Greaves, 1995, p. 13). They were also more productive, producing more goods and services for themselves and everyone around them. Improved transportation and communication shrank the world and allowed the division of labor to develop internationally, further increasing productivity, as did the global movement of capital: "Production was shifted to areas where the marginal productivity per worker was greater. New trade channels were developed." The increasing international trade, in turn, "brought peoples in different parts of the world closer together. It fostered mutual respect and friendship. People came to realize that voluntary transactions brought gains to both parties and benefits to nation and state. The way to wealth was through trade, not conquest or war." As a result, "peace and good will reigned in most of the world throughout the nineteenth century" (*Ibid.*).

While free trade encouraged peace, high tariffs and blockades encouraged war. Greaves noted the importance of resource scarcity in the rise of Adolf Hitler and Nazi Germany:

> In Germany after World War I, rampant inflation had wiped out all savings, completely destroying the middle class. The people were hungry. Adolf Hitler, a rabble rouser with dramatic flair, had attracted a few misfits and malcontents to his movement. The depression added to the distress. … Hitler made the Jews scapegoats and reached out for "Lebensraum" (living space) to obtain the food and other resources needed to make Germany self-sufficient. Hence the occupation of Austria (March 1938), the Czech Sudetenland (October 1938), and the invasion of Poland (September 1, 1939), also of Belgium, Denmark, Norway, Netherlands, Luxembourg, and Russia.

Although Hitler had grandiose reasons for at least some of these invasions, Greaves is correct to observe that economic scarcity fostered his rise to political power and the German people's acceptance of his program of occupation. Greaves quotes Ludwig von Mises as having written during World War II, "Germany does not aim at autarky because it is eager to wage war. It aims at war because it wants autarky – because it wants to live in economic self-sufficiency" (*Ibid.,* p. 15).

Regarding Germany's fellow Axis power Japan, Greaves notes: "Japan too needed 'lebensraum.' Its population was increasing." Japan's inability to produce enough food and other needed resources drove a fervor for conquest. "Japan was becoming a modern industrial state and depended on imports more than most countries. Yet Japan's attempts to buy food and resources abroad were blocked." Japan's expansion into Korea and Manchuria and its war with China spurred the United States, Britain, and Netherlands to impose trade restrictions on the island nation in the late 1930s, further increasing Japan's need for self-sufficiency. As a result, "Japan attacked Pearl Harbor to protect its flank as she struck the Dutch East Indies and British Malaya to obtain needed food, oil, rubber, and other resources (*Ibid*.)."

The dire consequences of the forced isolation of Germany and Japan led nations away from free trade in the early years of the twentieth century, and conflicts increased. Later in the century, after the brutality of two world wars and a worldwide depression, governments once again turned to freer trade, with a big boost from a technological advance: fossil fuels. Productivity worldwide began to rise rapidly once again.

The increase in trade among nations, made possible by the efficiency of fossil fuels, both alleviates hunger crises in nations hit by natural disasters or poor crop years and allows surpluses in successful nations to be sent to those suffering long-term productivity problems. Trade also increases the stock of human knowledge and inspires the spread of ideas. Consider, for example, the rapid rise of electronics production in Japan in the 1970s and 1980s, computer software in India in the 2000s, electronics in Korea in the 1990s and 2000s, and computer production in China in the 2000s. This fossil-fuel-accelerated process further increases the pace of trade. Goklany notes:

> Without relatively cheap fossil fuels, the volume and speed with which goods are traded would be much lower. But trade is one of the fastest methods of disseminating technologies. Introducing new technologies to new places also helps generates new ideas. Or, as Matt Ridley has noted, ideas have "sex," which then propagates new ideas. Absent trade, such devices as personal computers, notebooks, and cell phones may not have been available outside of a handful of industrialized countries, and their prices

> would have been higher everywhere. This would translate into lower human capital per capita. These products also contain substantial amounts of polycarbonate and other petroleum-based plastics (Goklany, 2012, p. 25).

The argument has been made that income inequality accompanying rising prosperity results in violent conflicts and even war (Piketty, 2014; Scheidel, 2017). An analysis by Goklany (2002), however, finds rich nations are not advancing at the expense of the poor: "Gaps in these critical measures of well-being between the rich countries and the middle- or low-income countries have generally shrunk dramatically since the mid-1900s irrespective of trends in income inequality" (p. 14). Where there have been losses in well-being in the poorest nations, "the problem is not too much globalization but too little," Goklany writes. Specifically, the cycle of prosperity has been inhibited by government policies. Pinkovskiy and Sala-i-Martin (2009) estimated the income distribution for 191 countries between 1970 and 2006 and confirmed Goklany's analysis. They found,

> Using the official $1/day line [the United Nations' definition of poverty], we estimate that world poverty rates have fallen by 80% from 0.268 in 1970 to 0.054 in 2006. The corresponding total number of poor has fallen from 403 million in 1970 to 152 million in 2006. Our estimates of the global poverty count in 2006 are much smaller than found by other researchers. We also find similar reductions in poverty if we use other poverty lines. *We find that various measures of global inequality have declined substantially* and measures of global welfare increased by somewhere between 128% and 145% (italics added).

In the 1990s, the gap in life expectancy between sub-Saharan Africa and the rest of the world grew due largely to government policies prohibiting the use of DDT and the subsequent return of malaria to that region of the world. Even with the AIDS epidemic, sub-Saharan mortality rates might have held their own if not for the resurgence of malaria. Thus, "the fact that life expectancy in the Sub-Saharan countries still exceeds the 20–30 years that was typical prior to globalization indicates that, despite the AIDS epidemic and the resurgence of malaria, the net effect of globalization has been positive as far as life expectancy is concerned," Goklany concludes. (*Ibid.*)

Lichbach (2000) observes that the "global political order" has not eliminated conflicts among nations and in fact encourages countries to band together to wage war against others: "The so-called global order makes overt war in Kosovo, continues unnoticed bombing in Iraq, and does nothing about genocide in East Timor," he writes. Markets, by contrast, create social order not only on the local, regional, and national level but also on a global scale. He goes on to say,

> [T]he globalization problem is a perfect example of how markets can create rather than destroy social order. Global social order will come, if at all, from international markets (that is, international trade), which will lead to social contracts about international markets that, in turn, will require more general global political order. ... Given the global pluralism of values, only rationally arrived at social contracts can produce predictability, cooperation, and the absence of violence (p. 148).

This cycle of progress is entirely dependent on fossil fuels, Goklany argues:

> Although fossil fuels did not initiate the cycle of progress and are imperfect, they are critical for maintaining the current level of progress. It may be possible to replace fossil fuels in the future. Nuclear energy is waiting in the wings but, as the high subsidies and mandates for renewables attest, renewables are unable to sustain themselves today. Perhaps, with help from fossil fuels, new ideas will foster technologies that will enable a natural transition away from such fuels (Goklany, 2012, p. 27).

More recent research on the economics of renewable energies – mainly wind power and solar photovoltaic cells – reported in Chapter 3, Section 3.5, shows renewables indeed have been unable to replace fossil fuels in most applications and particularly with regards to generating "dispatchable" (always available) electricity. Other research suggests there is a strong positive linkage between cheap energy, the economic growth it enables, and international stability. A report commissioned by the

U.S. Agency for International Development surveyed 93 countries to test a model attempting to show the relationships between energy consumption, gross domestic product, life expectancy, and probability of stability (Vasudeva *et al.*, 2005). Access to cheap, affordable energy and economic growth were found to increase the odds of peace by a factor of 2.5. By raising energy consumption, "the occurrence of peace is now 1.5 times more likely than the occurrence of instability in any given country," the study found. (*Ibid*., p. 32)

The cycle of progress increases prosperity, alleviates resource scarcity crises, and fosters international trade and cooperation, all made possible by the widespread and increasing use of fossil fuels.

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7.1.2 Democracy

> *Prosperity is closely correlated with democracy, and democracies have lower rates of violence and go to war less frequently than any other form of government. Because fossil fuels make the spread of democracy possible, they contribute to human security.*

Democracy can be defined as a system for selecting political leadership characterized by popular participation, broad access by candidates to the ballot, and institutional checks on the power of officials once elected (Gurr *et al.*, 1990). The rise of democracy has been called the "preeminent development" of the twentieth century (Sen, 1999). Samuel Huntington identified three "waves of democratization" in his important book titled *The Third Wave: Democratization in the Late Twentieth Century* (Huntington, 1991). Some of his findings are summarized in Figure 7.1.2.1.

The association between democracies and human security has been extensively studied. Halperin *et al*. (2004) surveyed the literature and found:

> Counter to the expectations of the prevailing school, a great deal of research in the 1990s on the political dimension of conflict has revealed a powerful pattern of a "democratic peace." Democracies rarely, if ever, go to war with each other. This pattern has held from the establishment of the first modern democracies in the nineteenth century to the present. As an ever-greater share of the world's states become democratic, the implications for global peace are profound. Indeed, as the number of democracies has been increasing, major conflicts around the world (including civil wars) have declined sharply. Since 1992, they have fallen by two-thirds, numbering just 13 as of 2003 (p. 12).

According to Siegle *et al*., 80% of all interstate conflicts are instigated by autocracies and 95% of the worst economic performances over the past 40 years were overseen by nondemocratic governments, as well as "virtually all contemporary refugee crises." They write, "Over the past 40 years, autocracies have been twice as likely to experience economic collapse as democracies." Citing Nobel laureate Amartya Sen, they report there has never been a democracy with a free press that has experienced a famine (*Ibid.,* pp. 17–18).

Writing in *Foreign Affairs* in 2004, Halperin, Siegle, and Weinstein documented how low-income democracies do a superior job advancing human security than their autocratic counterparts, observing that "development can also be measured by social indicators such as life expectancy, access to clean drinking water, literacy rates, agricultural yields, and the quality of public-health services. On nearly all of these quality-of-life measures, low-income democracies dramatically outdo their autocratic counterparts" (Siegle *et al.,* 2004). They also report:

> People in low-income democracies live, on average, nine years longer than their counterparts in low-income autocracies, have a 40 percent greater chance of attending secondary school, and benefit from agricultural yields that are 25 percent higher.
>
> … Poor democracies also suffer 20 percent fewer infant deaths than poor autocracies (*Ibid.*).

Lipset and Lakin (2004) observe "there is an extremely high correlation between civil and political liberties" (p. 32), though civil liberties may not be part of a "minimalist" definition of democracy. On the association of democracy and violence, they write:

> Democracy promotes the institutionalization of nonviolent forms of social conflict and the substitution of nonviolent for violent struggle. While its inception may be the result of rational choice rather than any deep moral commitment, the institutionalization of nonviolent conflict through repeated practice eventually cultivates abiding moral support. Likewise, out-groups that have to fight for entrance into the political game often develop democratic ideologies that suit their purposes, but upon seizing power, they find that the democratic ideal has rooted itself in society, that many adherents genuinely believe in it. Thus what began as instrumental support becomes culturally entrenched (*Ibid.,* p. 35).

diZerega (2000) noted, "Unlike other forms of government, liberal democracies have never fought wars *with others of their own kind*" (p. 1). He suggests

Figure 7.1.2.1
Comparing waves of democratization

Wave	Percentage-point increase in the number of democratic states	Approximate duration (Years)
First	45	100
Second	13	20
Third	35	25

Source: Huntington, 1991, p. 26.

the reason is "democracies are spontaneous orders in [Friedrich] Hayek's sense of the term. Consequently democracies are not states in the usual sense, and often do not act like them." According to diZerega (and Hayek, 1973, 1977, 1979), a spontaneous order does not have a single purpose or an individual who can impose such a purpose on the system. Consequently,

> In a democracy all specific policy goals are subordinated to democratic procedures, with the partial exception of wartime. It is only during wartime that democracies can come to resemble instrumental organizations, that is, typical states. Even here, any suspension of democratic procedures such as Britain's suspending elections during WWII, is justified as necessary in order to win the war *and return to democratic procedures*. No general agreement as to the polity's specific goals (beyond survival) need exist.

Fossil fuels and the Industrial Revolution they brought about empowered the common man relative to governments and elites by enabling even poor workers and members of their households to replace their labor with machine labor, dramatically improving their productivity and so their personal consumption or ability to trade with others. The effect was broadly egalitarian, allowing ordinary people to attain what just a generation earlier could be had only by the very rich or very privileged. Lomborg (2001) likened the productivity-boosting effect of technology to giving everyone multiple "virtual servants," each able to do the work of a person without the assistance of machines. "[E]ach person in Western Europe today has access to 150 virtual servants, in the U.S. about 300, and even in India each person has about 15 servants to help along," he reports (p. 119).

The prosperity made possible by fossil fuels can take some but not all of the credit for the spread of democracy around the world. The relationship between democracy and prosperity has been closely studied, starting with the pioneering empirical research conducted by Lipset (Lipset, 1959). More recently, Lipset and Lakin observed "democracy is supported by a variety of non-political factors including, and *preeminent among them, economic well-being*" (Lipset and Lakin, 2004, p. 12, italics added).

Friedman (2006), cited in the previous section of this chapter, said "the evidence suggests that economic growth usually fosters democracy and all that it entails." He goes on to say, "The main story of the last two decades throughout the developing world, including many countries that were formerly either member states of the Soviet Union or close Soviet dependencies, has been *the parallel advance of economic growth and political democracy"* (p. 18, italics added).

Friedman argues the close correlation between economic growth and democracy is not a coincidence, but that the values and institutions that create economic growth are similar to those that make democracies possible. "While economic growth makes a society more open, tolerant, and democratic, such societies are, in turn, better able to encourage enterprise and creativity and hence to achieve ever greater economic prosperity" (p. 21). "[T]aken as a

whole," he concludes, "the experience of the developing world during the last two decades, indeed since World War II, is clearly more consistent with a positive connection between economic growth and democratization" (p. 18; see also Friedman, 2005).

Siegel *et al*. (2004) make the important distinction that economic growth by itself does not lead to democracy. Their objective is to dispel what they call the "development first, democracy later" argument in economic development circles, which justifies massive transfers of income from developed countries to less-developed autocracies in hopes that improved economic well-being will lead to the emergence of democratic institutions. In reality, the authors say, such policies serve only to reinforce the political power of autocrats and undermine market-based economic growth. Economic aid to autocracies, they write, "has led to atrocious policies – indeed, policies that have undermined international efforts to improve the lives of hundreds of millions of people in the developing world."

Affluence may not be necessary for democracies to arise, but affluence does ensure their survival. Pzeworski (2004), widely regarded as one of the world's leading experts on democracy, notes:

> [N]o democracy ever, including the period before World War II, fell in a country with a per capita income higher than that of Argentina in 1975, $6,055. This is a startling fact, given that since 1946 alone 47 democracies collapsed in poorer countries. In contrast, 35 democracies spent 1,046 years in wealthier countries and not one died. Affluent democracies survived wars, riots, scandals, economic and governmental crises, hell or high water.

Pzeworski's statistical analysis found:

> [T]he probability that democracy survives increases monotonically with per capita income. In countries with per capita income under $1,000, the probability that a democracy would die during a particular year was 0.0845, which implies that their expected life was about twelve years. Between $1,001 and $3,000, this probability was 0.0362, for an expected duration of twenty-seven years. Between $3,001 and $6,055, the probability was 0.0166, which translates into about sixty years of expected life. And what happens above $6,055 we already know: democracy lasts forever" (*Ibid.*).

Pzeworski explains the association between democracy and prosperity this way:

> The reason everyone opts for democracy in affluent societies is that too much is at stake in turning against it. In poor societies there is little to distribute, so that a group that moves against democracy and is defeated has little income to lose: in poor countries, incomes of people suffering from a dictatorship are not much lower than of those living under democracy, whether they won or lost an election. But in affluent societies, the gap between incomes of electoral losers and of people oppressed by a dictatorship is large (*Ibid.*).

Finally and in summarizing his findings, Pzeworski observes, "We know that democracies are frequent among the economically developed countries and rare among the very poor ones. The reason we observe this pattern is not that democracies are more likely to emerge as a consequence of economic development but that they are much more likely to survive if they happen to emerge in more developed countries" (*Ibid.*).

The research cited above makes it clear that fossil fuels, by making possible the dramatic rise in global prosperity since the great expansion of their use starting in the eighteenth century, have created the conditions necessary for democracies to survive. Democracies, in turn, promote world peace and create other conditions needed to ensure human security. Rather than being a net cost to society in terms of human security, fossil fuels clearly have been human security's surest guarantor.

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7.1.3 Wars for Oil

> *The cost of wars fought in the Middle East is not properly counted as one of the "social costs of carbon" as those conflicts have origins and justifications unrelated to oil.*

According to the Rocky Mountain Institute, quoting Alan Greenspan, "the Iraq War 'is largely about oil.' That war has already cost more than 4,400 U.S. lives, plus one to several trillion borrowed dollars" (Lovins, 2011, p. 5, no citation to Greenspan). The author continues: "in 2010, a Princeton study pegged the cost of U.S. forces just in the Persian Gulf in just one year (2007) at half a trillion dollars, or about three-fourths of the nation's total military expenditures" (*Ibid.,* citing Stern, 2010).

In the wake of President George W. Bush's invasion of Iraq in 2003, countless other commentators claimed the effort was undertaken to ensure the availability of oil for U.S. consumers. This "blood for oil" argument has a long history. More than three decades ago, Husbands (1983) noted, "One frequently hears that our presence in the Middle East is necessary to protect 'our' oil. The implication is that in our absence, the oil would necessarily fall into unfriendly hands and those parties would then embargo exports to the United States" (Husbands, 1983). It is an implausible claim, Husbands argued, given that U.S. oil companies at the time were making efforts to minimize their purchases of oil from Saudi Arabia in favor of cheaper oil from Russia and Mexico.

Although resource scarcity historically has been a common factor in war, the "blood for oil" thesis relies on several premises, all of which are dubious: that the United States suffers from a scarcity of oil; that the U.S. government could reasonably expect that invading Iraq would reduce scarcity by an amount great enough to provide a larger return than the amount of resources and human lives it would cost; that there were no less-expensive (in money and lives) ways to achieve a similar increase in the supply of oil; and that there were no other, more compelling reasons for the intervention in Afghanistan, Iraq, and Pakistan.

The notion that the United States has a scarcity of oil is a value judgment, not a factual statement. The amount of oil people use depends on its price and its value to the consumer: People will use oil as long as the money spent on it brings them greater benefits than the same amount of money spent on something else. Hence, the issue is not whether there is "enough" oil but whether people can afford it. The latter is visible in consumption numbers: U.S. crude oil consumption reached a peak of 20,800 billion barrels a day in 2005, which stayed stable until 2007, at just under 20,700 billion barrels, according to the U.S. Energy Information Administration. When the United States invaded Iraq in March 2003, consumption was at 20,000 barrels a day, up from just under 17,000 in 1990 and 19,700 in 2000. As a

result of the 2008 recession, daily consumption fell to 18,700 in 2009, and then 18,400 in 2012.

As those figures indicate, U.S. crude oil consumption tracks with the strength of the nation's economy. We use more when the economy is strong, and we use less when it is weak. The notion that oil is so scarce that the United States had to go to war to ensure supplies is not supported by the facts. Glaser (2017) noted,

> Indeed, the United States today is far less reliant on foreign oil supplies than it once was. In 2015, only about 24 percent of the petroleum consumed by the United States was imported from foreign countries (the lowest level since 1970), and only about 16 percent of that was imported from the Middle East. This is largely because U.S. domestic production has significantly increased thanks to technological advances in exploiting shale reserve areas. Since 2008, annual U.S. crude production has grown by about 75 percent and net import volumes are projected to decline by 55 percent by 2020. Canadian oil output is also expected to double by 2040, meaning North America is on track to be a net oil exporter by 2020 and to remain so through 2040.

Glaser also points out:

> [O]il is a fungible commodity traded on global markets and subject to the laws of supply and demand. Supply disruptions from one source impact the overall price, but can quickly be offset by an increase in output from another source. In every oil shock since 1973, global energy markets adapted quickly, by increasing production from other sources, rerouting existing supplies and putting both private and government-held stockpiles around the world into use. These market adjustments mitigated the ramifications of the shocks and stabilized prices and supply. U.S. military presence in the Persian Gulf did not prevent the disruptions, nor did it ease the resulting economic pain (*Ibid*.).

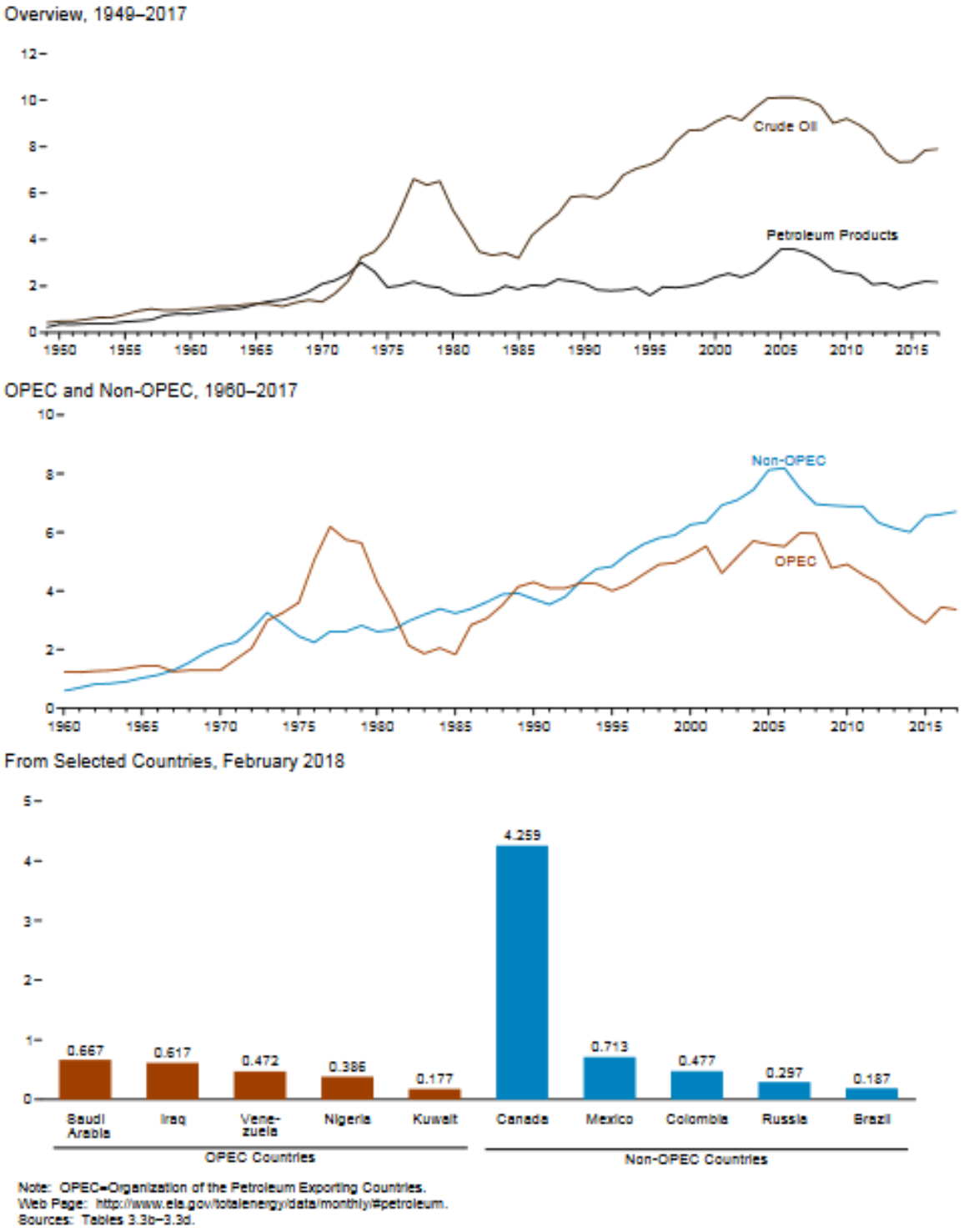
As to the costs and presumed oil-supply benefits of the War in Iraq, that war alone had cost $1.7 trillion by 2013, and the nation owed another almost half-billion dollars in benefits to veterans of wars in Afghanistan, Iraq, and Pakistan, according to the Costs of War Project by the Watson Institute for International Studies at Brown University, as reported by Reuters (2013). The combined cost of the wars in Afghanistan, Iraq, and Pakistan was estimated at nearly $4 trillion. In addition, the interest costs for paying off the U.S. government debt incurred in the wars were expected to tally another $4 trillion over the next 40 years. "The report concluded the United States gained little from the war while Iraq was traumatized by it," Reuters noted. (*Ibid.*)

At the approximate 2017 price of crude oil of about $50 per barrel, the United States could have purchased *160 billion* barrels of oil for the $8 trillion the wars in Afghanistan, Iraq, and Pakistan cost. In 2014, the United States consumed just under seven billion barrels of petroleum products in total. That means the United States could have purchased almost 23 years of its *total* oil consumption with what the wars in the Middle East cost. If ensuring access to cheap oil were the rationale for the U.S. presence in the Middle East, then it has been a spectacularly bad investment. Taylor and Peter Van Doren (2008) remarked, "The U.S. 'oil mission' is thus best thought of as a taxpayer-financed gift to oil regimes and, perhaps, the Israeli government that has little, if any, effect on the security of oil production facilities. One may support or oppose such a gift, but our military expenditures in the Middle East are not necessary to remedy a market failure."

Instead of ensuring a greater flow of oil from the Middle East to the United States, the years since the War in Iraq have brought a decreasing dependency on oil from the Middle East. As Figure 7.1.3.1 indicates, U.S. imports of OPEC oil have been falling since 2008, and non-OPEC sources have supplied more U.S. oil imports since the early 1990s, with the gap widening. Canada now supplies the lion's share of U.S. oil imports.

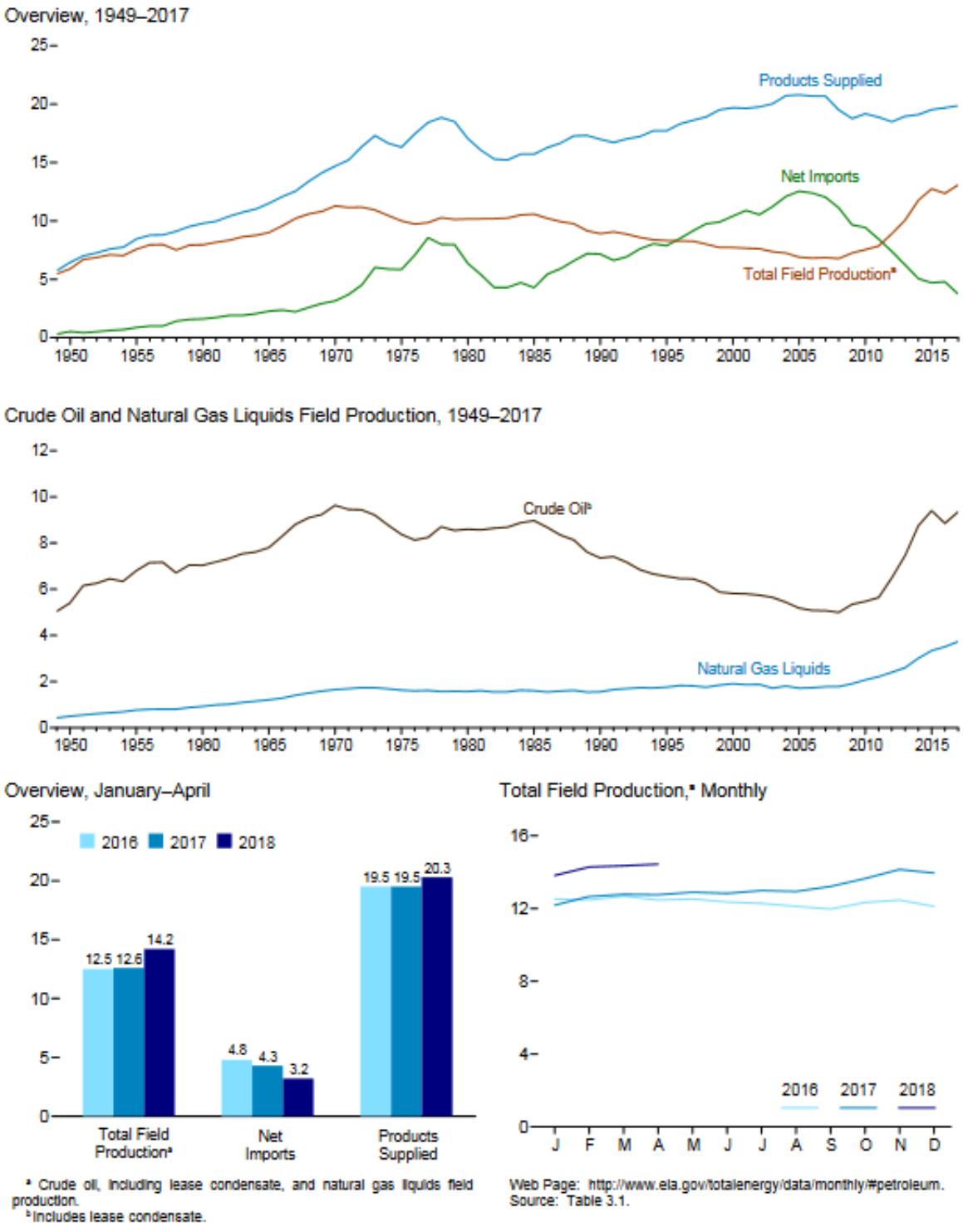
In February 2018, the Persian Gulf region, led by Saudi Arabia at 8%, provided the United States with just 18% of its imported oil. Iraq itself has not been a major supplier of oil to the United States for quite some time. The International Energy Agency projects Iraq will raise production to 6.1 million barrels by 2020, but most of that oil will be exported to China and other Asian markets. Although it is possible to argue the war backfired in ensuring an adequate supply of oil from Iraq, the important thing to note is that Iraq was not, and never had been, a significant supplier of U.S. oil. And even if other Middle Eastern oil-producing nations wanted the United States to

Figure 7.1.3.1
U.S. crude oil and petroleum products imports by year and by nation of origin, 1950–2017 (million barrels per day)



Source: EIA, 2018b, Figure 3.3.b, p. 56.

Figure 7.1.3.2
U.S. crude oil and natural gas liquids imports, exports, and production, 1950-2017 (million barrels per day)



Source: EIA 2018b, Figure 3.1, p. 50.

invade Iraq, their production was already of decreasing importance at the time, as noted above.

While imports of Middle Eastern oil have fallen, domestic U.S. oil production has risen since the War in Iraq. When the U.S. forces invaded in March 2003, U.S. domestic crude oil and natural gas production was just under 18 million barrels per day (b/d) (see Figure 7.1.3.2 on the previous page). Production fell to about 14.6 million b/d in November 2005, but it has been rising steadily since then. The U.S. Energy Information Administration (EIA, 2018a) estimates U.S. crude oil production will average 10.9 million b/d in 2018, up from 9.4 million b/d in 2017, and will average 12.1 million b/d in 2019. Note U.S. oil production declined when OPEC imposed its embargo in 1973. The United States did not see fit to increase oil production at that time, much less go to war in the Middle East to ensure a resumption of supplies.

The rising U.S. consumption of non-Middle Easter oil production shows the wars in Afghanistan, Iraq, and Pakistan did not increase U.S. consumption of Middle Eastern oil but instead accompanied a rise in the use of oil from other suppliers. Instead of spending $8 trillion on wars, the United States, were it intent on increasing oil supplies, could simply have continued to develop these other sources, especially domestic production. That was indeed much less expensive, in money and lives, as a way of ensuring an ample supply of oil.

The U.S. government had, and repeatedly stated, other significant reasons for its interventions in Afghanistan, Iraq, and Pakistan. U.S. intervention in the Middle East has long been based on geopolitical and humanitarian concerns that have nothing to do with oil supplies. Defending Israel, the lone stable democracy in the region, has been a high U.S. priority since May 14, 1948, when Israel declared its existence and President Harry S. Truman recognized the new nation on the same day. Since the collapse of the former Soviet Union, it has been learned that Israel figured more prominently in the communist regime's cold war stratagems than was publicly known at the time, providing another justification for the U.S. presence in the region (Ginor and Remez, 2007).

Testifying before the U.S. Senate Armed Services Committee on U.S. policy in the Middle East in September 2015, former Obama administration CIA Director David Petraeus urged the government to intervene in Syria by threatening to destroy President Bashar Assad's air force if the Syrian forces continued to bomb the Syrian people. Petraeus also recommended "the establishment of enclaves in Syria protected by coalition air power, where a moderate Sunni force could be supported and where additional forces could be trained, internally displaced persons could find refuge, and the Syrian opposition could organize" (Wong, 2015). Syria is not an oil-exporting country, so there are obviously other reasons for the U.S. government to be so concerned about its affairs.

In 1991, the United States established safe havens and enforced no-fly zones under Operation Provide Comfort in an effort to stop Iraqi leader Saddam Hussein from massacring Kurds in northern Iraq after his suppression and killings of Shiites in the southern part of the nation. That effort resulted in self-rule for Iraqi Kurdistan. These interventions and many others have no bearing on U.S. oil supplies and appear to be the result of humanitarian and geopolitical concerns, not U.S. economic interests, and certainly not the flow of imported oil from the Middle East.

If claims of a humanitarian mission in the Middle East are not persuasive, then perhaps the explanation lies in American hubris. Bacevich (2017) summarized U.S. involvement in the Middle East as follows:

> From day one, the larger purpose of America's War for the Greater Middle East has been to affirm that we are a people to whom limits do not apply. The advertised purpose has been to liberate, defend, or deter. Yet the actual purpose has been far more ambitious in my view. The real mission has been to sustain the claims of American exceptionalism that have long since become central to our self-identity – to bring into compliance with American purposes the revolutionaries, warlords, terrorists, despots, or bad actors of various stripes given to defiance. To employ the kind of jargon that's popular in this city, back in 1980, the United States set out in willy-nilly fashion to "shape" the greater Middle East. Given the conditions existing there, employing military means to bring the region into conformity with American purposes has resulted in an undertaking of breathtaking scope.

Bacevich's views on U.S. military involvement in the Middle East are echoed by many other military experts (Glaser and Kelanic, 2016; Cohen, 2011; Glaser, 2017; Codevilla, 2018). It is safe to say none

of them believes U.S. military forces are in the Middle East to protect American access to oil.

Finally, it is unclear whether a forced transition from fossil fuels would reduce violence in the Middle East. Indeed, the opposite is more likely to be the case. Pipes (2018) observed, "yes, the demise of oil and gas will bring some good news: More water desalination plants, less Islamism (petrodollars basically fund it), and Israel's enemies weakened. But the negative implications of a gas and oil price collapse will be much greater" (p. 21). He explained:

> Foreign direct investment will shrivel. The majority of Middle Eastern economies will convulse. Regimes such as the Islamic Republic of Iran or the People's Democratic Republic of Algeria will not survive, leading to more anarchy (already rampant in Afghanistan, Egypt, Iraq, Lebanon, Libya, Somalia, Syria, the West Bank, and Yemen). Disagreements over access to scarce resources will spur new conflicts. Guest workers will return home in droves, upsetting those economies. Economic and other migrants will pour out of the region, headed mostly to the West, further upsetting the politics of Europe. Key airline and shipping routes will be disrupted. U.S. disengagement will enable nuclear weapons programs. In brief, the world's chief trouble spot will retain its role, only more so. Attention to the Middle East, still the world's premier irritant, will continue long after the decline of oil and gas (p. 21).

* * *

In summary, fossil fuels have made the world a safer place than ever before. Prosperity has led to more tolerance, optimism, and egalitarian perspectives and less xenophobia, pessimism, and violence. Driving this movement toward world peace is the rising abundance of food and other necessities as well as international trade that brings people together in their common pursuit of happiness. Prosperous countries are more likely to be (and remain) democracies, and democracies have lower rates of violence and go to war less frequently than any other form of government. Limiting access to affordable energy threatens to prolong and exacerbate poverty in developing countries, increasing the likelihood of domestic violence, state failure, and regional conflict. Wars will continue to be fought in the Middle East even if, and perhaps especially if, the world reduces its reliance on fossil fuels.

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7.2 Climate Change

Section 7.1 makes clear that far from threatening human security, fossil fuels are actually its best guarantor. *But what if fossil fuels cause or contribute to climate change?* Would higher global surface temperatures trigger floods, droughts, more violent weather, and other climate effects described in vivid detail in IPCC reports? Would those climate changes reduce human security? The survey of climate science presented in Chapter 2 concludes such an outcome is highly unlikely, but the IPCC and its followers plainly disagree. The rest of the current chapter assumes *arguendo* that the IPCC is right and man-made climate change is a genuine possibility.

Section 7.2.1 describes how the IPCC frames the discussion of "human security and points out the major problems with it. Section 7.2.2 addresses sea-level rise, Section 7.2.3 addresses impacts on agriculture, and Section 7.2.4 addresses other impacts on human security.

7.2.1 The IPCC's Perspective

> *The IPCC claims global warming threatens "the vital core of human lives" in multiple ways, many of them unquantifiable, unproven, and uncertain. The narrative in Chapter 12 of the Fifth Assessment Report illustrates the IPCC's misuse of language to hide uncertainty and exaggerate risks.*

The introduction to this chapter discussed the elastic definition of "threats to human security" used by Working Group II in Chapter 12 of IPCC's Fifth Assessment Report (AR5) to characterize the alleged damages caused by man-made climate change. The IPCC sorts these damages into "deprivation of human needs" and "erosion of livelihood and human capabilities," provides a table, reproduced below as Figure 7.2.1.1, presenting additional "dimensions of impact" and examples of observed and potential impacts of climate change.

Gleditsch and Nordås (2014), quoted in the introduction, observed how "the definition in the Human Security chapter is too wide to allow serious attempts to assess the secular trend" pp. 85–86). A second general problem is the confusion of impacts due to natural causes and those that could be attributable to and an impact on climate due to the human presence. In the *Summary for Policymakers* of the Working Group II contribution to the Fifth Assessment Report, IPCC says:

> Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use. (IPCC, 2014a, p. 5, Background Box SPM.2).

A third problem is IPCC's frequent assertion of unproven causal links between climate change and factors contributing to or detracting from human security. The IPCC admits to some uncertainty, saying "Given the many and complex links between climate change and human security, uncertainties in the research on the biophysical dimensions of climate change, and the nature of the social science, highly confident statements about the influence of climate change on human security are not possible," citing Scheffran *et al.* (2012). But then in characteristic IPCC fashion, the very next sentence tries to deny the uncertainty it just confessed: "Yet there is good evidence about many of the discrete links in the chains of causality between climate change and human insecurity" (IPCC, 2014b, p. 760).

At issue is not whether "highly confident statements" can be made, but whether declarative statements with *any* degree of confidence can be made. The assertion of unproven causal links pervades Chapter 12, more so than any other chapter of AR5, partly because of the nature of the issues being addressed. The fact that many alleged consequences cannot be measured and are largely subjective already has been mentioned. But it also is due to the methodology the IPCC chose. Much of the "evidence" is based on futurology – attempts to predict the future – woven from historic anecdotes and expert opinions. There is an extensive literature on scientific forecasting demonstrating that such an approach is no more likely to produce accurate forecasts than uneducated guesses (see the literature surveys in Armstrong, 2001, 2006). But there are no

references in AR5 either to the general literature on scientific forecasting or to its application to climate change.

A fourth problem with AR5 Chapter 12 is what is called, in statistics, propagation of error. The errors or uncertainty in one variable, due perhaps to measurement limitations or confounding factors, are compounded (propagated) when that variable becomes part of a function involving other variables that are similarly uncertain. For example, there is a range of uncertainty regarding surface temperatures due to the placement of temperature stations and changes in technology over time. The human impact on global average temperature is uncertain due to incomplete understanding of the climate (e.g., exchange rates between CO_2 reservoirs and the behavior of clouds). There are also ranges of uncertainty regarding human emissions of CO_2 in the past, present, and future. There are also ranges of uncertainty as to how to measure an alleged effect (e.g., loss of livelihood, loss of personal property, forced migration) and how much of the effect to attribute to a specific weather-related event (e.g., flood, hurricane, drought) or to some other variable (e.g., poverty, civil war, mismanagement of infrastructure). The more variables in a function, the wider the "uncertainty bars" surrounding the outcome must be. Even a formula with few variables is subject to propagation error if it attempts to forecast events far into the future, e.g., a century or more in the case of climate models (Frank, 2015).

Figure 7.2.1.1
IPCC's list of threats to human security due to climate change

Dimensions of impact		Illustrative examples of observed impacts due to aggravating climate stresses	Illustrative examples of potential changes in livelihoods and capabilities as a consequence of climate variability and climate change
Deprivation of basic needs	Livelihood assets	Household assets such as livestock sold or lost during drought: documented examples are the 1999–2000 drought, Ethiopia, and 1999–2004 drought, Afghanistan (Carter et al., 2007; de Weijer 2007). Riverbank erosion, floods, and groundwater depletion and salinization are associated with changed hydrological regimes and cause loss of agricultural land (Paul and Routray, 2010; Taylor et al., 2013).	Simulated future climate volatility leads to reduced future production of staple grains and increases in poverty (Ahmed et al., 2009). Changes in the viability of livestock feed crops have an impact on smallholder farmers: maize yields are projected to decline in many regions (Jones and Thornton, 2003; Section 7.4). Projections of land loss, riverbank erosion, and groundwater depletion, in combination with environmental change and human interventions, suggest future stress on livelihood assets (Le et al., 2007; Taylor et al., 2013).
	Water stress and scarcity	Glacier retreat leads to lower river flows and hence affects water stress and livelihoods, representing a cultural loss (Orlove et al., 2008). For example, glacier recession in the Cordillera Blanca in Peru has altered the hydrological regime with implications for local livelihoods and water availability downstream (Mark et al., 2010).	Projected stresses to water availability show increased populations without sustainable access to safe drinking water (Hadipuro, 2007). Projected reduction in glacier extent and the associated loss of a hydrological buffer is expected to increase (Vuille, 2008; Section 3.4.4).
	Loss of property and residence	Floods destroy shelter and properties and curtail ability to meet basic needs. For example, the Fiji flood in 2009 resulted in economic losses of F$24 million affecting at least 15% of farm households (Lal, 2010). Sea level rise and increased frequency of extreme events increases the risk of loss of lives, homes, and properties and damages infrastructure and transport systems (Adrianto and Matsuda, 2002; Suarez et al., 2005; Philips and Jones, 2006; Ashton et al., 2008; Von Storch et al., 2008).	Changes in flood risk may increase and cause economic damages: in the Netherlands, the total amount of urban area that can potentially be flooded has increased sixfold during the 20th century and may double again during the 21st century (de Moel et al., 2011). In England and Wales, projected changes in flood risk mean economic damages may increase up to 20 times by the 2080s (Hall et al., 2003).
Erosion of livelihood and human capabilities	Agriculture and food security	Interaction of climate change with poverty and other political, social, institutional, and environmental factors may adversely affect agriculture production and exacerbate the problem of food insecurity (Downing, 2002; Saldana-Zorrilla, 2008; Trotman et al., 2009). Examples include in Kenya (Oluoko-Odingo, 2011); in Southern Africa (Drimie and Gillespie, 2010); in Zimbabwe and Zambia (Mubaya et al., 2012).	Studies of African agriculture using diverse climate scenarios indicate increasing temperature and rainfall variation have negative impacts on crops and livestock production and lead to increased poverty, vulnerability, and loss of livelihoods. Examples include Ethiopia (Deressa and Hassan, 2009); Kenya (Kabubo-Mariara, 2009); Burkina Faso, Egypt, Kenya, and South Africa (Molua et al., 2010); and sub-Saharan Africa (Jones and Thornton, 2009). Potential livelihood insecurity among small-scale rain-fed maize farmers in Mexico is projected owing to potential loss of traditional seed sources in periods of climate stress (Bellon et al., 2011).
	Human capital (health, education, loss of lives)	Food shortage, absence of safe and reliable access to clean water and good sanitary conditions, and destruction of shelters and displacements all have a negative bearing on human health (Costello et al., 2009; Sections 11.4 and 11.8). Droughts and floods can intensify the pressure to transfer children to the labor market (Ethiopia and Malawi; UNDP, 2007). Indian women born during a drought or flood in the 1970s were 19% less likely to ever attend primary school, when compared with women of the same age who were not affected by natural disasters (UNDP, 2007).	Analysis of the economic and climatic impacts of three emission scenarios and three tax scenarios estimates the impacts on food productivity and malaria infection to be very severe in some Asian countries (Kainuma et al., 2004). Studies of the impacts of future floods using a combination of socioeconomic and climate change scenarios for developed countries show an increase in mortality. For example, in the Netherlands, sea level rise, combined with other factors, potentially increases the number of fatalities four times by 2040 (Maaskant et al., 2009).

Source: IPCC, 2014a, Table 12-1, p. 761.

Propagation of error means it is likely to be impossible to attribute to climate change *any* impacts on human security. Deaths and loss of income due to storms, flooding, and other weather-related phenomena are and always have been part of the human condition. We can at best document trends in the frequency of storms, the number of deaths, and the value of property losses, but these statistics are meaningless for a discussion of public policy if they cannot be reliably correlated with long-term climate change, and climate change with human greenhouse gas emissions.

A final problem with AR5 Chapter 12 is the language the IPCC uses to hide uncertainty and exaggerate risks. Statements seeming to express certainty are often followed immediately by sentences expressing uncertainty, or vice versa. To some extent this is the result of editing by committees seeking consensus. Advocates of making strong statements are allowed to use their language on the condition that doubters and skeptics can follow with sentences that begin with "However…" or "Nevertheless… ." This dynamic produces reports that journalists and advocates can use to justify dramatic headlines, but it misleads serious researchers, policymakers, and the public.

Gleditsch and Nordås (2014) describe the many "expressions of uncertainty" that appear in IPCC reports, including such words as may, might, can, and could, and such phrases as "has a potential to," "is a potential cause of," and "is sensitive to." The terms that are most vague appear more frequently in Working Group II reports on "impacts, adaptation, and vulnerability" than in Working Group I reports on "the physical science basis." Gleditsch and Nordås write,

> The frequent use of "may" terms might have been justified as a way of indicating that "under certain circumstances, a relationship is likely." But this does not work well if those circumstances are not specified. On the whole, it would probably be best to avoid the use of terms like "may" in academic writing except to state conjectures. Misrepresentation of the scientific basis is a real hazard when using such terminology (p. 88).

In conclusion, the IPCC claims climate change threatens "the vital core of human lives" in multiple ways, many of them unquantifiable, unproven, and uncertain. The narrative in AR5 Chapter 12 illustrates the IPCC's misuse of language to hide uncertainty and exaggerate risks.

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7.2.2 Extreme Weather

> *Real-world data offer little support for predictions that CO_2-induced global warming will increase either the frequency or intensity of extreme weather events.*

According to the IPCC (quoting from Figure 7.2.1.1), "sea level rise and increased frequency of extreme events increases the risk of loss of lives, homes, and properties, and damages infrastructure and transport systems." Extrapolating from isolated incidents, damages associated with these calamities are imagined to cost billions or hundreds of billions of

dollars a year. But the link is very tenuous. Though often cited as the source of alarming projections of violent weather, the IPCC has been quite cautious on the topic. In a special report on the issue published in 2012, it found only mixed and weak evidence of a trend toward more extreme weather:

> There is evidence from observations gathered since 1950 of change in some extremes. Confidence in observed changes in extremes depends on the quality and quantity of data and the availability of studies analyzing these data, which vary across regions and for different extremes. Assigning "low confidence" in observed changes in a specific extreme on regional or global scales neither implies nor excludes the possibility of changes in this extreme (IPCC, 2012).

In Working Group II's contribution to IPCC's Fifth Assessment Report, in Chapter 10, the IPCC admits "The impact of natural disasters on economic growth in the long-term is disputed, with studies reporting positive effects (Skidmore and Toya, 2002), negative effects (Raddatz, 2009), and no discernible effects (Cavallo *et al*., 2013)" (*Ibid.*, p. 692). The IPCC authors conclude, "The literature on the impact of climate and climate change on economic growth and development has yet to reach firm conclusions. There is agreement that climate change would slow economic growth, by a little according to some studies and by a lot according to other studies" (IPCC, 2014, p. 693).

However, the *Summary for Policymakers* of the Working Group I contribution to the IPCC's AR5, as usual more alarmist than the underlying report itself, claims, "Extreme precipitation events over most of the mid-latitude land masses and over wet tropical regions will *very likely* become more intense and more frequent by the end of this century, as global mean surface temperature increases" (IPCC, 2013, p. 23).

Literature reviews conducted in Chapter 2 of this volume and for previous volumes in the *Climate Change Reconsidered* series failed to find a convincing relationship between global warming over the past 100 years and increases in any of these extreme weather events. Other authors have reached the same conclusion (Maue, 2011; Alexander *et al.,* 2006; Khandekar, 2013; Pielke Jr., 2013, 2014). Instead, the number and intensity of extreme events wax and wane often in parallel with natural decadal or multidecadal climate oscillations. Basic meteorological science suggests a warmer world would experience fewer storms and weather extremes, as indeed has been the case in recent years.

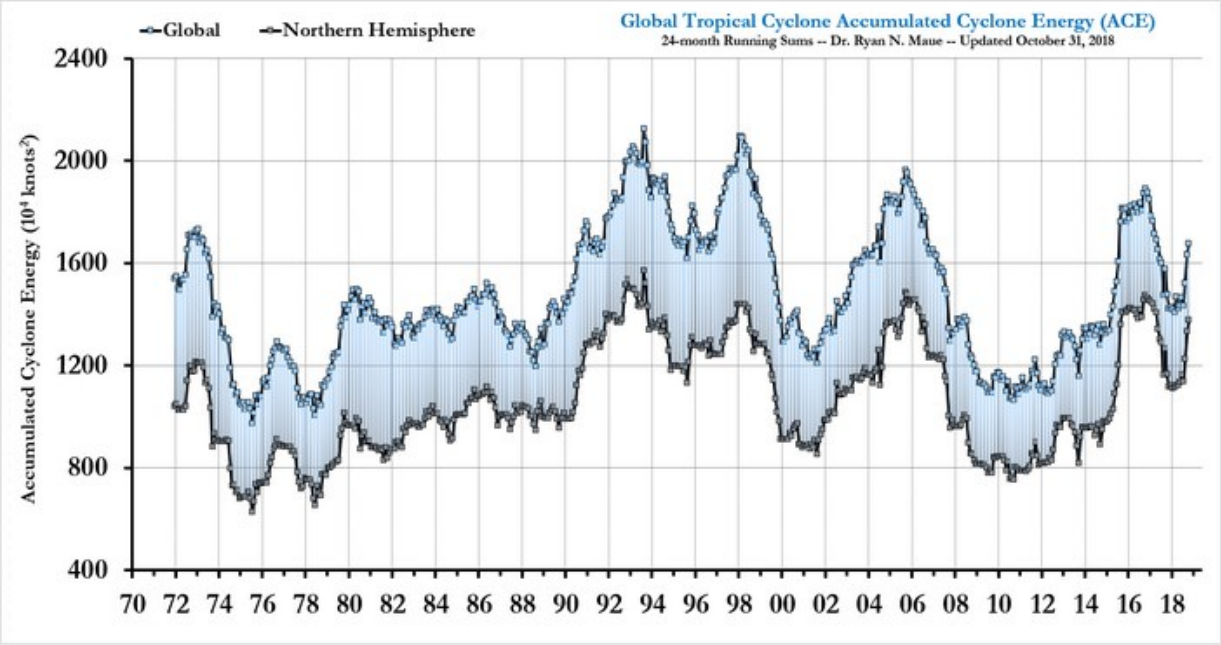
Globally, there has been no detectable long-term trend in the amount or intensity of tropical storm activity. The trend in the number of storms making landfall in the United States has been relatively flat since the 1850s. Before the active 2017 hurricane season in the United States, there was a lull in the number of major hurricane landfalls that lasted nearly 12 years, the longest such drought in the United States since the 1860s (Landsea, 2018).

Hurricane activity varies year to year and over multidecadal periods. Activity is affected by numerous factors, including ocean cycles and the El Niño and La Niña oscillations. Data show multidecadal cycles in the Atlantic and Pacific Oceans favor some basins over others. An evaluation of the Accumulated Cyclone Energy (ACE) Index – which takes into account the number, duration, and strength of all tropical storms in a season – shows over the past 45 years there has been variability but no trend in tropical storms, both in the Northern Hemisphere and globally. See Figure 7.2.2.1, which is the same as Figure 2.7.5.1 in Chapter 2

Khandekar and Idso summarized their extensive survey of the literature in 2013 as follows:

> Air temperature variability decreases as mean air temperature rises, on all time scales. Therefore the claim that global warming will lead to more extremes of climate and weather, including of temperature itself, seems theoretically unsound; the claim is also unsupported by empirical evidence. Although specific regions have experienced significant changes in the intensity or number of extreme events over the twentieth century, for the globe as a whole no relationship exists between such events and global warming over the past 100 years.
>
> Observations from across the planet demonstrate droughts have not become more extreme or erratic in response to global warming. In most cases, the worst droughts in recorded meteorological history were much milder than droughts that occurred periodically during much colder times. There is little or no evidence that precipitation will become more variable and intense in a

Figure 7.2.2.1
Cyclonic energy, globally and northern hemisphere, from 1970 through October 2018



Last 4 decades of Global and Northern Hemisphere Accumulated Cyclone Energy: 24 month running sums. Note that the year indicated represents the value of ACE through the previous 24-months for the Northern Hemisphere (bottom line/gray boxes) and the entire global (top line/blue boxes). The area in between represents the Southern Hemisphere total ACE. *Source:* Maue, 2018.

> warming world; indeed, some observations show just the opposite. There has been no significant increase in either the frequency or intensity of stormy weather in the modern era.
>
> Despite the supposedly "unprecedented" warming of the twentieth century, there has been no increase in the intensity or frequency of tropical cyclones globally or in any of the specific ocean basins (Khandekar and Idso, 2013, pp. 809–810).

Khandekar and Idso conclude, "It is clear in almost every instance of each extreme weather event examined, there is little support for predictions that CO_2-induced global warming will increase either the frequency or intensity of those events. The real-world data overwhelmingly support an opposite conclusion: Weather will more likely be less extreme in a warmer world (*Ibid.,* p. 810).

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7.2.3 Sea-level Rise

Little real-world evidence supports the claim that global sea level is currently affected by atmospheric CO_2concentrations, and there is little reason to believe future impacts would be distinguishable from local changes in sea level due to non-climate related factors.

The IPCC claims, in the *Summary for Policymakers* for the Working Group I contribution to AR5, that "Under all RCP scenarios, the rate of sea level rise will *very likely* exceed that observed during 1971 to 2010 due to increased ocean warming and increased loss of mass from glaciers and ice sheets" (IPCC, 2013, p. 25). Most IAMs duly incorporate estimates of damages due to flooding and "climate refugees" forced to retreat from shorelines.

IPCC and IAM modelers can find support for their forecasts in studies relying on computer models and manipulation of recent satellite data purporting to be able to measure small changes in global sea level and to be sufficiently comparable to observational data from tidal gauges to justify being grafted onto past trends despite the different methodologies (e.g., Nerem *et al.,* 2018). But many experts observe the new model-derived estimates do not agree with tidal gauges located in geologically stable areas of the world and conclude any recent warming trend they claim to reveal is an artifact of the change in methodologies.

Tidal gauges continue to show local and regional sea levels exhibit typical natural variability – in some places rising and in others falling. Parker and Ollier reported in 2017,

> Sea levels are oscillating, with well-known inter-annual, decadal and multi-decadal oscillations well evidenced in the measurements collected by tidal gauges. There are oscillations of synchronous and non-synchronous phases moving from one location to another. Furthermore, it is well known that local sea-level changes occur also because of local factors such as subsidence due to groundwater or oil extraction, or tectonic movements that may be either up or down. *Relative sea-level changes due to subsidence or uplift are sometimes far larger than the global average sea-level changes* (Parker and Ollier, 2017, italics added).

Parker and Ollier report "the loud divergence between sea-level reality and climate change theory – the climate models predict an accelerated sea-level rise driven by the anthropogenic CO_2 emission – has been also evidenced in other works such as Boretti (2012a, b), Boretti and Watson (2012), Douglas (1992), Douglas and Peltier (2002), Fasullo *et al.* (2016), Jevrejeva *et al.* (2006), Holgate (2007), Houston and Dean (2011), Mörner (2010a, b, 2016), Mörner and Parker (2013), Scafetta (2014), Wenzel

and Schröter (2010) and Wunsch *et al.* (2007) reporting on the recent lack of any detectable acceleration in the rate of sea-level rise" (*Ibid.*) To which we would add Wöppelmann *et al.* (2009) and Frederikse *et al.* (2018).

If unusual sea-level rise were occurring, it has not forced significant numbers of people to migrate. Andrew Baldwin *et al.*, writing in 2014, observed:

> The origins of climate change-induced migration discourse go back to the 1980s, when concerned scientists and environmental activists argued that unchecked environmental and climate change could lead to mass displacement (Mathews 1989; Myers 1989). However, at that time, hardly any actual climate or environmental refugees could be detected. *Even today, almost three decades later, the term as such remains merely a theoretical possibility but not an actually existing, clearly defined group of people* (Baldwin *et al.,* 2014, p. 121, italics added).

Similarly, the British government's *Foresight Report on Migration and Global Environmental Change,* widely regarded as the most authoritative study of the issue of environmental migration, found "the range and complexity of the interactions between these drivers [of migration] means that it will rarely be possible to distinguish individuals for whom environmental factors are the sole driver" (Foresight, 2011, p. 9) and "Environmental change is equally likely to make migration less possible as more probable. This is because migration is expensive and requires forms of capital, yet populations who experience the impacts of environmental change may see a reduction in the very capital required to enable a move" (*Ibid.*). In other words, there may be *no net increase* in the number of environmental refugees.

The best available data show dynamic variations in Pacific sea level in accord with El Niño-La Niña cycles, superimposed on a natural long-term eustatic rise (Australian Bureau of Meteorology, 2011). Island coastal flooding results not from sea-level rise, but from spring tides or storm surges in combination with development pressures such as borrow pit digging or groundwater withdrawal. Persons emigrating from the islands are doing so for social and economic reasons rather than in response to environmental threat.

Another claim concerning the effect of climate change on oceans is that increases in freshwater runoff into the oceans will disrupt the global thermohaline circulation system. But the range of natural fluctuation in the global ocean circulation system has yet to be fully delineated (Srokosz *et al.*, 2012). Research to date shows no evidence of changes that lie outside previous natural variability, nor of any malign influence from increases in human-related CO_2 emissions. Singer summarized the state of current knowledge on sea-level rise in 2018,

> Currently, sea-level rise does not seem to depend on ocean temperature, and certainly not on CO_2. We can expect the sea to continue rising at about the present rate for the foreseeable future. By 2100 the seas will rise another 6 inches or so – a far cry from Al Gore's alarming numbers. There is nothing we can do about rising sea levels in the meantime. We'd better build dikes and sea walls a little bit higher (Singer, 2018).

See the data on sea-level rise graphed in Chapter 2, Section 2.1 for further evidence that sea-level rise is unrelated to CO_2 levels, and Figure 2.7.3.1 in that same chapter for more findings about climate change and oceans from Chapter 6 of *Climate Change Reconsidered II: Physical Science*. The myth of "climate refugees" is addressed again later in the chapter as part of the discussion of whether climate change causes violent conflicts.

In conclusion, there is too little scientific evidence to support the contention that changes in global sea level are being affected by CO_2concentrations in the atmosphere. Further, there is little scientific effort to support the contention that any future impact would be distinguishable from local changes in sea level due to groundwater or oil extraction, tectonic movements, sedimentation, and other non-climate related factors.

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7.2.4 Agriculture

Alleged threats to agriculture and food security are contradicted by biological science and empirical data regarding crop yields and human hunger.

Another alleged threat to human security is harms to agriculture and food security caused by extreme heat and drought. According to the IPCC, "illustrative examples of observed impacts due to aggravating climate stresses" on agriculture and food security can be found in Kenya, Southern Africa, Zambia, and Zimbabwe. Illustrative examples the IPCC says are a consequence of climate change also come from Africa and one reference to "small-scale rain-fed maize farmers in Mexico" (IPCC, 2014a, p. 761). In the *Summary for Policymakers* for the WGII contribution to AR5, the IPCC says:

> For the major crops (wheat, rice, and maize) in tropical and temperate regions, climate change without adaptation is projected to negatively impact production for local temperature increases of 2°C or more above late-20th-century levels, although individual locations may benefit (*medium confidence*). Projected impacts vary across crops and regions and adaptation scenarios, with about 10% of projections for the period 2030–2049 showing yield gains of more than 10%, and about 10% of projections showing yield losses of more than 25%, compared to the late 20th century. (IPCC, 2014b, pp. 17–18, italics in original).

There is much to question here. The examples cited do not support a broad projection onto world food production. The forecast focuses oddly on two ends of a probability distribution, which implies that 80% of studies find little or no impact of climate change on agriculture. Why are not they more likely to be true? The assumption that there would be no adaptation is plainly wrong. The human capability to produce food in the face of climate change has been on display since at least the last Ice Age. At that time, a nomadic people we call the Grevettians used mammoth-skin tents instead of living in caves. That permitted them to pursue the mammoths and other game animals that had to migrate because their grass had turned to less-nourishing tundra.

The Grevettians also used atlatls (spear-throwers) to kill mammoths from a safe distance. Perhaps most importantly, they tamed wolves and bred them into dogs, to help find game on the trackless steppes. The dogs also protected their communities where campfires were inadequate. Language evolved into writing, writing evolved into printing and libraries and then into today's research laboratories and digital communications. All this has allowed humans to learn collectively and thus evolve better survival strategies than our forebears could have imagined. There is no reason to expect the collective learning that has given us books, libraries, computers, and space travel would somehow fail to meet humanity's most basic need – adequate food production techniques – in the years ahead.

The application of technology to agriculture makes adaptation far easier and faster than it has ever been before (Waggoner, 1995; Goklany, 2009). During the twentieth and early twenty-first centuries, when the IPCC claims the world's temperatures rose at an "unprecedented" pace, increases in agricultural output rose even faster. Despite global population growth, "the number of hungry people in the world has dropped to 795 million – 216 million fewer than in 1990–92 – or around one person out of every nine" (FAO, 2015). In developing countries, under-nourishment (having insufficient food to live an active and healthy life) fell from 23.3% 25 years earlier to 12.9%. A majority of the 129 countries monitored by FAO reduced under-nourishment by half or more since 1996 (*Ibid*.). This is not evidence of a negative effect of climate change on food security in the world today, but evidence of just the opposite.

Extensive evidence reviewed in Chapters 3, 4, and 5 showed rising ambient CO_2 concentrations and higher temperatures *benefit* and do not harm food crops and nearly all other plant life on Earth, and why shouldn't they? Most plants on Earth today evolved during times when research shows the planet was much warmer and CO_2 levels were much higher than they are today.

The IPCC admits "food security is determined by a range of interacting factors including poverty, water availability, food policy agreements and regulations, and the demand for productive land for alternative uses (Barrett, 2010, 2013)." Blurring the issue of causation, the IPCC says "many of these factors are themselves *sensitive* to climate variability and climate change" (IPCC, 2014a, p. 763, italics added). The IPCC identifies incidents where "food price spikes have been associated with food riots," but then cites literature attributing those riots to other factors. It says "there are complex pathways between climate,

food production, and human security and hence this area requires further concentrated research as an area of concern" (*Ibid.*). Why, then, does IPCC say in Figure 7.2.1.1 that climate change "may adversely affect agriculture production and exacerbate the problem of food insecurity"?

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7.2.5 Human Capital

> *Alleged threats to human capital – human health, education, and longevity – are almost entirely speculative and undocumented. There is no evidence climate change has eroded or will erode livelihoods or human progress.*

The final "dimension of impact" described by the IPCC in its Table 12-1, reprinted as Figure 7.2.1.1 above, is "human capital (health, education, loss of lives)." As "illustrative examples of observed impacts due to aggravating climate stresses" it includes examples that duplicate those offered in its description of "deprivation of basic needs," such as "food shortage, absence of safe and reliable access to clean water and good sanitary conditions, and destruction of shelters and displacements" (IPCC, 2014, p. 761). Examples specifically attributed to climate change are computer projections of falling food productivity and increased malaria infection and fatalities due to floods.

The IPCC's labeling of these possible effects as threats to "human capital" is curious at best and likely misleading. Human capital is more typically and usefully defined as "intangible collective resources possessed by individuals and groups within a given population. These resources include all the knowledge, talents, skills, abilities, experience, intelligence, training, judgment, and wisdom possessed individually and collectively, the cumulative total of which represents a form of wealth available to nations and organizations to accomplish their goals" (Encyclopedia Britannica, n.d.). In economics, the term has come to refer more narrowly to the knowledge, skills, health, and values people possess that enable them to be productive, produce earnings, and live a comfortable life. Becker (n.d.) wrote,

> Schooling, a computer training course, expenditures on medical care, and lectures on the virtues of punctuality and honesty are also capital. That is because they raise earnings, improve health, or add to a person's good habits over much of his lifetime. Therefore, economists regard expenditures on education, training, medical care, and so on as investments in human capital. They are called human capital because people cannot be separated from their knowledge, skills, health, or values in the way they can be separated from their financial and physical assets.

Does climate change threaten "human capital" as *Encyclopedia Britannica* or Becker defines it? The case, as has been shown to be true with every other "dimension of impact" in the IPCC's list, seems tenuous. Climate change might cause extreme weather events or flooding, although this assertion is not supported by the climate science and data presented in Chapter 2. Such events might interrupt

people's educations or training or their ability to pass knowledge and skills on to others, but only if one assumes no adaptation, no response by civil and political institutions, and no long-term recovery. But this only rarely happens. More often the effects of even natural catastrophes are short-term, and over time they severely affect shrinking numbers of people thanks to the mobility, technologies, and resiliency made possible by fossil fuels.

Available evidence on crop yields and hunger in the world shows rising productivity and a trend that is likely to continue, boosted rather than hurt by rising temperatures and carbon dioxide levels in the atmosphere (Waggoner, 1995; Epstein, 2014). Fear that warmer temperatures will lead to the spread of malaria and other diseases is entirely speculative and contradicted by extensive real-world research, much of it summarized in Chapter 4. To date, global warming's main effects appear to be *increasing* food supplies and food security and a greening of Earth that is much more beneficial than harmful (Zhu *et al.,* 2016). Violent weather has become less common, not more common, as the world has warmed. Each of these points was made and documented in previous chapters.

As also was demonstrated in previous chapters, the fossil fuels the IPCC holds responsible for some part of global warming in the late twentieth and early twenty-first centuries were clearly a boon to human capital. They provided the prosperity that made possible huge investments in schooling, health care, and technologies that in turn boosted human productivity. They helped protect human capital from nature by providing technologies that made it possible to survive hot or cold weather and periods of heavy rain or drought, and even to escape the paths of floods or hurricanes (Goklany, 2002, 2012). This positive trend since the beginning of the fossil fuel era has overwhelmed any negative effects that might be attributed to a slight and gradual rise in average global surface temperatures.

Human capital is the solution to whatever problems climate change might present to humanity (Simon, 1996). The IPCC's claim that climate change threatens human capital is almost entirely speculative and undocumented. There is no evidence global warming has eroded or will erode livelihoods or human progress.

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7.3 Violent Conflict

According to the IPCC, "Climate change has the potential to increase rivalry between countries over shared resources. For example, there is concern about rivalry over changing access to the resources in the Arctic and in transboundary river basins. Climate changes represent a challenge to the effectiveness of the diverse institutions that already exist to manage relations over these resources. However, *there is high scientific agreement that this increased rivalry is unlikely to lead directly to warfare between states*" (IPCC, 2014a, p. 772, italics added).

The IPCC reviews the literature on "the relationship between short-term warming and armed conflict" and concludes: "Some of these find a weak relationship, some find no relationship, and *collectively the research does not conclude that there*

is a strong positive relationship between warming and armed conflict" (*Ibid.,* italics added).

As is typical of the IPCC *Summaries for Policymakers*, the uncertainty made so clear in the full report is dropped from the much more widely read summary: "Climate change can indirectly increase risks of violent conflicts in the form of civil war and inter-group violence by amplifying well-documented drivers of these conflicts such as poverty and economic shocks (*medium confidence*). Multiple lines of evidence relate climate variability to these forms of conflict" (IPCC, 2014b, p. 20). This is certainly the message politicians and the media took from the Fifth Assessment Report.

In 2015, U.S. President Barack Obama issued an executive statement echoing those claims, but with much more than "medium confidence." According to Obama, "A changing climate will act as an accelerant of instability around the world, exacerbating tensions related to water scarcity and food shortages, natural resource competition, underdevelopment, and overpopulation" (Executive Office of the President, 2015, p. 8). These effects, he said, "are threat multipliers that will aggravate stressors abroad such as poverty, environmental degradation, political instability, and social tensions – conditions that enable terrorist activity and other forms of violence. The risk of conflict may increase" (*Ibid.*).

Reliance by the U.S. government on the IPCC for the "scientific consensus" on climate change reached its apex during the Obama administration, but it predated Obama's election. Dr. Thomas Fingar, deputy director of National Intelligence for Analysis and chairman of the National Intelligence Council, testified to Congress in 2008 that "our primary source for climate science was the United Nations Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report" and "we relied predominantly upon a mid-range projection from among a range of authoritative scenario trajectories provided by the IPCC. … In the study, we assume that the climate will change as forecast by the IPCC" (Fingar, 2008, pp. 2–3). Apparently no one at the IPCC told Fingar the IPCC does not issue "forecasts," only scenarios.

Environmental groups endorse and promote the climate-conflict hypothesis without reviewing the data in part because their leaders believe it is an argument that appeals to conservatives and Republicans in the United States (Ungar, 2007; Baldwin *et al.,* 2014). The motivation of members of the defense and intelligence communities and some retired senior military officials is different. They see in climate change a justification for investments in new military equipment and force planning. Like economists who say they support "market-based solutions to climate change" yet know little about climate science, these military experts accept the findings of the IPCC without critical review and then limit their own contributions to the debate to planning efficient responses to scenarios derived from the IPCC's computer models, misunderstood to be forecasts or predictions. By doing so, they create the appearance of validating or endorsing the IPCC's exaggerated and implausible claims.

A robust set of studies has emerged in recent years examining the climate-conflict hypothesis. These studies cast much doubt on the central links of the argument and, in turn, undermine support for the notion that a warming planet will give rise to future conflict. Section 7.3.1 summarizes some of the scholarly research on the association between climate and armed conflict. (A much larger literature review appears later, in Section 7.4, where the historical relationship between climate and conflict is reported.) Section 7.3.2 addresses methodological problems with the climate-conflict theory, helping to explain why the hypothesis fails in the real world. Section 7.3.3 reviews evidence on five specific alleged sources of conflict: abrupt climate change, water, famine, resource scarcity, and refugee flows.

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7.3.1 Empirical Research

> *Empirical research shows no direct association between climate change and violent conflicts.*

There is no empirical evidence that natural disasters have tended to lead directly to violent conflict in the years since the end of the Little Ice Age. But then the weather has been wonderfully supportive of humans, no matter how we decry our comparatively feeble storms, floods, and droughts. In addition, food productivity has soared through technology. The outstanding example was Dr. Norman Borlaug's Agricultural Green Revolution, which tripled most of the world's crop yields with disease-resistant seed varieties, modern pesticides, and chemical fertilizers. Borlaug's own father had dealt with Norman's departure for college by buying an early model of a gasoline tractor with his brother. The Borlaugs' tractor quadrupled the farm's productivity, in no small part because no land was needed any longer for horse feed.

Hunger-driven conflicts had been characteristic of "little ice ages" from the dawn of time until the Colombian Exchange of the fifteenth and sixteenth centuries, but no longer. The modern world relies on a vastly successful pattern of research and engineering to support history's most effective food production system. The modern world also typically offers food aid (and the vital transportation to carry it) to nations stricken by droughts, floods, and other natural impacts.

Gleditsch and Nordås observed, "none of the studies on climate and conflict, with the possible exception of literature on heat and individual aggression, assume that climate has a direct influence on violence. The assumption, usually if not always made explicit, is that climate change (be it increasing heat or changes in precipitation) influences other factors, which in turn lead to conflict" (Gleditsch and Nordås, 2014, p. 85). The attribution of violent conflict to global warming does not rest on empirical data, but is a hypothesis (see Hsiang and Burke, 2014), and as the following sections will show, a very complicated and unlikely one at that.

The research summarized in this section consists of only a few recent studies in the literature often referred to as "peace studies." A much larger literature exists, primarily found in academic history journals, concerning the historical association between climate and conflict reaching back centuries and including findings from nearly every country in the world. That literature appears to be largely unknown to the climate science community, and in particular the IPCC. Since that literature is so voluminous, it is reviewed in its own section, Section 7.4, below.

Raleigh and Kniveton (2012) observed "the climate-conflict literature suffers from a lack of theoretical connections between its main driver (climate) and its possible consequence (conflict)." Concluding an extensive review of the literature, Theisen *et al*. (2013) similarly found, "Taken together, extant studies provide mostly inconclusive insights, with contradictory or weak demonstrated effects of climate variability and change on armed conflict" (Theisen *et al*., 2013).

Like Homer-Dixon (1999) and Nel and Righarts (2008) before him, Slettebak (2012) focused primarily on how natural disasters might cause the breakdown of social structures or scarcity of important resources. His analysis addressed the environmental impacts frequently alleged to be associated with rising temperatures, including storms, droughts, floods, landslides, wildfires, and extreme temperatures. He tested six models incorporating a host of socioeconomic and environmental variables, concluding:

> I set out to test whether natural disasters can add explanatory power to an established model of civil conflict. The results indicate that they can, but that *their effect on conflict is the opposite of popular perception*. To the extent that climate-related natural disasters affect the risk of conflict, they contribute to *reducing* it. This holds for measures of climate-related natural disasters in general as well as drought in particular (p. 174, italics added).

Another approach hypothesizes that climate change-driven natural disasters will slow economic growth in the affected area, increasing the likelihood of social unrest. Bergholt and Lujala (2012) tested that possibility for the period 1980–2007, developing a dataset covering 171 countries with a total of more than 4,000 country-year observations. Finding natural disasters do in fact slow economic growth, they nevertheless conclude "climate-related natural disasters do not have any direct effect on conflict onset," nor did "economic shocks caused by climate-related disasters have an effect on conflict onset" (Bergholt and Lujala, 2012, p. 148).

Similarly, Koubi *et al.* (2012) tested how deviations in precipitation and temperature trends from their long-run averages relate to economic growth and civil conflict. For the period 1980–2004, they conclude, "climate variability … does not affect violent intrastate conflict through economic growth" (Koubi *et al.*, 2012).

The IPCC, as noted earlier, has been cautious in declaring a direct causal relationship between climate change and armed conflict. In a special report released in 2012 titled "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation," the IPCC admitted great uncertainty over forecasts of more extreme weather events as a result of climate change. It notes,

> Confidence in projecting changes in the direction and magnitude of climate extremes depends on many factors, including the type of extreme, the region and season, the amount and quality of observational data, the level of understanding of the underlying processes, and the reliability of their simulation in models. Projected changes in climate extremes under different emissions scenarios generally do not strongly diverge in the coming two to three decades, but these signals are relatively small compared to natural climate variability over this time frame. Even the sign of projected changes in some climate extremes over this time frame is uncertain. For projected changes by the end of the 21st century, either model uncertainty or uncertainties associated with emissions scenarios used becomes dominant, depending on the extreme (IPCC, 2012, p. 11).

The statement is significant for its admission that natural forces will exert dominant influence over "climate extremes" over the period of 10 to 20 years and that, in some instances, the models are unable to state whether the purported human impact is positive or negative. The IPCC also expresses caution about the climate-conflict link in AR5 Chapter 18, on "Detection and attribution of observed impacts," saying "the detection of the effect of climate change [on warfare] and an assessment of its importance can be made only with *low confidence*. There is no evidence of a climate change effect on interstate conflict in the post-World War II period. … [N]either the detection of an effect of climate change on civil conflict nor an assessment of the magnitude of such an effect can currently be made with a degree of confidence" (IPCC, 2014, p. 1001).

Also in 2014, in the introduction to a 2014 special issue of *Political Geography* devoted to climate and conflict, Idean Salehyan, a professor in the department of political science at the University of North Texas, wrote,

> The relationship between climate, climate change, and conflict has been empirically tested in a wide variety of studies, but the literature has yet to converge on a commonly accepted set of results. This is mainly due to poor conceptualization of research designs and empirical measurements. Data are often collected at different temporal, geographic, and social scales. In addition, "climate" and "conflict" are rather elusive concepts and scholars have utilized different measures of each. The choice of measures and empirical tests is not a trivial one, but reflects different theoretical frameworks for understanding environmental influences on conflict. Therefore, results from different analyses are often not commensurable with one another and readers should be wary of broad, sweeping characterizations of the literature (Salehyan, 2014, abstract).

Gleditsch and Nordås (2014) wrote, "there is no consensus in the scholarly community about such dire projections of future climate wars; in fact most observers conclude that there is no robust and consistent evidence for an important relationship between climate change and conflict (Bernauer, Bohmelt, & Koubi, 2012; Scheffran, Brzoska, Kominek, Link, & Schilling, 2012; Theisen, Gleditsch, & Buhaug, 2013)" (pp. 1–2).

In conclusion, empirical research shows no direct association between climate change and violent

conflicts, and we should be surprised if it did. A warmer world is a safer and more prosperous world in which there is less cause for conflict.

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7.3.2. Methodological Problems

> *The climate-conflict hypothesis is a series of arguments linked together in a chain, so if any one of the links is disproven, the hypothesis is invalidated. The academic literature on the relationship between climate and social conflict reveals at least six methodological problems that affect efforts to connect the two.*

Why do nearly all empirical studies invalidate the climate-conflict hypothesis? The climate-conflict hypothesis is driven by a number of unproven assumptions, many of which have been challenged in previous chapters of this volume and previous volumes of the *Climate Change Reconsidered* series. The hypothesis assumes not only that climate models are accurate on a global scale but also that these models can accurately move from global to regional scales. The hypothesis also assumes the accuracy of computer-model-generated scenarios projecting economic growth, demand for energy, and consumer behavior (among other factors) even though the flaws of such projections are well known.

Using President Barack Obama's language quoted at the beginning of Section 7.3 (Executive Office of the President, 2015), the hypothesis can be expressed like this:

> *Any changes in climate* ("a changing climate") will result in changes to the weather, *all of them negative* (droughts, floods, hurricanes or storms, etc. etc.), which in turn will exacerbate *and never alleviate* "tensions" that already exist due to other causes (water scarcity and food shortages, underdevelopment, etc.), which in turn will always create *and never relieve* "social tensions" (poverty, environmental

degradation, etc.), which in turn will "enable" *and never handicap* terrorists and other armed combatants, thereby increasing *and never reducing* the "risk of conflict."

How plausible is this hypothesis? On its face, not very. Consider only the text in italics and see how brittle the hypothesis is:

- Climate is always changing, it did so before and without the human presence, so there is no way to test the hypothesis by "stopping climate change" for, say, a few decades, and seeing what impact that might have on the frequency of violent conflicts.

- Some of the impacts of a warmer planet would clearly be good: expanded ranges for wildlife, forestry, and agriculture, longer growing seasons, lower winter heating bills, and fewer deaths due to cold weather. Climatology and the historical record also suggest there are *fewer* extreme weather events, not more, in a warmer world.

- More precipitation and a greening Earth, two well-documented trends occurring during the twentieth and early twenty-first centuries, result in more food production and more food security, not less, which likely alleviate social tensions arising from poverty and hunger.

- Civil wars are statistically most closely associated with low per-capita income and slow economic growth and are not related at all to average global surface temperature, so the effect of global warming on terrorists and other armed combatants must be ambiguous at best.

- The actual *rate* of conflict around the world has been falling, as reflected in the rapid decline in the number of deaths arising from armed conflicts around the world reported in Section 7.1.1. So the effect of climate change on the "risk of conflict" is either negative – meaning the world grows safer as temperatures rise – or too small to detect.

The climate-conflict hypothesis, like all the alleged threats to human security in Chapter 12 of the Fifth Assessment Report, is an argument linked together in a chain, so if any one of the links is disproven, the hypothesis is invalidated. For example, if it can be demonstrated that the human impact on climate is probably too small to measure, then the entire chain of reasoning ends with falsification of the first assumption. If a human impact on climate is found and thought to be statistically significant, then its negative impacts on food, water, housing, or other basic needs must be found to be so large as to not only cancel out its positive impacts but also to cause natural disasters that can "exacerbate social tensions." If the benefits of modest warming to human prosperity, health, and even to the environment previously documented in Part II outweigh the costs, then the chain of reasoning ends with that link.

If the small human impact on climate is nevertheless causing natural disasters, what evidence is there that these disasters lead to civil war or other forms of violence? As reported above and again below, there is no consistent association between natural disasters and war or civil conflicts, so the chain of reasoning ends again. How often might such conflicts, should they occur, rise to the level where they affect the security of other countries? If they are rare, this will probably not rank high on a list of priorities for more than a few undeveloped countries. It certainly would not justify placing climate change at the top of a list of priorities for the U.S. military, as called for by U.S. President Obama. Finally, to what extent do these new security threats require investments in new military equipment or changes to force planning? Would such changes even require a net increase in spending, rather than only small shifts in resources?

The academic literature on the relationship between climate and social conflict reveals at least six methodological problems that affect efforts to connect the two.

A. Untestable Models

The case studies used to construct the proofs typically rely on multiple independent variables acting through intervening variables, such as changing rainfall patterns creating droughts that reduce food supplies, leading to group manipulation of food supplies and social unrest. Many of the dependent variables used are imprecise as well, such as social unrest or health problems, meaning they defy measurement in a meaningful fashion. Without greater specificity in the dependent variable, tests for causal connections are imprecise.

B. Lack of a Control Group

The case study approach by its nature is anecdotal, and scholars must take care to construct their research designs in ways that enable variation of the factors under examination. A defense of biased case selections for environmental scenarios has been offered by Homer-Dixon (1999) and others, claiming environmental scenarios offer greater complexity than other sources of conflict. Not only is that untrue, but accepting that view requires the concession that environmental scenarios cannot be tested in a qualitative format with variable variation. Empirical work done subsequently reveals such tests are possible.

C. Reverse Causality

In many of the regions examined by the literature, ongoing conflicts have destroyed and damaged local environments resulting in lost food supplies and dislocated populations. In turn, that damage decreases a community's resiliency in the face of natural disasters, resulting in more damage caused by climate change. In the context of the climate-conflict debate, these ongoing conflicts cut against the explanatory power of climate change as the source of local environmental degradation and potential causation of local or regional tension or conflict.

D. Using the Future as Evidence

Much of the literature presents environmental variables as a cause of future, rather than past, conflicts. The environment may be a causal element in conflict, but reliance on the future is an appeal to argument, rather than evidence, as proof of the causal relationship. All the environmental variables cited in the climate-conflict literature are documentable and therefore testable against known instances of conflict. A review of that evidence should show a positive link between past floods, droughts, or other environmental degradation with intra- or interstate conflict when other explanatory variables are accounted for. If it does not, then the hypothesis is not proven and the conclusion that environmental conditions breed conflict is not supported.

E. Drawing Lessons from Foreign and Domestic Conflict

The resource wars literature draws lessons from interstate war, but most warfare in the post-World War II period is internal to states. Internal conflicts have very different characteristics and causes. Generalizing lessons from interstate to intrastate conflict is problematic, and the climate-conflict literature generally fails to reflect those lessons. As was documented in Section 7.1.1, empirical data show civil war is most strongly correlated with low income and slow economic growth, not with climate (Hegre and Sambanis, 2006).

F. Changing Levels of Analysis

The climate-conflict literature freely jumps between systems, nations, and individual levels of analysis when developing theories and examining empirical evidence. Hypotheses appropriate for one level of analysis may not follow to another or even be logically consistent with the other levels. In their study of the effects of changing rainfall patterns on rates of rebel and communal violence in Africa, Raleigh and Kniveton (2012) offer an illustration of how these concerns can manifest themselves and confound the resulting interpretations. As noted, in order for social disorder or conflict to emerge from an environmental cause, a number of intervening actions and reactions have to occur in sequence. Raleigh and Kniveton observed that alternative, and sometimes competing, hypotheses can emerge during careful consideration of those sequences. In their case, the key intervening variable between climate and conflict is rainfall pattern change. Raleigh and Kniveton offer four competing hypotheses to illustrate this point:

- Increased conflict is likely to follow periods of above-average decreases in rainfall as groups compete over a scarce resource;
- Decreases in conflict are likely to be correlated with decreased rainfall because there is little to fight for because the gains to be had from conflict do not justify the costs of conflict;
- Increases in political violence will follow periods of higher than average rainfall as agricultural abundance spurs greed; and

- Political violence is less following increases in rainfall because agricultural abundance breeds contentment and self-sufficiency (p. 54).

In this example, climatic variables are hypothesized to have positive and negative influences on the likelihood of conflict, further highlighting the methodological critiques. Prevailing public argumentation on the issue has all tended in the same direction, but the variances in the intervening variables can generate alternative outcomes. Careful examination shows these critiques have persisted in study after study, decades after Gleditsch (1998) published the first substantive review of the literature. Combined, they cast doubt on the explanatory power of the central claim and undermine the generalizability of the argument.

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7.3.3 Alleged Sources of Conflict

> *There is little evidence that climate change intensifies alleged sources of violent conflict including abrupt climate changes, access to water, famine, resource scarcity, and refugee flows.*

The literature on the climate-conflict hypothesis, including Chapter 12 of the IPCC's Fifth Assessment Report, cites five sources of violent conflict allegedly intensified by climate change: abrupt climate changes, access to water, famine, resource scarcity, and refugee flows. Yet the literature on each of these alleged sources of conflict does not support claims of a causal relationship for any one of them.

7.3.3.1 Abrupt Climate Change

The possibility that climate change could occur suddenly rather than gradually is clear from the geological record. By happening too suddenly for plants, humans, and other animals to adapt, abrupt climate change could result in sudden losses of livelihood and residences, famines, mass migrations, and other conditions that could, in turn, lead to violent conflict. That is the theory, but how credible is it?

In 2002, the National Research Council of the U.S. National Academies of Sciences published a report titled *Abrupt Climate Change: Inevitable Surprises* (NRC, 2002). The report quickly became the most frequently cited source said to support the claim that abrupt climate change could lead to violent conflicts. In fact, conflict is hardly mentioned in the report, and only once regarding conflicts over water. It actually makes the opposite case, that adaptation is likely:

> It is important not to be fatalistic about the threats posed by abrupt climate change. Societies have faced both gradual and abrupt climate changes for millennia and have learned to adapt through various mechanisms, such as moving indoors, developing irrigation for crops, and migrating away from inhospitable regions. Nevertheless, because climate change will likely continue in the coming decades, denying the likelihood or downplaying the relevance of past abrupt events could be costly. Societies can take steps to face the potential for abrupt climate change.
>
> The committee believes that increased knowledge is the best way to improve the effectiveness of response, and thus that research into the causes, patterns, and likelihood of abrupt climate change can help reduce vulnerabilities and increase our adaptive capabilities. The committee's research recommendations fall into two broad categories: (1) implementation of targeted research to expand instrumental and paleoclimatic observations and (2)

> implementation of modeling and associated analysis of abrupt climate change and its potential ecological, economic, and social impacts (NRC, 2002, p. 2).

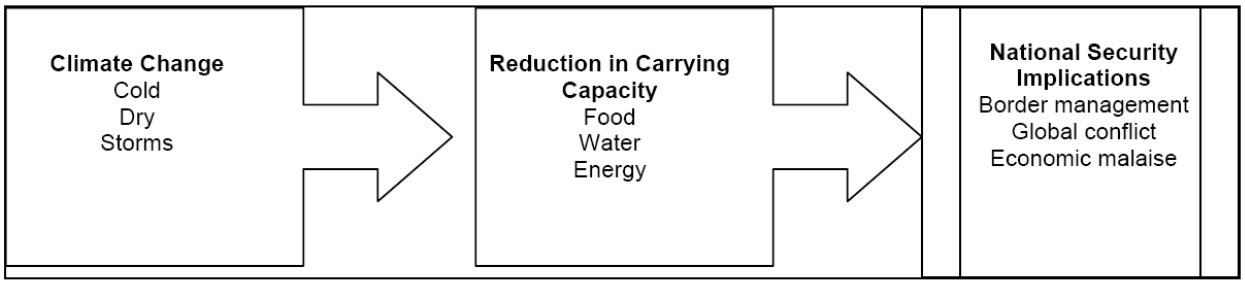
This nuanced approach was quickly forgotten when, in response to the NRC report, the U.S. Pentagon commissioned a report by two consultants, Peter Schwartz and Doug Randall, on the national security implications of abrupt climate change (Schwartz and Randall, 2003). The resulting report released in 2003, titled "An Abrupt Climate Change Scenario and Its Implications for United States National Security," is still one of the most frequently cited sources on the subject. The saliency of the topic and the paper were not hurt by the debut in 2004 of a movie, *The Day After Tomorrow,* whose premise was a nearly instantaneous return to a global ice age.

Schwartz and Randall illustrated what they believed to be the association between abrupt climate change and national security in the graphic reproduced in Figure 7.3.3.1.1 below. As close inspection of the figure might suggest, Schwartz and Randall is not a scholarly report, and it is surprising it was ever treated as though it were. It is a 22-page essay with only two footnotes. The authors, both affiliated at the time with a consulting firm called Global Business Network, are "futurists" without any background or publications in climate science or warfare. They made no effort to document any part of their narrative by referring to any authoritative article or book. As befits consultants to Hollywood moviemakers, they say, "Rather than predicting how climate change will happen, our intent is to dramatize the impact climate change could have on society if we are unprepared for it." "Dramatize," "could," and "if" are the key words in this sentence. The authors do not over-sell their work. The following disclaimer of sorts appears on the first page in a large font:

> The purpose of this report is to imagine the unthinkable – to push the boundaries of current research on climate change so we may better understand the potential implications on United States national security.
>
> We have interviewed leading climate change scientists, conducted additional research, and reviewed several iterations of the scenario with these experts. The scientists support this project, but caution that the scenario depicted is extreme in two fundamental ways. First, they suggest the occurrences we outline would most likely happen in a few regions, rather than on globally [sic]. Second, they say the magnitude of the event may be considerably smaller.
>
> We have created a climate change scenario that although not the most likely, is plausible, and would challenge United States national security in ways that should be considered immediately (Schwartz and Randall, 2003, p. 1).

The methodology used by the authors, interviewing "leading climate change scientists," is not promising. As mentioned in Section 7.2.1, basing

Figure 7.3.3.1.1
Association of abrupt climate change and national security



Source: Schwartz and Randall, 2003, p. 3.

forecasts on the opinions of experts is no more likely to be accurate than making uneducated guesses (Armstrong, 2001, 2006). When done scientifically, the most accurate forecasts concerning climate science virtually rule out the possibility of an abrupt climate change resembling Schwartz and Randall's scenario in the coming century (Green *et al.*, 2009).

The scenario presented by the authors is hardly plausible. They imagine "the thermohaline collapse begins in 2010, disrupting the temperate climate of Europe," whereas the IPCC has "*low confidence* in projections of when an anthropogenic influence on the AMOC [Atlantic meridianal overturning circulation] might be detected" (IPCC, 2013, p. 995). Schwartz and Randall assume that over the course of a decade rapid temperature declines of 5°F *per year* occur over Asia and North America and 6°F in northern Europe, and annual temperature increases up to 4°F in "key areas throughout Australia, South America, and southern Africa." Drought would strike "critical agricultural regions and in the water resource regions for major population centers in Europe and eastern North America." Winter storms and winds would intensifySchwartz and Randall then *assume to be true* every link in the chain of association that must be proven to make the rest of their scenario credible: food shortages due to decreases in net global agricultural production, decreased availability and quality of fresh water in key regions due to shifted precipitation patterns, and disrupted access to energy supplies due to extensive sea ice and storminess. The literature on the associations between climate change and all of these variables, and then these variables and violent conflict, is reviewed in the sections above and below, but it needs to be said here that real experts on these subjects are nearly unanimous that violent conflicts only rarely arise from these conditions and when they do, they are invariably the result of the failure of civil and political institutions to address public needs.

The Schwartz and Randall report cannot be taken seriously. It more closely resembles a movie script or hurriedly composed college term paper than a serious research paper. Nevertheless, the paper influenced the public debate and set the stage for a more alarmist report by the U.S. Climate Change Science Program (2008) and a new report from NRC issued in 2013 titled "Abrupt Impacts of Climate Change: Anticipating Surprises" (NRC, 2013).

There is no plausible scenario under which small increases in carbon dioxide in the atmosphere lead to abrupt climate changes like those observed in the geologic record. To plan for possible violent conflicts that might arise from such a scenario is a waste of public resources and human capital.

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7.3.3.2 Water as a Source of Conflict

According to the *Summary for Policymakers* for the Working Group II contribution to AR5, "Freshwater-related risks of climate change increase significantly with increasing greenhouse gas concentrations (*robust evidence, high agreement*). The fraction of global population experiencing water scarcity and the fraction affected by major river floods increase with the level of warming in the 21st century. Climate change over the 21st century is projected to reduce

renewable surface water and groundwater resources significantly in most dry subtropical regions (*robust evidence, high agreement*), intensifying competition for water among sectors (*limited evidence, medium agreement*) (IPCC, 2014, p. 14).

Water, whether too much or too little, is a main variable in the climate-conflict argument. An Intelligence Community Assessment published in February 2012 by the Office of the Director of National Intelligence asserts as its "bottom line" that "during the next 10 years, many countries important to the United States will experience water problems – shortages, poor water quality, or floods – that will risk instability and state failure, increase regional tensions, and distract them from working with the United States in important U.S. policy objectives" (Intelligence Community Assessment, 2012, p. iii).

"Tensions" over water were cited as a source of conflict by the Center for Naval Analyses in 2007. John Podesta (who served in the Clinton and Obama administrations) and Peter Ogden of the liberal Center for American Progress predicted in 2008 that "increasing water scarcity due to climate change will contribute to instability throughout the world … water scarcity also shapes the geopolitical order when states engage in direct competition with neighbors over shrinking water supplies" (Podesta and Ogden, 2008, pp. 104–5). The Obama administration repeatedly claimed water scarcity and floods would exacerbate tensions and flooding could harm U.S. military bases and installations at home and abroad (e.g., Executive Office of the President, 2015).

The empirical evidence strongly refutes these claims. A thorough analysis of 412 crises during the period 1918–1994 reveals only seven where water was even a partial cause (Wolf, 1999). "As we see, the actual history of armed water conflict is somewhat less dramatic than the water wars literature would lead one to believe. … As near as we can find, there has never been a single war fought over water," Wolf concluded. Writing in the pages of *International Security*, a preeminent security studies journal, three Norwegian scholars examined the linkages between water scarcity, drought, and incidence of civil wars. Factors other than the environment were much more significant in explaining the onset of conflict. They conclude:

> The results presented in this article demonstrate that there is no direct, short-term relationship between drought and civil war onset, even within contexts presumed most conducive to violence. … Ethnopolitical exclusion is strongly and robustly related to the local risk of civil war. These findings contrast with efforts to blame violent conflict and atrocities on exogenous non-anthropogenic events, such as droughts or desertification. The primary causes of intrastate armed conflict and civil war are political, not environmental (Theisen *et al.*, 2011, p. 105).

Salehyan and Hendrix (2014) examined civil conflict, defined as confrontation between organized, armed groups as well as terrorism, and confirmed the absence of a positive relationship between water scarcity and conflict. They summarized their findings:

> Most importantly, we have shown that analysts and policy planners should not look for significant increases in armed violence during periods of acute water scarcity. Climate change may cause certain regions of the world to be more drought-prone, but such droughts are not likely to cause fighting to erupt – at least in the short term. It would be more appropriate to focus on humanitarian concerns, capacity building, and development needs in order to assure that drought-stricken communities are able to adapt to a more uncertain climate (p. 249).

A war over water is difficult to imagine. A downstream state may have high motivation to secure greater supplies, but unless it could exert control over the entire watershed, it would be continually subject to manipulation by upstream sources. The costs of ensuring complete control would be quite high with little guarantee of short- or long-term success. This explains why the opposite result – peaceful cooperation to manage a shared resource – is the more likely consequence of water scarcity. International cooperation over transboundary water sources is much more common than conflict over the same resources (Yoffe *et al.*, 2003). Tir and Stinnett (2012) tested whether the pressures exerted by climate change will weaken transboundary river treaties and encourage non-compliance. By testing historical data on water availability between 1950 and 2000, they found the slightly increased risk of military conflict was offset by institutionalized agreements. The length of time over which the effects of climate change will be felt offers sufficient time to

strengthen and institutionalize international treaties governing use of water.

Of course, treaties and agreements that have limited conflict in the past may not do so in the future. Climate-conflict proponents imply that states would ignore those agreements and move to protect their interests by any means necessary. Proponents of the "water wars" view appeal to the future and contend past trends will be overwhelmed by the enormity of the problems to come; they point to specific hot-spots where water-induced conflicts seem most probable. Podesta and Ogden (2008), for example, viewed the Middle East as the primary location where a water conflict could emerge, as have a number of others (see Trondalen, 2009, and Brown and Crawford, 2009). CNA (2007) pointed to water as a source of interstate and intrastate tension in the region and a contributor to terrorism.

Feitelson *et al.* (2012) tested these claims using four scenarios of climate change, along with varying assumptions about refugee return, in the Israeli-Palestinian context projected to 2030. They conclude:

> … based on analysis of extreme scenarios, we find that the likely direct effects of climate change per se are limited. While climate change may affect the livelihood of Palestinian farmers and semi-nomads, particularly in remote areas, it is unlikely to affect the welfare of the urban population substantially if some water re-allocation occurs, even under extreme scenarios (Feitelson *et al.*, 2012, p. 253).

The authors conclude "climate change does not seem to pose a major direct security risk in the Israeli-Palestinian context" (*Ibid*., p. 254). They do note a danger in characterizing water as a security problem. "However, the framing of water issues and of climate change as security issues, and the subservience of water and environmental issues to the 'high politics' of conflict may hinder the ability to undertake adaptive measures that may mitigate the effects of climate change" (*Ibid.*). Adding a security dimension to environmental or shared resource concerns, when other factors have created conditions of mistrust and tension among the parties, is expected to greatly reduce the probability of an amicable resolution. As Feitelson *et al.* show, water shortage is not a sufficiently robust condition to generate conflict on its own. Ironically, the climate-conflict literature may do more than climate change itself to militarize environmental crises by characterizing them as security challenges, thereby prompting decision-makers to turn away from cooperative or diplomatic solutions and towards military options.

In Central Asia, the Syr Darya river basin is cited as another area where a transboundary dispute over water could spark conflict (see Swarup, 2009 and Hodgson, 2010). The region is comprised of poor, undemocratic states with weak international water management agreements. It is a perfect test case for the claim that the introduction of new supply pressures borne out of climate change will incite conflict and tension. Bernauer and Siegfried (2012) tested this proposition using IPCC climate models projected to 2050. They conclude that even though climate change is expected to make water supplies scarcer in the region (not a surprising conclusion given the previous discussion of the IPCC modeling approach), "such shifts are likely to occur only in the medium to long term" (Bernauer and Siegfried, 2012, p. 237). Rather than conflict, which they judge as "unlikely," Bernauer and Siegfried believe the countries in the region will respond by strengthening the international agreements governing water; a response consistent with past experiences, globally and regionally (Deudney, 1990).

Examining the relationship between precipitation, temperature, and drought on the incidence of civil war in Asia, Wischnath and Buhaug (2014) found climatic events play only a "trivial role" in explaining the risk of conflict.

Africa is frequently cited as a case where rainfall and changing water patterns could elicit greater risk of conflict. Darfur was called the first climate conflict by Jan Egeland, former United Nations Undersecretary General for Humanitarian Affairs, and U.N. Secretary General Ban Ki-Moon (see Salehyan, 2008, and Mazo, 2010). A strong relationship between rising temperature and civil war has been suggested to exist in Africa (Burke *et al.*, 2009). A subsequent analysis, however, shows Burke *et al.*'s findings are not supported when tested using different methods, notably a different set of armed conflict data (Buhaug, 2010).

Raleigh and Kniveton (2012) look at the Africa case from the perspective of small-scale conflict, rather than interstate conflict. Since a major hypothesis of the climate-conflict literature is that changing water dynamics create conditions within states that weaken social structures and government institutions, their examination of rainfall variability on rebel and communal violence is highly informative. Most studies that have examined the causes of civil wars have shown little statistical

significance for environmental variables when other standard political and economic variables are controlled for (see Nordås and Gleditsch, 2007, and Raleigh and Urdal, 2007).

Detailed examination of rebel and communal conflicts in East Africa shows rainfall patterns emerge as an explanation for conflict only when other socioeconomic conditions exist. Then, the outcome that emerges is one where communal violence has a tendency to increase during wet periods, when the abundance of resources provides the motives and opportunities for inter-group violence. In contrast, during dry periods, communal violence is suppressed and the conditions for rebel conflicts emerge (Raleigh and Kniveton, 2012).

Other examinations of the impact of climate variability on social unrest and conflict in Africa show less connection between the two. Looking at the Sahel, which under climate change scenarios will become drier as rainfall is reduced through the effects of rising temperatures, a team of researchers from the Peace Research Institute in Oslo studied land use conflicts using both statistical and case study approaches. Both methods "provide little evidence supporting the notion that water scarcity and rapid environmental change are important drivers of intercommunal conflict in the Sahel" (Benjaminsen *et al.*, 2012). They judge political and economic forces as more significant than climate variability. Similarly, an examination of the Kenyan range found drought conditions suppress conflict and encourage groups to share resources (see Butler and Gates, 2012, and Eaton, 2008), further reinforcing the finding of cooperation rather than conflict arising out of environmental pressures.

Examining Kenyan armed conflict below the common civil conflict level, Theisen (2012) determined that years with below-average rainfall were generally more peaceful, concluding, "Tests of the hypotheses on resource scarcity lend most support to those that argue that resource scarcity does not fuel violence and seems even to favor those that see droughts as temporarily cooling tensions" (Theisen, 2012, p. 93).

In conclusion, the notion that global warming's effect on access to water might lead to more armed conflict around the world has been repeatedly tested and invalidated by a wide range of researchers using data from many parts of the world.

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7.3.3.3 Famine as a Source of Conflict

Famine does not appear in Chapter 12 of the Working Group II contribution to the Fifth Assessment Report as one of the factors that increase the risk of violent conflicts and are "sensitive" to climate change, but it was featured in the previously discussed report by Schwartz and Randall commissioned by the U.S. Pentagon (Schwartz and Randall, 2003) and made regular appearances in declarations by President Barack Obama and federal agencies during his two terms in office (see Executive Office of the President, 2015). It frequently appears in the popular media, as illustrated by a *Newsweek* story in 2017 titled "Famine Isn't Just a Result of Conflict – It's a Cause" (Hopma, 2017).

Yet according to Nobel laureate Amartya Sen, there has never been a democracy with a free press that has experienced a famine (Sen, 1999, p. 178). While Sen's statement has been criticized as being overly broad and dependent on the definition of "famine," it has withstood the test of time (see Halperin *et al.*, 2004, p. 18). Sen's observation is significant because it illustrates a huge confounding factor in the climate-famine-conflict theory. If climate drives famines, why are democracies somehow immune? Given the close association between prosperity and democracy documented in Section 7.1.2, the solution to famines would seem to be to promote prosperity and democracy by making energy more abundant and affordable, rather than attempt to control the weather by increasing the cost of energy and impoverishing people.

While famines still occur in the world today, they invariably are the result of government mismanagement of food supplies or use of starvation by autocracies to oppress their people. Worldwide, food production outpaced population growth during the past century, with production per capita rising along with significant increases in world production of maize (203%), wheat (122%), rice (131%), vegetables (251%), cassava (146%), and soybeans (431%) between 1969 and 2009 (Hofstrand, 2011). Food production has "never been higher than it is today, largely due to fertilizers, pesticides, irrigation and farm machinery" (Goklany, 2011, p. 168).

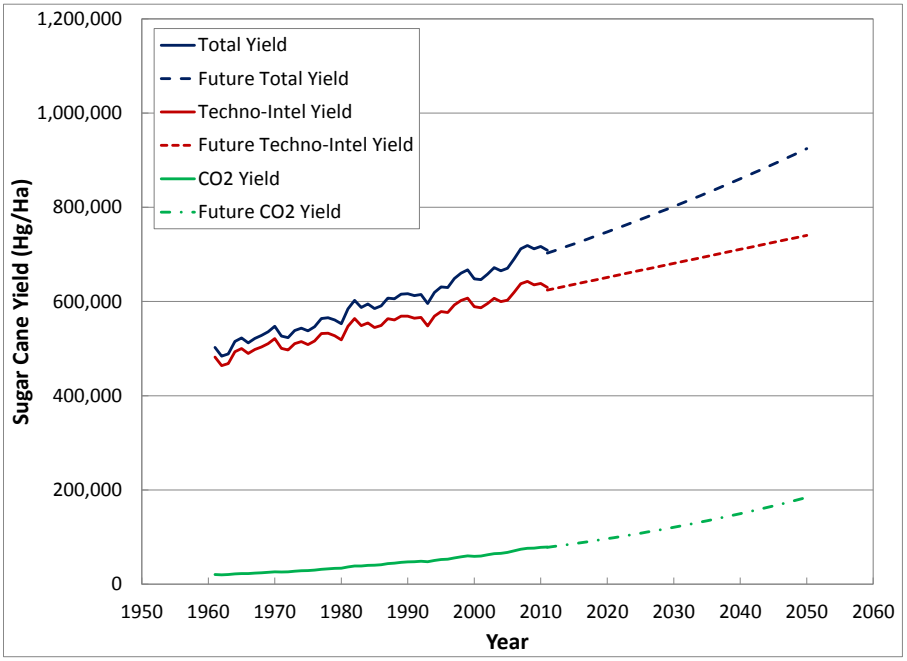
According to the Food and Agriculture Organization of the United Nations (FAO), "the number of hungry people in the world has dropped to 795 million – 216 million fewer than in 1990–92 – or around one person out of every nine" (FAO, 2015). In developing countries, the share of population that is undernourished (having insufficient food to live an active and healthy life) fell from 23.3% 25 years earlier to 12.9%. A majority of the 129 countries monitored by FAO reduced undernourishment by half or more since 1996 (*Ibid*.).

Claims that climate change will reduce global food output are frequently made (e.g., Challinor *et al.*, 2014), but these forecasts invariably are based on computer models not validated by real-world data. Biological science, some of it summarized in Chapter 5, Section 3, conclusively shows plants thrive in a warmer world with higher-than-current levels of carbon dioxide (CO_2). Since aerial fertilization by CO_2 helps plants thrive even in hot and dry conditions, there is no scientific reason to believe those benefits will not continue even into the distant future.

In Chapter 3, Section 3.3.4, the graph below was presented and explained. It shows improvement in yields of one representative crop, sugar cane, due to improvements in technology ("techno-intel") and CO_2 fertilization continuing to 2050 and beyond (Idso, 2013).

The climate scenarios used by the IPCC improperly discount the adaptive capacity of modern agriculture and the large beneficial impacts of atmos pheric CO_2 on crop productivity and food production. Idso and Idso (2000) identified the 45 crops that at the turn of the century supplied 95% of the world's food needs and projected historical trends in the productivities of these crops 50 years into the future, after which they evaluated the growth-enhancing effects of atmospheric CO_2 enrichment on these plants and made similar yield projections based on the increase in atmospheric CO_2 concentration likely to have occurred by that future date. While world population would likely be 51% greater in the year

Figure 7.3.3.3.1
Historical and projected increases in total yield and the portion of the total yield due to the techno-intel and CO_2 effects, 2012–2050



Source: Idso, 2013.

2050 than it was in 1998, Idsos' exercise revealed that as a consequence of anticipated improvements in agricultural technology and expertise and the aerial fertilization effect of anthropogenic CO_2 emissions, farm production would keep pace with population growth.

Norman Borlaug, father of the Green Revolution and recipient of the 1970 Nobel Peace Prize, wrote about the need to vastly increase the world's agricultural productivity. In an article published at the turn of the twenty-first century he wrote, "agricultural scientists and leaders have a moral obligation to warn political, educational, and religious leaders about the magnitude and seriousness of the arable land, food, and population problems that lie ahead, *even with breakthroughs in biotechnology* [italics added]." In fact, "if we fail to do so," as he described it, "we will be negligent in our duty and inadvertently may be contributing to the pending chaos of incalculable millions of deaths by starvation" (Borlaug, 2000).

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7.3.3.4 Resource Scarcity as a Source of Conflict

The authors of Chapter 12 of the Working Group II contribution to AR5 say "Climate change has the potential to increase rivalry between countries over shared resources," but as reported earlier, they stop short of claiming any empirical evidence to support such a link (IPCC, 2014, p. 772). The authors of Chapter 22 of AR5, on Africa, are more assertive, claiming "the degradation of natural resources as a result of both overexploitation and climate change will contribute to increased conflicts over the distribution of those resources" (*Ibid.,* p. 1204).

The possibility of armed conflicts over scarce resources caused by abrupt climate change was raised by Schwartz and Randall in their 2003 report for the U.S. Pentagon. More credibly, Rune Slettebak, a Norwegian researcher affiliated with the Norwegian University of Science and Technology and the Peace Research Institute Oslo, writes, "Within the current debate on how environmental factors may affect the risk of conflict, scarcity of important resources holds a prominent place" (Slettebak, 2012). Similarly, Barnett and Adger write, "Acute scarcities, caused by reduced supply, increased demand or skewed distribution, are suggested as a significant current and future source of violent conflict" (Barnett and Adger, 2007).

That resource scarcity might lead to instability, state collapse, civil strife, or international conflict is a familiar argument in international security affairs. Under the "resource war" framework, nations are said to fight over territory, raw materials, energy, water, and food (Gleditsch, 1998). Deteriorating environmental conditions create resource scarcity and competition, thus creating conditions conducive to violence, the argument goes. Therefore, to the extent

that climate change contributes to deteriorating environmental conditions, it is viewed in this framework as one of many possible causal factors.

These perspectives became popular in the 1970s and gained prominence with the end of the Cold War. The first Gulf War appeared to offer an excellent case supporting the view that the United States would go to war to secure a vital resource – petroleum (see Klare, 2001). More recently Kahl argued resource scarcity can result in the collapse of a state's ability to operate effectively, thereby undermining social structures and the cohesion of the state. He also identified another possible outcome: cooption of the state by groups that exploit the power of government to disperse resources selectively (Kahl, 2006).

Drawing on archaeological data, LeBlanc and Register (2003) argue warfare was "quite common in the past" and "not a fluke but the norm" throughout human history. Humans often fight when population growth outstrips the "carrying capacity" of their natural environment, they say, while peace occurs when carrying capacity increases faster than population growth thanks to the invention of agriculture, the discovery of new energy sources and technologies, and the expansion of trade with other regions. According to LeBlanc and Register, modernity has broken the pattern of "constant battles," though a war-free future is not guaranteed, human nature being what it is. They write, "In spite of the pronounced impact industrialized states make on the environment, their technology and slow [population] growth rates enable them to live well below the carrying capacity. The decline in warfare among those countries is incredibly strong" (*Ibid.*, p. 228) and "For the first time in history, technology and science enable us to understand Earth's ecology and our impact on it, to control population growth, and to increase the carrying capacity in ways never before imagined. The opportunity for humans to live in long term balance with nature is within our grasp if we do it right" (*Ibid.*, p. 229).

Much of the argument and evidence presented in the debate over resource scarcity-conflict are the same as that presented in the climate-conflict debate. A recent review of the literature by Shields and Solar (2011) provides a nuanced view of the scarcity-conflict hypothesis. Conflicts over minerals do occur, they say, but they are dependent upon the existence of other social factors (weak rule of law, inequitable distribution of revenue) and not the depletion of the supply. In fact, "in modern times, no interstate conflicts have been driven by depletion," the review concludes (p. 261).

Four critiques of the resource scarcity-conflict hypothesis have been advanced:

- Human inventiveness and technological innovation enhance agricultural output and improve resource extraction abilities.
- International trade enables the reallocation of resources that are plentiful in one location to those areas where they are scarcer.
- Many raw materials have substitutes that are cheaper or more plentiful.
- Under conditions of scarcity, prices will rise which in turn encourages innovation, trade, and incentives to substitute (Simon, 1996).

Since the resource scarcity argument grew into prominence during the 1970s, actual experience shows the concerns to be overstated. The *Limits to Growth* report (Meadows *et al.,* 1972), for instance, predicted aluminum, copper, gold, lead, tin, zinc, and many other materials would be exhausted by the 1990s–2000s. All remain in widespread production today. Further illustration of the absence of predictive foresight were the expectations that natural gas supplies would be exhausted by 1994 and petroleum by 1992. The application of new technologies has greatly expanded known and recoverable supplies of both natural gas and petroleum in recent years.

Scarcity may give rise to cooperation, rather than conflict. Deudney argued, "analysts of environmental conflict do not systematically consider ways in which environmental scarcity or change can stimulate cooperation" (Deudney, 1999). As discussed in Section 7.3.3.2, water scarcity more often gives rise to cooperation than to conflict (Dinar, 2011).

The logic behind cooperation, trade, or innovation as the preferred strategy for addressing resource scarcity is simple and compelling. The costs of military action are always high, the probability of success (in either the short or long run) is not guaranteed, and the costs of holding the gains from military action undermine the benefits of securing supplies of the desired resource. The German and Japanese experiences during World War II are instructive for these purposes. Both nations were strongly incentivized to secure supplies of resources before the onset of conflict and during the course of the war. Neither succeeded – obviously at great cost.

Institutions, international markets, and diplomatic solutions offer options short of conflict for resolving natural resource disputes. Trading on the international market expands supply options, as does investment in efficiency or substitutions. For these reasons, few wars in the modern era were fought over natural resources, and that is likely to continue to be the case.

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7.3.3.5. Refugee Flows as a Source of Conflict

Flows of environmental refugees are another source of concern raised by the climate-conflict argument. According to the *Summary for Policymakers* of the Working Group II contribution to AR5,

> Climate change over the 21st century is projected to increase displacement of people (*medium evidence, high agreement*). Displacement risk increases when populations that lack the resources for planned migration experience higher exposure to extreme weather events, in both rural and urban areas, particularly in developing countries with low income. Expanding opportunities for mobility can reduce vulnerability for such populations. Changes in migration patterns can be responses to both extreme weather events and longer-term climate variability and change, and migration can also be an effective adaptation strategy. There is low confidence in quantitative projections of changes in mobility, due to its complex, multi-causal nature (IPCC, 2014, p. 20).

These migrations of displaced peoples, driven from their homes out of necessity because of drought, flood, or famine, or driven out intentionally by more powerful groups looking to secure greater shares of scarcer resources for themselves, are regularly cited. CNA (2007), for example, warns of unwelcomed migrations in Africa, Asia, Europe, and North America. Fingar (2008) cites migration concerns as well.

A widely cited figure for the number of possible "climate refugees" is 200 million, often attributed to a 1993 book by British environmentalist Norman Myers (Myers, 1993, and see Environmental Justice Foundation, 2009). The figure was cited by the IPCC in its Third Assessment Report, but not in AR5. Of Myers, Gleditsch and Nordås write, "it is generally recognized that this figure represents guesswork rather than a scientifically-based estimate" (Gleditsch and Nordås, 2014). The number in fact is pure

speculation and detached from any current real-world estimates of the actual number of people forced to move by climate change. The United Nations endorsed the prediction of 50 million environmental refugees by 2010, a claim subsequently discredited by reality (Atkins, 2011).

Like conflicts over water, the environmental refugee problem is a future one, conditioned on the assumption that things will be worse than ever observed. All forecasts are based on anecdotal accounts of natural disasters causing migration, and then computer models predicting increased incidences of such disasters and no human adaptation. The models have not been validated and the best global data show declining, not increasing, frequency of extreme weather events. (See Chapter 2 for citations.)

Any cases of "environmental refugees" in the world today are either model predictions with no real-world data to confirm them, or the result of naturally occurring disasters (hurricanes, tornadoes, floods) with no evidence of a connection to long-term climate change, whether caused by the human presence or by natural cycles. Baldwin *et al.*, writing in 2014, observed:

> The origins of climate change-induced migration discourse go back to the 1980s, when concerned scientists and environmental activists argued that unchecked environmental and climate change could lead to mass displacement (Mathews 1989; Myers 1989). However, at that time, hardly any actual climate or environmental refugees could be detected. *Even today, almost three decades later, the term as such remains merely a theoretical possibility but not an actually existing, clearly defined group of people* (Baldwin *et al.,* 2014, p. 121, italics added).

In 2011, the British Government Office for Science published the *Foresight Report on Migration and Global Environmental Change,* the work of some "350 experts and stakeholders from 30 countries across the world" and referred to by Baldwin *et al.* as "by far the most authoritative scientific account of the relationship between climate change and human migration." According to the report, "the range and complexity of the interactions between these drivers [of migration] means that it will rarely be possible to distinguish individuals for whom environmental factors are the sole driver" (Foresight, 2011, p. 9). After pointing out that "17 million people were displaced by natural hazards in 2009 and 42 million in 2010," the authors say, "Environmental change is equally likely to make migration less possible as more probable. This is because migration is expensive and requires forms of capital, yet populations who experience the impacts of environmental change may see a reduction in the very capital required to enable a move" (*Ibid.*). In other words, there may be *no net increase* in the number of environmental refugees.

While it is certainly possible to speculate about scenarios wherein displaced peoples create conflict, directly or indirectly, the empirical evidence suggests that is highly unlikely (Salehyan, 2005). The research shows "there are few, if any, cases of environmental refugees leading to violent conflict in receiving areas and while there are certainly examples of sporadic violence, such violence is generally small-scale, interpersonal and disorganized" (Buckland, 2007, p. 9).

According to a 2017 Reuters news story, "Statements by such public voices as Britain's Prince Charles and former U.S. Vice President Al Gore have linked the violence in Syria with global warming, saying the 2006 drought played a key role in urban migration that helped spark the civil war." But according to University of Sussex Professor Jan Selby, the coauthor of a study of the matter published in the journal *Political Geography,* "There is no sound evidence that global climate change was a factor in sparking the Syrian civil war. … It is extraordinary that this claim has been so widely accepted when the scientific evidence is so thin" (Reuters, 2017). In their journal article, Selby *et al.* (2017) report,

> This article provides a systematic interrogation of these claims, and finds little merit to them. Amongst other things it shows that there is no clear and reliable evidence that anthropogenic climate change was a factor in Syria's pre-civil war drought; that this drought did not cause anywhere near the scale of migration that is often alleged; and that there exists no solid evidence that drought migration pressures in Syria contributed to civil war onset. The Syria case, the article finds, does not support 'threat multiplier' views of the impacts of climate change; to the contrary, we conclude, policymakers, commentators and scholars alike should exercise far greater caution

> when drawing such linkages or when securitizing climate change.

After examining many environmental refugee claims, Tertrais (2011) concluded, "Such are the reasons why experts of environmental migrations generally agree that climate change in itself is rarely a root cause of migration. Major population displacements due to environmental and/or climatic factors will remain exceptional except in the case of a sudden natural disaster. And most importantly for the sake of this analysis, they are rarely a cause of violent conflict" (p. 24).

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7.3.4 U.S. Military Policy

> *Climate change does not pose a military threat to the United States. President Donald Trump was right to remove it from the Pentagon's list of threats to national security.*

Throughout his two terms in office, President Barack Obama tried to frame climate change as a matter of United States national security. In May 2015, the White House issued a report saying,

> Climate change is an urgent and growing threat to U.S. national security, contributing to increased weather extremes which worsen refugee flows and conflicts over basic resources like food and water. The national security implications of climate change reach far beyond U.S. coastlines, further threatening already fragile regions of the world. Increased sea levels and storm surges threaten coastal regions, infrastructure, and property. A changing climate will act as an accelerant of instability around the world, exacerbating tensions related to water scarcity and food shortages, natural resource competition, underdevelopment, and over-

> population (Executive Office of the President, 2015).

Obama did not invent the idea that climate change would threaten U.S. national security; he inherited it from the previous administration. Recall from Section 7.3 that Dr. Thomas Fingar, deputy director of National Intelligence for Analysis and chairman of the National Intelligence Council, testified to Congress in 2008 that "our primary source for climate science was the United Nations Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report" and "we relied predominantly upon a mid-range projection from among a range of authoritative scenario trajectories provided by the IPCC" (Fingar, 2008, pp. 2–3). This was *before* Obama took office.

Obama and activists in the environmental movement apparently thought by casting climate change as a security issue, they could win over conservatives and Republicans who prioritized national defense and spending on the military. It may have worked: Congress, even when controlled by Republicans, approved virtually all of Obama's spending requests involving military programs advancing his climate change agenda. Secretary of Defense Chuck Hagel, a Republican appointed to the position by Obama, said,

> Among the future trends that will impact our national security is climate change. Rising global temperatures, changing precipitation patterns, climbing sea levels, and more extreme weather events will intensify the challenges of global instability, hunger, poverty, and conflict. By taking a proactive, flexible approach to assessment, analysis, and adaptation, the Defense Department will keep pace with a changing climate, minimize its impacts on our missions, and continue to protect our national security (DoD, 2014b).

The Obama administration used the Department of Defense (DoD) to help wage its "war on coal," part of its announced strategy of weaning the nation away from fossil fuels. DoD, like other executive agencies, made public statements that seemed to validate the claims and predictions of climate change alarmists. The department's "2014 Climate Change Adaptation Roadmap" illustrates the acceptance of this view. Its preface reads like a news release from Greenpeace:

> Among the future trends that will impact our national security is climate change. Rising global temperatures, changing precipitation patterns, climbing sea levels, and more extreme weather events will intensify the challenges of global instability, hunger, poverty, and conflict. They will likely lead to food and water shortages, pandemic disease, disputes over refugees and resources, and destruction by natural disasters in regions across the globe. In our defense strategy, we refer to climate change as a "threat multiplier" because it has the potential to exacerbate many of the challenges we are dealing with today – from infectious disease to terrorism. We are already beginning to see some of these impacts (DoD, 2014a).

The U.S. military, with its abundant technological, scientific, and financial resources, has a massive platform from which to steward energy innovation. Research and development is a legitimate function of DoD and other government agencies. However, investing in unreliable renewable energy resources for purposes other than those supporting the department's mission is wasteful, unnecessary, and potentially dangerous when it diverts funding from higher priorities. Unfortunately, such diversion seems to be the goal of the various environmental advocacy groups and consultants paid to produce reports on how DoD can "accommodate" or "respond" to climate change (e.g, Busby, 2007; Center for a New American Security, 2008; McGrady *et al.*, 2010; CNA and Oxfam America, 2011; CNA, 2014). Most of these reports are little more than illustrated versions of the superficial Schwartz and Randall report commissioned by the Pentagon in 2003 (Schwartz and Randall, 2003).

During the Obama administrations, DoD was directed to spend scarce funds on expensive alternative energy projects to help pave the way to commercialization. In 2011, the U.S. Army Corps of Engineers issued a power purchase agreement (PPA) authorizing $7 billion in spending on alternative energy sources (biomass, geothermal, solar, and wind). In 2014, the program had 79 contracts to purchase power from third parties (Casey, 2014). Fossil fuel resources are far more affordable and reliable than alternatives available to DoD. Research reported in Chapter 3 found electricity generated by wind turbines and solar PV cells cost approximately

three times as much as fossil fuels (Stacy and Taylor, 2016).

In 2009, the U.S. Navy purchased 40,000 gallons of jet fuel derived from camelina (wild flax) at $67.50 per gallon and 20,055 gallons of algae-derived diesel-like fuel at a hefty $424 per gallon (Biello, 2009). Conventional jet fuel cost less than $2 a gallon in 1999. *Scientific American* also reported, "The Defense Advanced Research Projects Agency has spent $35 million to sponsor research into oil from algae and the Air Force is also looking for cleaner ways to fly and fight" (*Ibid.*).

Attempting to transition the U.S. military away from fossil fuels to biofuels, solar, and wind cannot be done without compromising military power and preparedness. T.A. "Ike" Kiefer, a captain in the U.S. Navy in addition to having degrees in physics and strategy, explained the trade-off as follows:

> No materials other than very exotic and toxic substances like lithium borohydride (LiBH4) or expensive rare metals like beryllium surpass the energy density of diesel and jet fuel. Biodiesel and ethanol both fall short. Hydrogen fuel cells, electrical storage batteries, and capacitors miss by a much greater margin. Other alternatives, such as wind, solar, geo-thermal, or waste-to-energy devices, can power some laptops and light some fixed facilities but simply cannot harvest enough energy to propel the tanks, jets, helos, and trucks that are by far the major battlefield fuel consumers. These can offer only an incidental decrease in overall fuel requirements for mechanized forces and then only in low-hostility circumstances where they can be set up and safeguarded (Kiefer, 2013, pp. 117–8).

According to Kiefer, "the US Navy directly rejected a RAND study conducted at the direction of Congress and delivered to the secretary of defense in January of 2011 that unambiguously found biofuels of 'no benefit to the military' (Bartis and Van Bibber, 2011; Maron, 2011). A second RAND study and a report by the U.S. National Academy of Sciences, both severely questioning the wisdom and efficacy of current U.S. biofuels policies, also resulted in no adjustments to U.S. biofuels programs (Bartis, 2012; NRC, 2011)" (*Ibid.*, p. 116).

Another unnecessary expense is "hardening" military installations for unrealistic forecasts of sea level rise or the increased probability of intense storms. According to Obama, "Installations near the coastlines are threatened by coastal erosion and sea level rise, damaging infrastructure and reducing the land available for operations" (Executive Office of the President, 2015, p. 9). But as reported in Chapter 2, Section 2.1.2, globally averaged sea-level change has been stable and less than seven inches per century for the past 1,000 years, a rate that is functionally negligible because it is frequently exceeded by coastal processes like erosion, sedimentation, and subsidence unrelated to climate.

What matters to military bases and military strategy is not global average sea level – itself an abstract concept and not an empirical finding – but actual *local* changes in sea level. Local sea-level trends vary considerably depending on tectonic movements of adjacent land and other factors. In many places vertical land motion, either up or down, exceeds the very slow global sea-level trend. Efforts to document an accelerated sea-level rise, to the extent they are made rather than simply assumed by relying on secondary sources and television documentaries, typically use very short measurement records or short, low-quality, satellite altimetry measurements rather than long, high-quality, coastal measurements. Church and White (2006), for example, spliced together measurements from different locations at different times and claimed to find (from the study's title) "A 20th Century Acceleration in Global Sea-Level Rise." Later researchers found all of the (very slight) acceleration Church and White measured occurred prior to 1930 – when atmospheric carbon dioxide levels were under 310 ppm (Burton, 2012).

More frequent or more intense storms could become a concern for military bases, but empirical data do not show a long-term trend in either measure (Alexander *et al.*, 2006; Khandekar, 2013; Pielke Jr., 2013, 2014; Landsea, 2018). The IPCC's computer models cannot produce reliable regional results, much less forecast the weather near existing military installations, so a global average is meaningless for military purposes. The best practice is to measure real-world weather conditions on-the-ground and determine if trends justify taking action.

Another unnecessary expense is making preparations for the U.S. military to respond to humanitarian crises. Natural disasters occur around the world on a nearly daily basis. In most cases, local governments, civic institutions, and private enterprise rise to the challenge by providing medical aid to the injured and rebuilding damaged homes and infrastructure. International aid organizations such as

Red Cross also arrive to help. Under Obama, DoD was told to anticipate conditions where the U.S. military would be called upon to provide disaster relief and humanitarian assistance on an ever-increasing basis; to consider how to alter force plans, training, and acquisition strategies; and to contemplate alterations and adaptations in DoD's bases and physical infrastructure to accommodate expected environmental challenges.

The United States is a generous nation. Natural disasters generally elicit an outpouring of money and assistance from U.S. citizens, philanthropic organizations, and the government, but not for every disaster and not in every circumstance. Using public concern and interest in climate change as a way to divert public resources intended for national defense to foreign aid missions, without congressional appropriations or express public approval, seems an improper use of presidential power. Choices must be made about when and how extensively to respond. In a world where such demands on U.S. resources might increase, policymakers and defense officials need to make choices based on solid science and real-world situations, not United Nations computer models (Hayward *et al.,* 2014).

Development of a credible national energy policy would help support national strategy that defines our role in international affairs. Where timing is of the essence, it would direct distribution of needed resources when circumstances warrant. Rather than burden the U.S. military with unnecessary and costly preparations for international assistance based upon unrealistic predictions of global warming, military planning ought to reflect national interests and strategic policies, and certainly our humanitarian values, and engender diplomatic and geopolitical advantage. DoD is never the sole repository of disaster relief capabilities. As noted above, various institutions also assist. Nor should key military resources be diverted for ill-conceived and premature infrastructure adaptations or altering basic force requirements, as was proposed by the Obama administration. A national energy policy brings unity to disparate public and private agencies involved with international assistance.

Among the choices to be made is whether to continue U.S. military engagements in the Middle East. Section 7.1.3 of this chapter addressed "wars for oil" in some depth, and concluded the United States is not in the Middle East to ensure access to cheap oil, since many of our interventions had other (among them humanitarianism and national pride) justifications, oil is hardly a scarce resource, and the United States is no longer dependent on the Middle East for a significant part of its oil supplies. With the United States about to become a net oil exporter thanks to the shale revolution (EIA, 2018), public support for maintaining so many troops in the region (approximately 35,000, with 13,000 in Kuwait and 5,000 in Bahrain, where energy security is the stated purpose (see Glaser, 2017)), may be expected to fall.

The election of Donald Trump as president of the United States marked a decisive turning point in climate change policy in the United States. Immediately after taking office, Trump approved the Keystone XL and Dakota Access natural gas pipeline projects that had been blocked by the Obama administration for years (Cama, 2017). In March 2017, Trump issued an "Executive Order on Promoting Energy Independence and Economic Growth" revoking and beginning the process of rescinding many Obama-era policies, including Obama's Climate Action Plan and Clean Power Plan, and disbanding the Interagency Working Group on Social Cost of Greenhouse Gases (Trump, 2017a).

In June 2017, Trump announced he would withdraw the United States from the Paris Climate Accord (Trump, 2017b). In December, he announced the administration would remove "climate change" from its list of threats to national security (Trump, 2017c). Indeed, the phrase appears nowhere in the *National Security Strategy* released that month; it says only, "The United States will continue to advance an approach that balances energy security, economic development, and environmental protection" (Executive Office of the President, 2017).

Under Trump, the U.S. Department of Energy, Department of the Interior, and the Environmental Protection Agency have taken steps to remove punitive regulations imposed on coal, oil, and natural gas producers during the Obama era, and recently announced plans to protect the nation's coal generation plants in the name of ensuring a reliable energy supply in the event of cyberattacks that could disable gas pipelines (Colman, 2018). These seem to be reasonable steps toward restoring balance to U.S. energy policy as well as military policy.

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7.3.5 Conclusion

> *Predictions that climate change will lead directly or indirectly to violent conflict presume mediating institutions and human capital will not resolve conflicts before they escalate to violence.*

Empirical research does not support the IPCC's contention that climate change will lead to violent conflicts, a failure easily explained by the methodological flaws in the argument. Each of the five alleged sources of conflict examined in this section – abrupt climate change, water shortages, famine, resource scarcity, and refugee flows – are revealed to be lacking in proof and plausibility.

One way in which proponents of the climate-conflict argument have responded to the lack of empirical support for their position is to suggest that climate-induced change will cause future conflicts because the problems will be *so much worse* than anything that has been experienced previously. This logic allows proponents to dismiss the lack of empirical evidence in support of the causal linkages, because the argument is purely concerned with the prospects for future conflict. Environmental factors then become an additive fuel to a combustible mixture. Statements like that offered by President Barack Obama's 2010 *National Security Strategy*, "The change wrought by a warming planet will lead to new conflicts over refugees and resources," are deterministic and predictive, but ultimately not testable.

The deterministic interpretation artificially assumes limits on the adaptability of the actors involved or other institutions that can play stabilizing roles. The countries and groups affected by an environmental phenomenon may not react in a manner consistent with the expectations of computer modelers or "futurists." The mediating effects of other nations, nongovernmental organizations, new technology, and the output of human capital can all defuse a crisis. These dynamics are impossible to model or incorporate into a testable hypothesis, and yet experience shows they exist and are important. As Tir and Stinnett observed, "Forecasts that do not account for the important conflict management potential of international institutions will produce overly pessimistic scenarios regarding the impact of climate change on international security" (Tir and Stinnett, 2012). Those agreements and institutions provide a means to seek reconciliation and adjudication of interests before conflict escalates to violence and offer a venue for the appropriate expression of tension. The conflict scenarios all presume these elements fail or are not present, and so they are wrong.

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7.4 Human History

A large literature exists on the historical relationship between climate and human security. Much of it shows humanity enjoyed periods of peace during warmer periods or periods of rising temperatures, while cooler periods or periods of falling temperatures have been accompanied by human suffering and often armed conflict. This research contradicts the narrative of the IPCC and its supporters, and for that reason it is seldom referenced in the IPCC assessment reports or by those who advocate for immediate action to address climate change.

Section 7.4.1 summarizes recent research on the relationship between climate and human security in China, the world's most populous nation and the one with the longest and most detailed historical records.

Section 7.4.2 presents research from other parts of the world.

7.4.1 China

Extensive historical research in China reveals a close and positive relationship between a warmer climate and peace and prosperity, and between a cooler climate and war and poverty.

China is a good test case for the relationship between global warming and violent conflict because it has been a well-populated, primarily agricultural country for millennia, and it has a relatively well-recorded history over this period. Accordingly, several researchers have conducted analyses of factors influencing social stability in China.

Zhang *et al.* (2005) noted historians typically identify political, economic, cultural, and ethnic unrest as the chief causes of war and civil strife in China. However, the five Chinese scientists contend climate plays a key role as well, and to examine their thesis they compared proxy climate records with historical data on wars, social unrest, and dynastic transitions in China from the late Tang to Qing Dynasties (mid-ninth century to early twentieth century). Their research revealed war frequencies, peak war clusters, nationwide periods of social unrest, and dynastic transitions were all significantly associated with cold, not warm, phases of China's oscillating climate. Specifically, all three distinctive peak war clusters (defined as more than 50 wars in a 10-year period) occurred during cold climate phases, as did all seven periods of nationwide social unrest and nearly 90% of all dynastic changes that decimated this largely agrarian society. They conclude climate change was "one of the most important factors in determining the dynastic cycle and alternation of war and peace in ancient China," with warmer climates having been immensely more effective than cooler climates in terms of helping "keep the peace."

Zhang *et al.* (2007a) utilized high-resolution paleoclimate data to explore the effects of climate change on the outbreak of war and population decline at a global and continental scale in the pre-industrial era, as discerned by analyses of historical socioeconomic and demographic data over the period AD 1400–AD 1900. In describing their findings, they report "cooling impeded agricultural production, which brought about a series of serious social problems, including price inflation, then successively war outbreak, famine, and population decline." And they suggest that "worldwide and synchronistic war-peace, population, and price cycles in recent centuries have been driven mainly by long-term climate change," wherein warm periods were supportive of good times and cooling led to bad times.

In response to "the gradual temperature drop and the increase in size of the cold area from the 'Medieval Warm Period' to the Little Ice Age," for example (when Zhang *et al.* found that every sudden temperature drop would induce a "demographic shock"), population growth rate "reached its lowest level in the 13–14th centuries, primarily because of epidemics, wars, and famines." In providing more detail, they say "the invasion by the Mongols in the 13–14th centuries was related to the ecological stress caused by cooling, which reduced China's total population nearly by half (~55 million decline)," while in Europe they report the Black Death held sway, "accompanied by massive social unrest and economic collapse, which wiped out a quarter to one-third of the population in AD 1347–1353, the coldest period in the last several hundred years." Then, in the seventeenth century, which was the longest cold period of the Little Ice Age, they report "more wars of great magnitude and the associated population declines in Europe and Asia followed." More specifically, they state "the European population was devastated by possibly the worst war in its history in terms of the share of the population killed in AD 1618–1648, starvation, and epidemics." Likewise, they report "in China, the population plummeted 43 percent (~70 million) because of wars, starvation and epidemics in AD 1620–1650."

Liu *et al.* (2009) derived a 2,485-year mean annual temperature history of the mid-eastern Tibetan Plateau based on Qilian juniper (*Sabina przewalskii*) tree-ring width chronologies spanning the time period 484 BC–AD 2000, which they demonstrated to be well correlated with several temperature histories of the Northern Hemisphere. The eight researchers report there were four periods of average temperatures in their record similar to "or even higher than" the mean of AD 1970–2000. Liu *et al.* also report the high-temperature intervals during the first millennium were what could be described as relatively good times. The downfalls of most major dynasties in China coincided with intervals of low temperature, or at least the beginnings of their downfalls did, citing the demise of the Qin, Three

Kingdoms, Tang, Song (North and South), Yuan, Ming, and Qing Dynasties.

Lee and Zhang (2010) examined data on Chinese history, including temperature, wars and rebellions, epidemics, famines, and population for the past millennium. Over their study interval of 911 years, they found nomad migrations, rebellions, wars, epidemics, floods, and droughts were all higher during cold periods. All of these factors tended to disrupt population growth or increase mortality. Overall, five of six population contractions, constituting losses of 11.4% to 49.4% of peak population, were associated with a cooling climate. The sixth cool period evinced a great reduction in population growth rate during a cool phase, but not a collapse. None of the population contractions was associated with a warming climate.

Zhang *et al.* (2010) note "climatic fluctuation may be a significant factor interacting with social structures in affecting the rise and fall of cultures and dynasties," citing Cowie (1998) and Hsu (1998). When the climate worsens beyond what the available technology and economic system can accommodate – that is, beyond the society's adaptive capacity – they state, "people are forced to move or starve." Zhang *et al.* also note "climate cooling has had a huge impact on the production of crops and herds in pre-industrial Europe and China (Hinsch, 1998; Atwell, 2002; Zhang *et al.*, 2007a), even triggering mass southward migration of northern nomadic societies (Fang and Liu, 1992; Wang, 1996; Hsu, 1998)," and "this ecological and agricultural stress is likely to result in wars and social unrest, often followed by dynastic transitions (Zhang *et al.*, 2005)." In fact, they write, "recent studies have demonstrated that wars and social unrests in the past often were associated with cold climate phases (Zhang *et al.*, 2005, 2007a,b)," and "climate cooling may have increased locust plagues through temperature-driven droughts or floods in ancient China (Stige *et al.*, 2007; Zhang *et al.*, 2009)."

In a study designed to explore the subject further, Zhang *et al.* employed "historical data on war frequency, drought frequency and flood frequency" compiled by Chen (1939), and "a multi-proxy temperature reconstruction for the whole of China reported by Yang *et al.* (2002), air temperature data for the Northern Hemisphere (Mann and Jones, 2003), proxy temperature data for Beijing (Tan *et al.*, 2003), and a historical locust dataset reported by Stige *et al.* (2007)," plus "historical data of rice price variations reported by Peng (2007)." In analyzing the linkages among these factors, the researchers report "food production during the last two millennia has been more unstable during cooler periods, resulting in more social conflicts." They specifically note "cooling shows direct positive association with the frequency of external aggression war to the Chinese dynasties mostly from the northern pastoral nomadic societies, and indirect positive association with the frequency of internal war within the Chinese dynasties through drought and locust plagues," which typically have been more pronounced during cooler as opposed to warmer times.

Zhang *et al.* conclude "it is very probable that cool temperature may be the driving force in causing high frequencies of meteorological, agricultural disasters and then man-made disasters (wars) in ancient China," noting "cool temperature could not only reduce agricultural and livestock production directly, but also reduce agricultural production by producing more droughts, floods and locust plagues." They also observe the subsequent "collapses of agricultural and livestock production would cause wars within or among different societies." Consequently, although "it is generally believed that global warming is a threat to human societies in many ways (IPCC, 2007)," Zhang *et al.* arrive at a different conclusion, stating some countries or regions might actually "benefit from increasing temperatures," citing the work of Nemani *et al.* (2003), Stige *et al.* (2007), and Zhang *et al.* (2009), while restating the fact that "during the last two millennia, food production in ancient China was more stable during warm periods owing to fewer agricultural disasters, resulting in fewer social conflicts."

In their study of widespread crises in China, Lee and Zhang (2013) write "the fall of the Ming dynasty in the first half of the 17th century and the Taiping Rebellion from 1851–1865 were two of the most chaotic periods in Chinese history," each of which "was accompanied by large-scale population collapses." Utilizing "high-resolution empirical data, qualitative survey, statistical comparison and time-series analysis" to investigate how climate change and population growth "worked synergistically to drive population cycles in 1600–1899," they found that "recurrences of population crises were largely determined by the combination of population growth and climate change." More specifically, "in China in the past millennium, the clustering of natural calamities and human catastrophes in times of cold climate was found not only in one or two cold phases, but in all of the cold phases (Lee and Zhang, 2010)."

China is not different from the rest of the world

in this regard. During what is known as the General Crisis of the Seventeenth Century, for example, Lee and Zhang note "the crown of the Holy Roman Empire was unsettled by the Thirty Years' War," "civil war devastated France," "in London, Charles I was condemned to death by his own subjects," and Spain's Philip IV "lost almost all his possessions in Asia." In addition, Lee and Zhang mention the Puritan Revolution in England, the revolts of Scotland and Ireland, the insurrections in the Spanish monarchy – including Catalonia and Portugal in 1640 and Naples and Palermo in 1647 – the Fronde in France between 1648 and 1653, the bloodless revolt of 1650 that displaced the stadholderate in the Netherlands, the revolt of the Ukraine from 1648 to 1654, as well as "a string of peasant risings across the [European] continent (Parker and Smith, 1978)."

After analyzing these situations and others, Lee and Zhang conclude "both natural calamities and human catastrophes are clustered in periods of cold climate," primarily because cooling "generates a devastating impact on agricultural production everywhere," citing the work of Atwell (2001, 2002), while also noting "declines in temperatures often have had catastrophic consequences for the world's food supply."

Wei *et al.* (2014) point out "climate change has long been suggested as a factor of great importance in facilitating the rise or fall of culture," citing Issar and Zohar (2007), but they note "this type of study still faces the lack of high-resolution data of long-term socio-economic processes." In research designed to overcome this deficiency, they found more than 1,100 such sets of information in 24 Chinese fiscal and economic history books, plus other well-preserved historical documents, from which they constructed a 2,130-year (220 BC to AD 1910) fiscal-state sequence with decadal resolution that is representative of the phase transition history of China's fiscal soundness.

Wei *et al.* found "the fiscal balance of dynasties from 220 BC to AD 1910 experienced seven large stages." More specifically, "the relatively sufficient periods dominated from 220 to 31 BC, AD 581–1020, AD 1381–1520 and from AD 1681–1910," whereas the relatively deficient periods were the three intervening time intervals. The three Chinese researchers discovered that "fiscal crisis was more likely to occur in cold-dry climatic scenarios," noting that "both temperature and precipitation displayed more significant effects on the fiscal fluctuation within the long term, particularly for temperature."

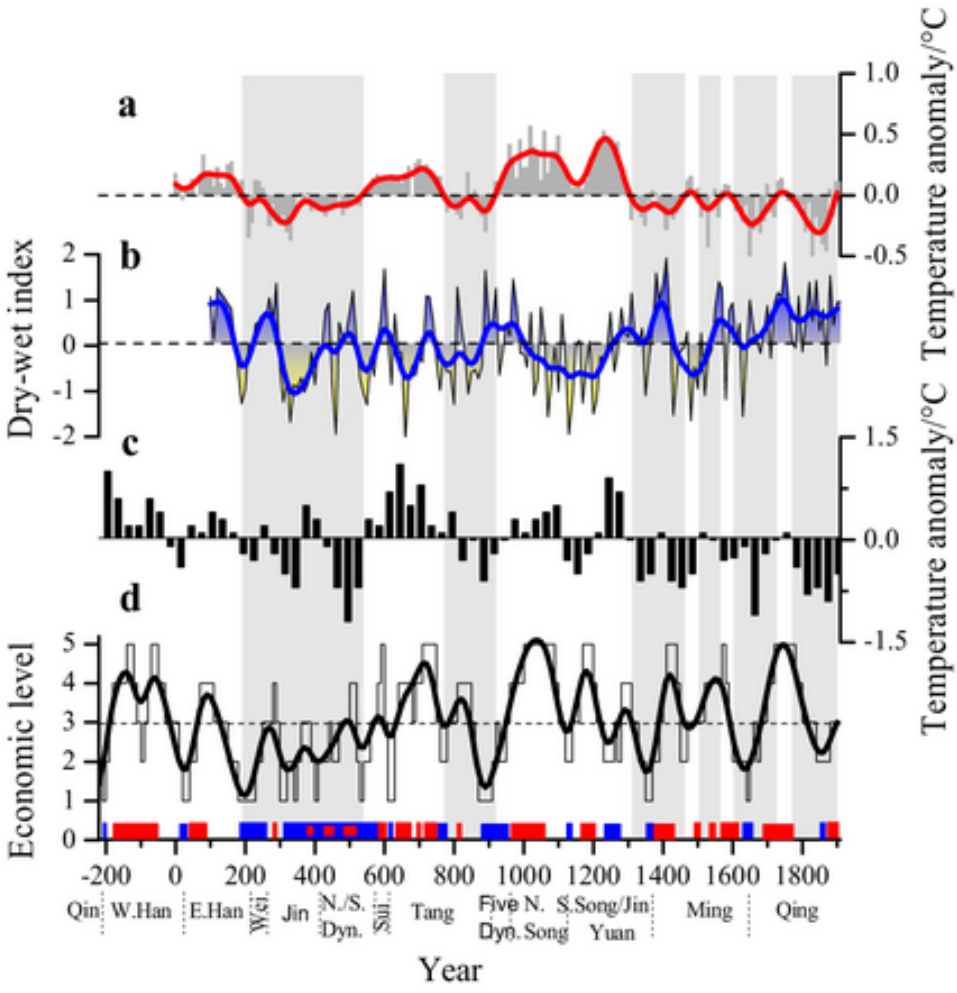
Jia (2014) notes China is "a good testing ground for the link between weather shocks and civil conflict, as there is detailed information on abnormal weather conditions and the occurrence of peasant revolts at the prefecture level going back to the 15th century," which data indicate a peasant revolt occurred in 0.22% of all prefecture-years. However, when focusing only on prefecture-years when there was an exceptional drought, Jia says "there was a peasant revolt in 0.58 percent of prefecture-years," such that "a peasant revolt at the prefecture level was almost three times more likely in a drought year." In addition, Jia found the price effect of droughts was nearly three times that of floods, and droughts thus had more severe negative effects on local food production, consistent "with historians' argument that droughts were the most important natural disasters driving historical peasant revolts," citing Xia (2010).

With respect to how the introduction of drought-resistant sweet potatoes helped mitigate civil conflict, Jia collected data on their adoption and diffusion across different provinces or collections of prefectures, finding that before the introduction of sweet potatoes "there was a peasant revolt in 0.78 percent of prefecture-years with an exceptional drought," but that "after the introduction of sweet potatoes, there was a peasant revolt in only 0.26 percent of prefecture-years with an exceptional drought."

Wei *et al*. (2015) investigated the long-term relationship between the climate and economy of China, returning to the 2,130-year record of the Chinese economy they developed in previous research. This proxy was statistically analyzed in conjunction with historical proxies of Chinese temperature and precipitation previously compiled by Ge *et al*. (2013) and Zheng *et al*. (2006), respectively. Wei *et al.* found that warm and wet climate periods coincided with more prosperous and robust economic phases (above-average mean economic level, higher ratio of economic prosperity, and less intense variations), whereas opposite economic conditions ensued during cold and dry periods, where the possibility of economic crisis was "greatly increased" (see Figure 7.4.1.1). They also report temperature was "more influential than precipitation in explaining the long-term economic fluctuations, whereas precipitation displayed more significant effects on the short-term macro-economic cycle."

In their study of climate change impacts on dynastic well-being in China over the period 210 BC to AD 1910, Yin *et al*. (2016) focused on relationships among dynastic transition and prosper-

Figure 7.4.1.1
Series comparison between economic fluctuations and climate changes in China from BC 220 to AD 1910



Panel a: Decadal temperature anomaly for all of China during the period AD 1–1910 (Ge *et al*., 2013); the red curve is the low-pass filtered series. Panel b: Decadal precipitation over eastern China during the period 101–1910 (Zheng *et al*., 2006); the blue curve is the low-pass filtered series. Panel c: Winter half-year temperature anomaly series for eastern China during the period BC 210–AD 1920 with a 30-year resolution (Ge, 2011). Panel d: Decadal macro-economic series during the period BC 220–AD 1910 in China; the black curve is the low-pass filtered series. The red and blue bars indicate typical episodes of prosperity and crisis periods (respectively). The gray and white areas delineate cold and warm phases, respectively.

Source: Wei *et al.,* 2015.

ity and how they were affected by historical climate change and its impacts on grain harvests. The three Chinese researchers report that from 210 BC to AD 1910, unfavorable dynastic transitions mostly coincided with changes from warm-to-cold and wet-to-dry periods, when there were relatively poor harvests, noting "dynastic prosperity mostly coincided with warm ages or the periods that changed from cold to warm and wet or dry-to-wet periods," when they report there were bumper grain harvests.

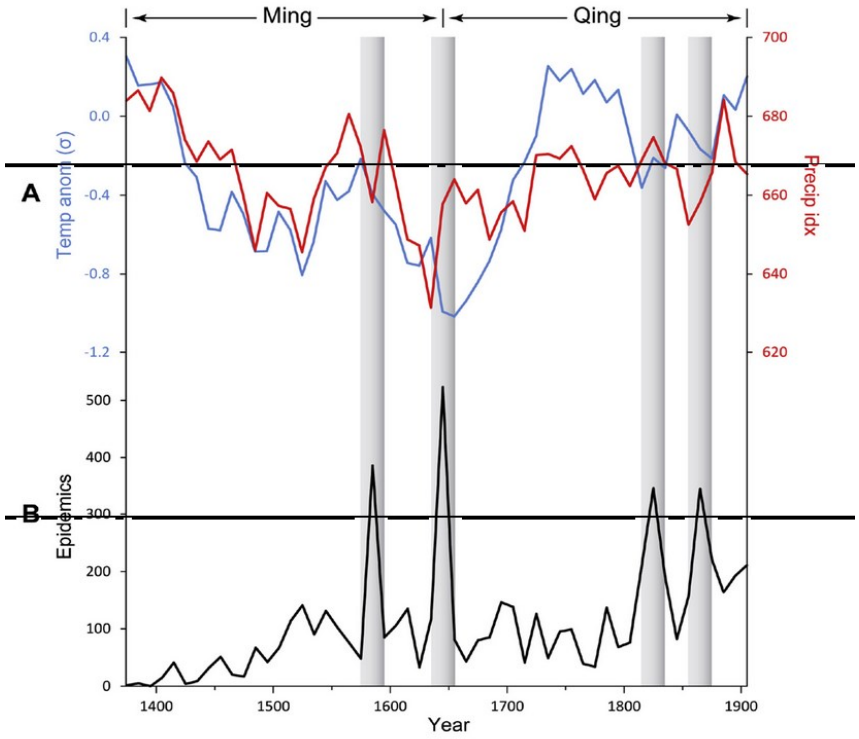
Yin *et al*. note "dynastic prosperity tended to appear in warm periods or cold-to-warm periods, wet

or dry-to-wet periods, and crop abundance periods," further noting "transitions from chaos to unity tended to occur at the ends of centuries-long cold periods and at the beginning of warm periods." They say "collapse of the Tang Dynasty was haunted by colder weather and declining grain harvests."

Lee *et al*. (2017) analyzed the association between climate change and health-related epidemics recorded in China over the period 1370–1909 AD. For climate data, they utilized the temperature reconstruction of Yang *et al*. (2002) and the precipitation reconstruction of Zhang *et al*. (2015). Epidemic data were aggregated from three independently derived datasets, *Collection of Meteorological Records in China over the Past Three Thousands Years* (Zhang, 2004), *Historical Records of Infectious Diseases in China* (Li, 2004), and *Epidemic Records in Historical China* (Zhang, 2007). All data and the relationships among them were analyzed on three spatial scales (national, regional, and provincial).There were a total of 5,961 epidemic incidents across China during the study period. Statistical analyses revealed that precipitation was not significantly correlated with epidemic count.

Temperature, on the other hand, was found to be "negatively correlated with epidemic incidents" (see Figure 7.4.1.2). Additionally, Lee *et al.* calculated that for every one standard deviation decrease in temperature at the country, regional, or provincial level, increases of 162, 34, and 3.4 epidemic outbreaks were observed, respectively. Consequently, Lee *et al*. conclude their analysis "supports the notion that climate change, be it the ultimate cause or direct trigger, acts as a driver of historical epidemics," but that global *cooling, not warming,* is to be feared.

Figure 7.4.1.2
The relationship between temperature and epidemic incident count for all of China over the period 1370-1909 AD



Panel (A) temperature anomaly (°C) (blue line) and precipitation index (red line). Panel (B) count of epidemics incidents.

Source: Lee *et al.,* 2017.

Wang *et al*. (2018) developed a 4,000-year proxy temperature reconstruction based on chironomid (midge) assemblages in a sediment core from Gonghai Lake (38.9°N, 112.23°E), an alpine freshwater lake located on the northeastern margin of the Chinese Loess Plateau in the Shanxi Province. The reconstruction was then compared with published war and population records for the Shanxi Province to explore the relationship between climate change and human societal changes for this region. Their findings are presented in Figure 7.4.1.3.

As shown in the figure, there have been multiple centennial-scale fluctuations but an overall decline in temperature over the 4,000 year record. That finding is not surprising since the record begins at the warmest interval of the current interglacial period. Notable warm events in the record include the Sui-Tang Warm Period (1270–1040 cal yr BP), the Medieval Warm Period (~970–570 cal yr BP), and the modern warm period. Notable cold events include the Chinese Period of Disunity (~1700–1270 cal yr BP), the Era of the Five Dynasties and Ten Kingdoms (~1040–970 cal yr BP), and the Little Ice Age (~570–270 cal yr BP).

In examining the relationship between climate (their chironomid temperature proxy and an independent pollen-based reconstruction from the same lake by Chen *et al*., 2015) and societal change, Wang *et al*. report wars "occurred more frequently when temperature and precipitation decreased abruptly," noting that war events were more strongly correlated with temperature than precipitation. The most severe era of war events occurred during the coldest period of the record, i.e., the Little Ice Age.

With respect to population, Wang *et al*. report "an increase [in population] often occurred during warm periods," which provided relief from the harsh economic pressures brought about by poor crop harvests during colder periods, when yields were reduced by as much as 50%. Not surprisingly, reduced crop yields during cold eras would trigger higher food prices and famine, creating "large numbers of homeless refugees and outbreaks of plague," eventually resulting in "wars and social unrest which acted to reduce the population size."

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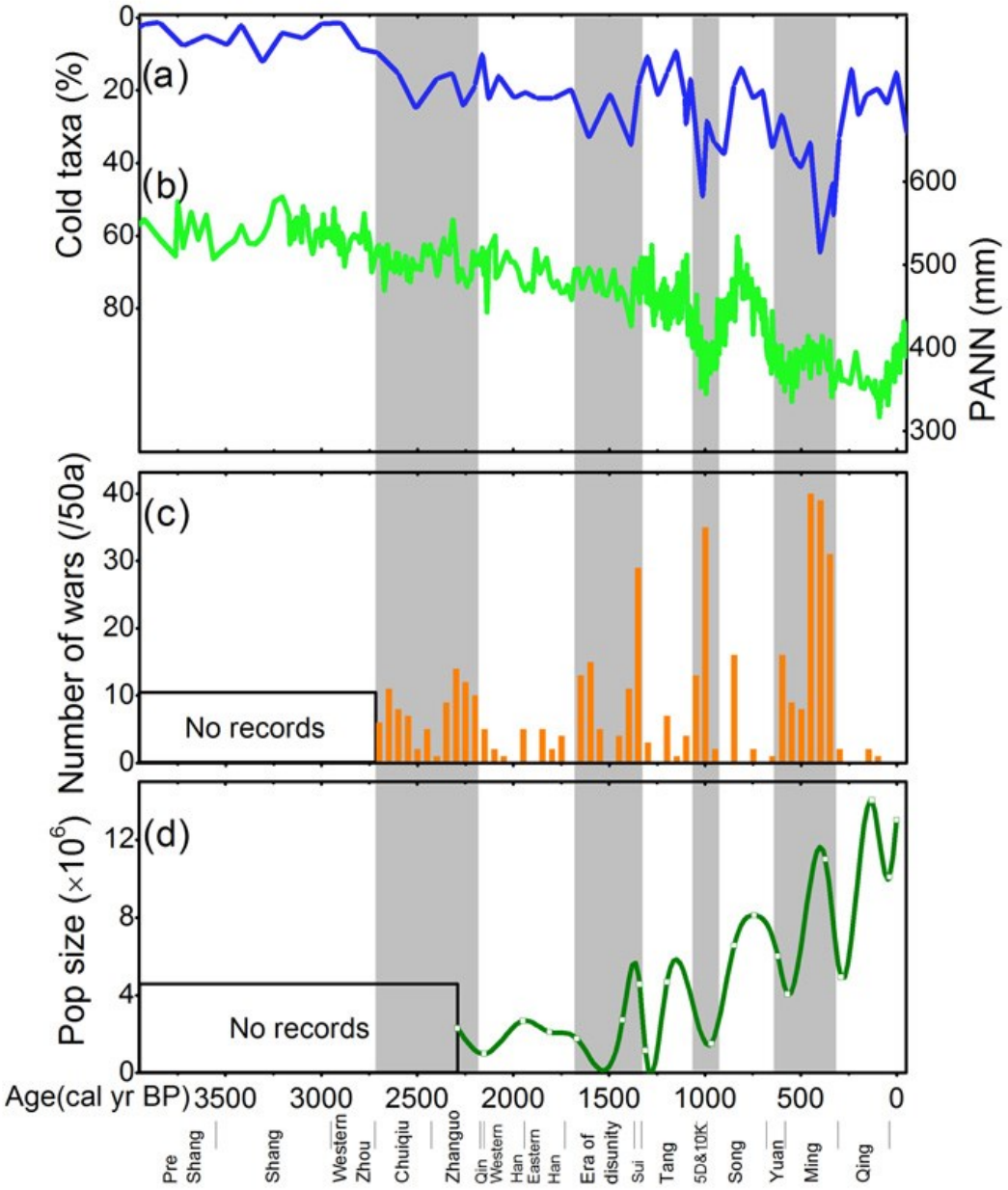
Figure 7.4.1.3
Temperature proxy, number of wars, and population of the Shanxi Province of China, from 4,000 years BP to current



Comparison of (a) cold-preferring taxa percentages and (b) reconstructed precipitation at Gonghai Lake (Chen *et al*., 2015) with (c) frequencies of wars in Shanxi Province, China, and (d) population size (in units of 1 million, square dots) of Shanxi Province during the past 2300 years; the data are spline connected. Grey shaded areas indicate cold events. *Source:* Wang *et al.,* 2018.

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7.4.2 Rest of the World

The IPCC relies on second- or third-hand information with little empirical backing when commenting on the implications of climate change for conflict.

Focusing on Europe, Tol and Wagner (2010) write that in "gloomier scenarios of climate change, violent conflict plays a key part," noting that in such visions of the future "war would break out over declining water resources, and millions of refugees would cause mayhem." They note "the Nobel Peace Prize of 2007 was partly awarded to the IPCC and Al Gore for their contribution to slowing climate change and thus preventing war." However, they warn "scenarios of climate-change-induced violence can be painted with abandon," citing the example of Schwartz and Randall (2003), because, as they continue, "there is little research to either support or refute such claims."

Tol and Wagner proceeded to do for Europe what Zhang *et al.* (2005, 2006) had done for China. Their results indicate "periods with lower temperatures in the pre-industrial era are accompanied by violent conflicts." They further determined "this effect is much weaker in the modern world than it was in pre-industrial times," which implies, in their words, "that future global warming is not likely to lead to (civil) war between (within) European countries." Therefore, they conclude, "should anyone ever seriously have believed that, this paper does put that idea to rest."

Buntgen *et al.* (2011) developed a set of tree ring-based reconstructions of central European summer precipitation and temperature variability over the past 2,500 years. In the abstract of their paper, the 12 researchers state, "wet and warm summers occurred during periods of Roman and medieval prosperity," and in the body of their paper they write, "average precipitation and temperature showed fewer fluctuations during the period of peak medieval and economic growth, ~1000 to 1200 C.E. (Kaplan *et al.*, 2009; McCormick, 2001)," which suggests a warmer climate is better than a colder one for humanity.

Support for this point of view is provided by Buntgen *et al.*'s description of what happened as temperatures declined and the Medieval Warm Period gave way to the Little Ice Age, with its onset "likely contributing," in their words, "to widespread famine across central Europe," when they say "unfavorable climate may have even played a role in debilitating the underlying health conditions that contributed to the devastating economic crisis that arose from the second plague pandemic, the Black Death, which reduced the central European population after 1347 C.E. by 40 to 60 percent (Buntgen *et al.*, 2010; Kaplan *et al.*, 2009; Kausrud *et al.*, 2010)." In addition, they note this period "is also associated with a temperature decline in the North Atlantic and the abrupt desertion of former Greenland settlements (Patterson *et al.*, 2010)," and "temperature minima in the early 17th and 19th centuries accompanied sustained settlement abandonment during the Thirty Years' War and the modern migrations from Europe to America."

Chen *et al.* (2011) developed a high temporal resolution (four-year) sea surface temperature (SST) history based on a dinoflagelate cyst record obtained from a well-dated sediment core retrieved from a site in the Gulf of Taranto located at the distal end of the Po River discharge plume (39°50.07'N, 17°48.05'E) in the southern Italian region of the Mediterranean Sea. According to the authors, SST reconstructions based on the composition of dinoflagellate cysts recovered from the sediment core "suggest high stable temperatures between 60 BC and 90 AD followed by a decreasing trend between 90 AD and 200 AD." They also observed their "reconstruction of relatively warm stable climatic conditions corresponds to the time of the 'Pax Romana'," i.e., the long period of relative peace and minimal expansion by military force experienced by the Roman Empire in the first and second centuries AD.

Zhang *et al.* (2011a) preface their work by noting early paleo-temperature reconstructions suggested "massive social disturbance, societal collapse, and population collapse often coincided with great climate change in America, the Middle East, China, and many other countries in preindustrial times (Bryson and Murray, 1977; Atwell, 2001; deMenocal, 2001; Weiss and Bradley, 2001; Atwell, 2002)." They also say it has been shown more recently that "climate change was responsible for the outbreak of war, dynastic transition, and population decline in China, Europe, and around the world because of climate-induced shrinkage of agricultural production (Zhang *et al.*, 2005, 2006, 2007a,b; Lee *et al.*, 2008; Lee *et al.*, 2009; Lee and Zhang, 2010; Tol and Wagner, 2010; Zhang *et al.*, 2010; Zhang *et al.*, 2011b)."

In a study designed to provide still greater support for this general relationship, Zhang *et al.* (2011a) "examined the climate-crisis causal mechanism in a period [AD 1500–1800] that contained both periods of harmony and times of

crisis," the most prominent of the latter of which was the General Crisis of the Seventeenth Century (GCSC) in Europe, which was marked by widespread economic distress, social unrest, and population decline. The researchers examined linkages between temperature data and climate-driven economic variables that defined the "golden" and "dark" ages in Europe and North America.

Zhang *et al.* demonstrated that "climate change was the ultimate cause, and climate-driven economic downturn was the direct cause, of large-scale human crises in pre-industrial Europe and the Northern Hemisphere." In addition, they say it was *cooling* that triggered the chain of negative responses in variables pertaining to physical and human systems. Initially, for example, they found agricultural production "decreased or stagnated in a cold climate and increased rapidly in a mild climate at the multi-decadal timescale," while the time course of crisis development was such that "bio-productivity, agricultural production and food supply per capita (FSPC) sectors responded to temperature change immediately, whereas the social disturbance, war, migration, nutritional status, epidemics, famine and population sectors responded to the drop in FSPC with a 5- to 30-year time lag." Thus, the dark ages they delineated by these means were AD 1212–1381 (the Crisis of Late Middle Ages) and AD 1568–1665 (the GCSC), whereas the golden ages were the tenth to twelfth centuries (the High Middle Ages), the late fourteenth to early sixteenth centuries (the Renaissance), and the late seventeenth to eighteenth centuries (the Enlightenment). It thus can be concluded from several centuries of European and Northern Hemispheric data that warming and warmth beget human wellness, while cooling and cold produce human misery.

Cleaveland *et al.* (2003) developed a history of winter–spring (November–March) precipitation for the period 1386–1993 for the area around Durango, Mexico, based on earlywood width chronologies of Douglas-fir tree rings collected at two sites in the Sierra Madre Occidental. This reconstruction, in their words, "shows droughts of greater magnitude and longer duration than the worst historical drought," and none of them occurred during a period of unusual warmth, as some researchers claim they should; instead, they occurred during the Little Ice Age. They also note, "Florescano *et al.* (1995) make a connection between drought, food scarcity, social upheaval and political instability, especially in the revolutions of 1810 and 1910," and they note the great megadrought that lasted from 1540 to 1579 "may be related to the Chicimeca war (Stahle *et al.*, 2000), the most protracted and bitterly fought of the many conflicts of natives with the Spanish settlers." If these concurrent events were indeed related, they too suggest warmer is better than cooler for maintaining social stability.

Working in East Africa, Nicholson and Yin (2001) analyzed climatic and hydrologic conditions from the late 1700s to close to the present, based on histories of the levels of 10 major African lakes and a water balance model they used to infer changes in rainfall associated with the different conditions, concentrating on Lake Victoria. The results they obtained were indicative of "two starkly contrasting climatic episodes." The first, which began sometime prior to 1800 during the Little Ice Age, was one of "drought and desiccation throughout Africa." This arid episode, which was most intense during the 1820s and 1830s, was accompanied by extremely low lake levels. As the two researchers describe it, "Lake Naivash was reduced to a puddle. ... Lake Chad was desiccated. ... Lake Malawi was so low that local inhabitants traversed dry land where a deep lake now resides. ... Lake Rukwa [was] completely desiccated. ... Lake Chilwa, at its southern end, was very low and nearby Lake Chiuta almost dried up."

Nicholson and Yin state that throughout this period "intense droughts were ubiquitous." Some, in fact, were "long and severe enough to force the migration of peoples and create warfare among various tribes." As the Little Ice Age's grip on the world began to loosen in the middle to latter part of the 1800s, however, things began to change for the better. The two researchers report, "semi-arid regions of Mauritania and Mali experienced agricultural prosperity and abundant harvests; floods of the Niger and Senegal Rivers were continually high; and wheat was grown in and exported from the Niger Bend region." Then, as the nineteenth century came to an end and the twentieth began, there was a slight lowering of lake levels, but nothing like what had occurred a century earlier; and in the latter half of the twentieth century, things once again improved, with the levels of some lakes rivaling high water characteristic of the years of transition to the Modern Warm Period.

According to Benjaminsen *et al.* (2012), "during the last few years, violent land-use conflict in the Sahel has become the most popular example of the alleged link between global climate change and conflict," noting "many politicians and international civil servants seem particularly attracted to this idea," as described in the study of Benjaminsen (2009).

They indicate this idea "was also at the core of the decision to award the 2007 Nobel Peace Prize to former US vice-president Al Gore and the Intergovernmental Panel on Climate Change (IPCC)."

Focusing on an area in the heart of the Sahel (the inland delta of the Niger River in the Mopti region of Mali), Benjaminsen *et al.* collected from the regional Court of Appeal in Mopti data on land-use conflicts that occurred within that region between 1992 and 2009, after which they compared the court data with contemporaneous climatic data. They also conducted a qualitative analysis of one of the many land-use conflicts in the region: a farmer-herder conflict, where young men from the village of Karbaye fired on a group of herders from the neighboring village of Guirowel, who were bringing livestock to a pond close to their homes, killing as many as five of them and injuring some 15 to 30 others.

With respect to the findings of the initial thrust of their study, the four Norwegian researchers found "a comparison of the conflict data with statistics on contemporaneous climatic conditions gives little substance to claims that climate variability is an important driver of these conflicts." And they go on to say they "interpret this finding as indicative evidence that land-use conflicts in the delta region are shaped by political and economic texts (e.g., confidence in the judicial system, economic opportunities, and learning) rather than climate variability." As for the second part of their study, they also conclude "factors other than those directly related to environmental conditions and resource scarcity dominate as plausible explanations of the violent conflict," arguing "three structural factors are the main drivers behind these conflicts: agricultural encroachment that obstructed the mobility of herders and livestock, opportunistic behavior of rural actors as a consequence of an increasing political vacuum, and corruption and rent seeking among government officials."

The findings of Benjaminsen *et al.*, and those of many others whom they cite (Grandin, 1987; Bassett, 1988; Ellis and Swift, 1988; Bonfiglioli and Watson, 1992; Behnke *et al.*, 1993; Turner, 1998, 2004; Hagberg, 2005; Hesse and MacGregor, 2006; Moritz, 2006; Nordås and Gleditsch, 2007; Benjaminsen, 2008; Benjaminsen *et al.*, 2009; Benjaminsen and Ba, 2009), give further credence to the conclusion of Nordås and Gleditsch (2007) that even the IPCC, which "prides itself on being a synthesis of the best peer-reviewed science, has fallen prey to relying on second- or third-hand information with little empirical backing when commenting on the implications of climate change for conflict." Real-world evidence for their climate-change-causes-conflict claim is just not there – at least in the case where the climate change involves warming.

In another study from Africa, O'Loughlin *et al.* (2014) write, "continued public and academic interest in the topic of global climate change consequences for political instability and the risk of conflict has generated a growing but inconclusive literature, especially about the effects in sub-Saharan Africa." They note many of the studies supporting that hypothesis "do not elaborate on nor test the causal mechanisms." So "using a new disaggregated dataset of violence and climate anomaly measures (temperature and precipitation variations from normal) for sub-Saharan Africa 1980–2012, we consider political, economic and geographic factors, not only climate metrics, in assessing the chances of increased violence."

O'Loughlin *et al.* found "the location and timing of violence are influenced less by climate anomalies than by key political, economic and geographic factors," such that "overall, the temperature effect is statistically significant, but important inconsistencies in the relationship between temperature extremes and conflict are evident in more nuanced relationships than have been previously identified." They cite several independent studies that reached a similar conclusion, including those of Buhaug (2010), Bergholt and Lujala (2012), Koubi *et al.* (2012), Raleigh and Kniveton (2012), and Wischnath and Buhaug (2014).

Field and Lape (2010) note it has been repeatedly suggested that in many parts of the world climate change has "encouraged conflict and territorialism," as this response "serves as an immediate means of gaining resources and alleviating shortfalls," such as those that occur when the climate change is detrimental to agriculture and the production of food. To investigate this hypothesis, they compared "periods of cooling and warming related to hemispheric-level transitions (namely the Medieval Warm Period and the Little Ice Age) in sub-regions of the Pacific with the occurrence of fortifications at the century-level." Their study revealed "the comparison of fortification chronologies with paleoclimatic data indicate that fortification construction was significantly correlated with periods of cooling, which in the tropical Pacific is also associated with drying." In addition, "the correlation was most significant in the Indo-Pacific Warm Pool, the Southwestern Pacific and New Zealand," where

"people constructed more fortifications during periods that match the chronology for the Little Ice Age (AD 1450–1850)," as opposed to the Medieval Warm Period (AD 800–1300) when the Indo-Pacific Warm Pool was both warm and saline "with temperatures approximating current conditions (Newton *et al.*, 2006)." Field and Lape's study provides additional evidence that periods of greater warmth have generally led to more peaceful times throughout the world, whereas periods of lesser warmth have typically led to greater warfare.

Zhang *et al.* (2011b) note it has long been assumed that "deteriorating climate" – defined as either cooling or warming – "could shrink the carrying capacity of agrarian lands, depriving the human population of sufficient food," with "population collapses (i.e., negative population growth)" the unavoidable consequence. They further note "this human-ecological relationship has rarely been verified scientifically," pointing out that at the high end of the temperature spectrum, "evidence of warming-caused disaster has never been found."

Zhang *et al.* performed time-series analyses to examine the association between temperature change and country-wide/region-wide population collapses in different climatic zones of the Northern Hemisphere (NH), focusing on all known population collapses over the period AD 800–1900. In addition, they computed regressions to estimate the relative sensitivity of population growth in the NH to climate change, where the independent variables employed were time and temperature anomalies. Of the 88 NH population collapses they identified, fully 80% were caused by cooling, while 12% occurred during what the six scientists called "mild conditions," and only 8% of them were caused by warming. They found "temperature was positive and highly significant in the regressions in which a 10 percent increase in temperature produced on average a 3.1 percent increase in population growth rate."

Historically, and for the Northern Hemisphere as a whole, warming and warmer times have most often been prosperous times for humanity, as exemplified by the greater numbers of people the Earth supports under such conditions, while cooling and colder times are typically just the opposite, with many significant population collapses caused by what Zhang *et al.* describe as "Malthusian checks (i.e., famines, wars and epidemics)."

Koubi *et al.* (2012) state "despite many claims by high-ranking policymakers and some scientists that climate change breeds violent conflict, the existing empirical literature has so far not been able to identify a systematic, causal relationship of this kind" – see, for example, Bruckner and Ciccone (2007, 2010), Buhaug (2010), Ciccone (2011), Theisen *et al.* (2011), and Bergholt and Lujala (2012) – which failure "may either reflect de facto absence of such a relationship, or it may be the consequence of theoretical and methodological limitations of existing work." In a study designed to explore these two possibilities, Koubi *et al.* "examine the causal pathway linking climatic conditions to economic growth and to armed conflict," as well as the degree to which this pathway is contingent upon the political systems of the potential conflict participants, using data "from all countries of the world in the period 1980–2004."

Koubi *et al.* say their results suggest "climate variability, measured as deviations in temperature and precipitation from their past, long-run levels (a 30-year moving average), does not affect violent intrastate conflict through economic growth." This finding, in their words, "is important because the causal pathway leading from climate variability via (deteriorating) economic growth to conflict is a key part of most theoretical models of the climate-conflict nexus." They further note there is "some, albeit weak, support for the hypothesis that non-democratic [i.e., 'autocratic'] countries are more likely to experience civil conflict when economic conditions deteriorate," but they add that even this weak connection "is fragile with regard to model specification."

Focusing on nearly the same time period, Bergholt and Lujala (2012) examined "how climate-related natural disasters, including flash floods, surges, cyclones, blizzards, and severe storms, affect economic growth and peace," after which they focused on the question of "whether climate-related disasters have an indirect effect on conflict onset via slowdown in economic growth." They utilized climate-related disaster data for the period 1980–2007 found in the Emergency Events Database developed by the Centre for Research on the Epidemiology of Disasters, economic growth data found in the Penn World Table Version 6.3 (Heston *et al.*, 2009), and armed civil conflict data tabulated in the annually updated UCDP/PRIO Armed Conflict Dataset (Gleditsch *et al.*, 2002; Harbom and Wallensteen, 2010).

In the first stage of their analysis, Bergholt and Lujala found "climate-related disasters have a negative impact on growth," but they say their analysis of disaster data and conflict onset shows "climate-related natural disasters do not have any direct effect on conflict onset." They also report they

"did not find any evidence that economic shocks caused by climate-related disasters have an effect on conflict onset," noting their findings "are similar to those in the recent cross-country study by Ciccone (2011)." They conclude "storms and floods adversely affect people and production inputs such as land, infrastructure, and factories, which in turn have a negative impact on the aggregate economy," but "these negative income shocks do not increase the risk of armed civil conflict as predicted by prominent studies in the field (Collier and Hoeffler, 2004; Fearon and Laitin, 2003; Miguel *et al.*, 2004)."

In another large-scale study, Slettebak (2012) writes, "academic, policy, and popular discussions that surround the issue of climate change predict changing weather patterns to increase natural disasters," and he states that many of the discussants "expect these disasters to increase the risk of violent conflict." In a test of this hypothesis, Slettebak examined "whether natural disasters can add explanatory power to an established model of civil conflict." Results "indicate that they can, but that their effect on conflict is the opposite of popular perception." He explains, "to the extent that climate-related natural disasters affect the risk of conflict, they contribute to reducing it." This result holds "for a measure of climate-related natural disasters in general, as well as drought in particular," adding these findings are "consistent with a large amount of research ... on the relation between disasters and the risk of anti-social behavior," going back to the work of Fritz (1961), which was not made public until some 35 years later (Fritz, 1996).

In commenting on his findings, Slettebak says his primary result "underscores the importance of being cautious about assuming that adversity will automatically translate into increased levels of conflict – a perception that appears frequent among a number of vocal actors in the debate around the political consequences of climate change." Thus he emphasizes "one worrying facet of the claims that environmental factors cause conflict is that they may contribute to directing attention away from more important conflict-promoting factors, such as poor governance and poverty," noting "there is a serious risk of misguided policy to prevent civil conflict if the assumption that disasters have a significant effect on war is allowed to overshadow more important causes."

According to Gartzke (2012), "while anecdote and some focused statistical research suggests that civil conflict may have worsened in response to recent climate change in developing regions, these claims have been severely criticized by other studies," citing Nordås and Gleditsch (2007), Buhaug (2010), and Buhaug *et al.* (2010). In addition, he states "the few long-term macro statistical studies actually find that conflict increases in periods of climatic chill (Zhang *et al.*, 2006, 2007[a]; Tol and Wagner, 2010)." He reports "research on the modern era reveals that interstate conflict has declined in the second half of the 20th century, the very period during which global warming has begun to make itself felt (Goldstein, 2011; Hensel, 2002; Levy *et al.*, 2001; Luard, 1986, 1988; Mueller, 2009; Pinker, 2011; Sarkees *et al.*, 2003)."

Gartzke explored "the relationship between climate change, liberal processes fueled by industrialization (development, democracy, international institutions) and interstate conflict," based on information gleaned from the Correlates of War (COR) Militarized Interstate Dispute (MID) dataset (Gochman and Maoz, 1984; Ghosn *et al.*, 2004) and annual average temperature data provided by NASA's Goddard Institute for Space Studies and the United Kingdom's Meteorological Office Hadley Centre and the Climatic Research Unit of the University of East Anglia, while measures of regime type come from the Polity IV project described by Gurr *et al.* (1989) and Marshall and Jaggers (2002).

"Surprisingly," Gartzke writes, "analysis at the system level suggests that global warming is associated with a reduction in interstate conflict," and "incorporating measures of development, democracy, cross-border trade, and international institutions reveals that systemic trends toward peace are actually best accounted for by the increase in average international income," which in turn is driven by "the processes that are widely seen by experts as responsible for global warming." Furthermore, in the concluding sentence of his paper's abstract Gartzke writes, "ironically, stagnating economic development in middle-income states caused by efforts to combat climate change could actually realize fears of climate-induced warfare." And thus he states in the concluding section of his paper that "we must add to the advantages of economic development that it appears to make countries more peaceful," and we must therefore ask if environmental objectives should be "modified by the prospect that combating climate change could prolong the process of transition from warlike to peaceful polities."

Buhaug *et al*. (2015) note earlier research has suggested there is "a correlational pattern between climate anomalies and violent conflict" due to "drought-induced agricultural shocks and adverse

economic spillover effects as a key causal mechanism linking the two phenomena." They compared half a century of statistics on climate variability, food production, and political violence across Sub-Saharan Africa, which effort "offers the most precise and theoretically consistent empirical assessment to date of the purported indirect relationship." Their analysis "reveals a robust link between weather patterns and food production where more rainfall generally is associated with higher yields." However, they also report "the second step in the causal model is not supported," noting "agricultural output and violent conflict are only weakly and inconsistently connected, even in the specific contexts where production shocks are believed to have particularly devastating social consequences," which leads them to suggest "the wider socioeconomic and political context is much more important than drought and crop failures in explaining violent conflict in contemporary Africa."

Buhaug *et al*. continue, "social protest and rebellion during times of food price spikes may be better understood as reactions to poor and unjust government policies, corruption, repression and market failure," citing the studies of Bush (2010), Buhaug and Urdal (2013), Sneyd *et al*. (2013), and Chenoweth and Ulfelder (2015). They note that even the IPCC's Fifth Assessment Report concludes "it is *likely* that socioeconomic and technological trends, including changes in institutions and policies, will remain a relatively stronger driver of food security over the next few decades than climate change," citing Porter *et al*. (2014).

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7.5 Conclusion

The IPCC relies on second- or third-hand information with little empirical backing when commenting on the implications of climate change for conflict.

This chapter makes a strong case that citizens and many policymakers around the world have been misled into believing the use of fossil fuels poses a threat to their security. The truth is just the opposite: The prosperity fossil fuels make possible, including helping produce sufficient food for a growing global population, is a major reason the world is safer today than ever before. And since prosperity is closely correlated with democracy, and democracies have lower rates of violence and go to war less frequently than any other form of government, it follows that fossil fuels contribute to human security by making the spread of democracy possible.

Some commentators set against this record of achievement the cost of wars "fought for oil" in the Middle East. While it is true that the presence in that region of troops from the United States and other nations has sometimes been justified by the desire to keep oil flowing from the region, those conflicts have origins and justifications unrelated to oil. The extraordinarily high cost of fighting those wars – in lost lives as well as the trillions of dollars spent on arms, equipment, and logistics – far exceed whatever benefits might have been obtained by keeping the global price of oil low, and likely did not even succeed in achieving that.

The IPCC claims climate change threatens "the vital core of human lives" in multiple ways, many of them unquantifiable, unproven, and uncertain. The narrative in Chapter 12 of the Working Group II contribution to the Fifth Assessment Report illustrates how the IPCC misuses language to hide uncertainty and exaggerate risks. The alleged threats to human security due to "deprivation of basic needs" are speculative, not supported by real-world evidence, and contradicted by the IPCC's own survey of the economic literature. Alleged threats to agriculture and food security are contradicted by biological science and empirical data regarding crop yields and human hunger. Alleged threats to human capital – human health, education, and longevity –

are almost entirely speculative and undocumented. There is no evidence global warming has eroded or will erode livelihoods or human progress.

Even though the IPCC is often cited as the scientific basis for the claim that climate change increases the risk of violent conflicts around the world, its reports express deep uncertainty over the matter. Recall the admission in Chapter 18 of the Working Group II contribution to AR5, on "Detection and Attribution of Observed Impacts," that "both the detection of a climate change effect and an assessment of the importance of its role can be made only with *low confidence* owing to limitations on both historical understanding and data" (IPCC, 2014, p. 1001). But the IPCC's spokespersons rarely mention these doubts and they may have been inconvenient truths for the politicians, interest groups, and journalists who have done so much to confuse the public.

While some politicians and the news media profess absolute certainty that global warming increases the risk of warfare, the academic community has produce extensive research pointing in the opposite direction. Empirical research shows no direct association between climate change and armed conflicts. The climate-conflict hypothesis is an argument linked together in a chain, and if any one of these links is disproven, the hypothesis is invalidated. The academic literature on the relationship between climate and social conflict reveals at least six methodological problems affecting efforts to connect the two.

The IPCC relies on second- or third-hand information with little empirical backing when commenting on the implications of climate change for conflict. Real-world evidence demonstrates warmer weather is closely associated with peace and prosperity, and cooler weather with war and poverty. A warmer world, should it occur, is therefore more likely to bring about peace and prosperity than war and poverty.

When Harvard archaeologist and history of war expert Steven LeBlanc looked to the future, he concluded "the decline in warfare among those countries is incredibly strong" and "for the first time in history, technology and science enable us to understand Earth's ecology and our impact on it, to control population growth, and to increase the carrying capacity in ways never before imagined. The opportunity for humans to live in long term balance with nature is within our grasp if we do it right" (LeBlanc and Register, 2003, p. 229).

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