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Hot and Violent

Researchers have begun to understand the economic and social damage caused by climate change.

By David Rotman [<http://www.technologyreview.com/contributor/david-rotman/>] n

No one knows how climate change will transform our lives. Not only is it uncertain how much elevated levels of carbon dioxide in the atmosphere will raise temperatures and affect precipitation in different parts of the world, but there remains much to learn about how these changes will reduce agricultural productivity, damage human health, and affect economic growth. In addition to these worrisome unknowns is a question that provokes even deeper anxiety: could the damage wrought by climate change, or even the threat of it, lead to a far more violent world?

In *Black Earth: The Holocaust as History and Warning*, Timothy Snyder argues that such fears have historical justification. A Yale University professor and a prominent scholar of the Holocaust, Snyder describes Hitler as driven by a twisted ecological panic that the German people would not have enough land to grow the food they needed. To Hitler, he writes, “ecology was scarcity, and existence meant a struggle for land.” Hitler particularly lusted after the fertile lands of Ukraine. In fact, Germany was not in danger of starving, and Snyder points out that many of the agricultural improvements that would later produce the Green Revolution were already under way. But Hitler, Snyder explains, did not

believe technology was capable of significantly increasing agricultural output; indeed, he rejected the idea that science in general could disrupt the racial struggle for survival he perceived.

Much of *Black Earth* is a description of how Germany ruthlessly destroyed neighboring countries and their political institutions, leading to the mass murder of Jews in those regions. But then, in the conclusion, Snyder makes a disturbing “warning” based on the lessons of the Holocaust. As the benefits of the Green Revolution peter out and the risks of climate change increase, he suggests, we are once again becoming vulnerable to fears of food insecurity—and, thus, once again in danger of battling over agricultural lands. “Another moment of choice, a bit like the one Germany faced in the 1930s, could be on the way,” Snyder writes. He adds: “We have changed less than we think.”

“It will be the largest redistribution of wealth from the poor to the wealthy in history.”

Snyder argues that the changing climate has already played a role in conflicts in Africa, such as the civil war in Sudan that began in 2003. But his real fears are for the future. China, he points out, is unable to feed

itself with domestic agricultural production, and many of its people have personally faced the terror of starvation: the famine caused by Mao's Great Leap Forward between 1958 and 1962 killed tens of millions. Much as Germany in the 1930s envied the agricultural resources of Eastern Europe, China is increasingly attempting to control those of Africa and eyeing the vast resources of its neighbor Russia, says Snyder.

Invoking the haunting evils of Nazi Germany to warn of future dangers ignores the unique perversion of Hitler's thinking. And, as Snyder readily acknowledges, China is not Nazi Germany; its rulers have embraced science and technology in addressing climate change. Nevertheless, Snyder's fundamental point remains: climate change—even the prospect of it—has the power to grotesquely transform global politics. And if history is any guide, governments and rulers may not respond to the threats in a rational manner.

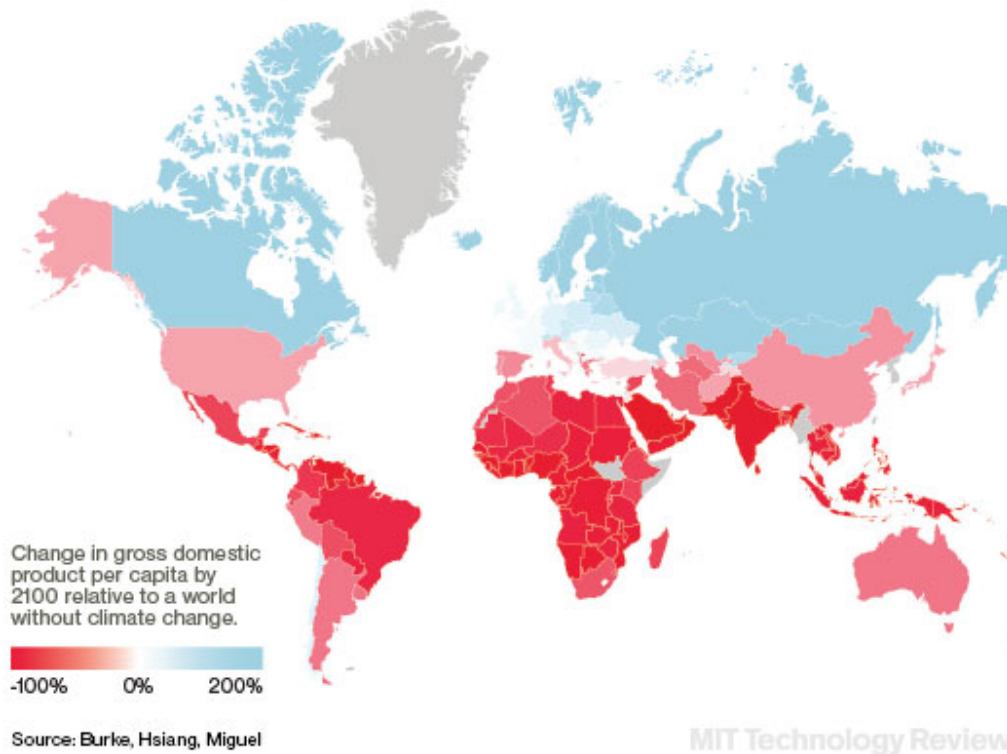
Syria and the Mideast

The suspicion that climate change will contribute to conflict is not new. - Nicholas Stern, a former chief economist of the World Bank and advisor to the British government, predicted in his 2006 report "Economics of Climate Change" that "higher temperatures will increase the chance of triggering abrupt and large-scale changes that lead to regional disruption, migration and conflict." Over the last decade, many researchers have tried to document the connection.

In 2011, Solomon Hsiang, then at Princeton and now a professor at the Goldman School of Public Policy at the University of California, Berkeley, coauthored a paper showing that instances of civil war doubled in the tropics during times when the El Niño effect produced unusually warm temperatures at those latitudes. The paper was the first to demonstrate that a global climate effect could be linked to conflict. A few years later, Hsiang and his colleagues at Berkeley and Stanford analyzed the growing literature on climate and conflict and found a consistent result in 60 research papers: rising temperatures and changes in precipitation patterns increased the risk of conflicts. Not only is there evidence that climate is connected to conflict, says his coauthor Marshall Burke, a Stanford professor, but the effects can be substantial. He says, “In sub-Saharan Africa, when temperatures are a degree warmer, we see 20 to 30 percent increase in civil conflict. That’s a huge number.”

The Unequal Effects of Climate Change in 2100

If global warming is largely unchecked, it will severely damage the economic productivity of many countries, particularly those in Africa, Asia, and South America. Colder countries, such as Russia and Canada, could benefit.



One explanation might lie in the way climate changes affect agriculture. Take the war in Syria, for example. Beginning in the winter of 2006-2007, the Fertile Crescent, which runs across northern Syria and provides the country with much of its food, experienced a three-year drought that was the most severe on record. It prompted as many as 1.5 million people to migrate to the country's urban centers. These formerly rural people joined more than a million refugees from Iraq's war of the mid-2000s, who were already living in the areas surrounding Syria's cities. There, growing crime, inadequate infrastructure, overcrowding, and a lack of response from the government all contributed to unrest. Widespread uprisings in these urban outposts quickly spun into today's civil war, which began in early 2011.

Climate change made the drought far more severe, and the subsequent widespread crop failure and resulting mass migration contributed to the

conflict, says Colin Kelley, a climate scientist at the University of California, Santa Barbara, who has specialized in the Mediterranean region. In a recent paper, Kelley and his coauthors document how rising levels of greenhouse gases disrupted the normal patterns of wind that bring moisture from the Mediterranean during the winter rainy season. It's part of a long-term drying effect in the region and consistent with predictions from climate-change models, he says. In general, he adds, subtropical regions around the world, such as the Fertile Crescent, are expected to become more arid.

Some political scientists aren't convinced that such climate effects trigger wars. "There is more that we don't know than what we do know, but we do know there is no general and

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BY MARSHALL BURKE, SOLOMON M.

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NATURE, VOL. 527, 235-239

climate variability and large-scale organized wars,” says Halvard Buhaug of the Peace Research Institute Oslo in Norway. Still, Buhaug does say it “makes sense” that climate change might exacerbate the main causes of civil war, which he says include systemic inequality, severe poverty, and poor governance. “If climate change affects groups in society differently or presents challenges too severe or too great for political systems to respond,” he says, “then of course climate change might contribute to more instability in the future.”

The relative importance of the drought in causing the Syrian war is very difficult to untangle from the other factors, Kelley acknowledges. But, he says, determining the specific role of climate is not merely an academic question, especially in regions as volatile as the Middle East. “Who’s next?” he asks. “What countries will climate change push over the edge?”

CostsThe research on the links between climate change and conflict is part of a larger effort to better understand the economic and social impact that rising temperatures will have on people in various parts of the world. The effort is designed to improve on previous analyses that often involved crude back-of-the-envelope calculations of impacts averaged over large areas. “Until a few years ago,” says Berkeley’s Hsiang, “we really had no idea what was coming down the road.”

In an attempt to make economic forecasts more rigorous, Hsiang and his

colleagues, who include climate scientists and social scientists, have looked at how temperature has affected labor productivity and agriculture in different countries over the years. In a paper published this fall in *Nature*, the group examined how yearly changes in temperature affected economic output in 160 countries between 1960 and 2010. Then they combined the data with climate-change models developed by dozens of teams around the world that predict how temperatures will change with global warming. The result is a projection of economic growth throughout the next century.

The findings are disturbing. The scientists expect that if climate change continues largely unabated, global economic output will drop 23 percent by century's end, a much higher cost than previously predicted. The researchers found that economic output universally declines as average yearly temperatures rise above 13 °C; labor performance, productivity, and agriculture output begin dropping as temperatures increase. Surprisingly, the drop after 13 °C is seen in both rich and poor countries, regardless of whether the economy was dependent on agriculture or nonagricultural industrial sectors.


But perhaps the most shocking finding is just how uneven the impacts will be. Since poorer countries already tend to be hotter, they will feel the brunt of the damage. While the economies of China, India, and much of South America suffer, those of Western Europe, Russia, and Canada could actually benefit. "It would be the largest redistribution of wealth from the poor to the wealthy in history," Hsiang says. "It's incredibly regressive."

populations respond to this growing wealth inequality could be the most Snyder reminds us how badly things can go if politicians and rulers prey on people.

One of the most powerful lessons from Hitler's regime has to do with, as Snyder puts it, "conflating science with politics." Rightly, he points an accusing finger at climate-change deniers motivated by political ideology. Likewise, he might have cited those on the other end of the political spectrum who turn their backs on technology and science, rejecting options such as nuclear power and genetic advances in agriculture that could help lessen the impact of climate change. Rather, he argues, policy decisions must be informed by objective scientific results.

Despite all the uncertainties about the future of climate change, the science is clear on a few basic points. We must move as quickly as possible to transform our energy infrastructure so that we can reduce carbon emissions and, by around midcentury, essentially stop such pollution altogether. But the science is also beginning to tell us that even radical steps to curb emissions may not be enough. The damage from climate change is already beginning to hurt people in many parts of the world and will escalate even if emissions begin to drop soon. It's time we figured out how to adapt. And that's where the recent research clarifying the social and economic costs could help. "The climate is going to change," says Hsiang. "We need to figure out how to minimize the losses."

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