SPOTLIGHT 5.4

Policymaking for sustainable development 2.0

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As policymakers around the world strive for global sustainability, research in support of this goal is racing ahead, driven by new and exciting innovations. Advances in data collection and computing capabilities and the integration of science with economics are transforming how we think about managing the planet.

A key step is to focus our attention on critical sustainability issues rather than trying to answer interesting but impractical questions. A large body of research has focused on pricing the total annual value produced by the world's natural systems—for example, how much the world values the totality of global rainforests or all biodiversity on the planet (see also chapter 7 and spotlight 7.3).[1] These tasks are both ambitious and inspiring, but they are almost impossible, from both a practical and a theoretical standpoint—and more important, they are unnecessary for guiding the world towards achieving sustainability.

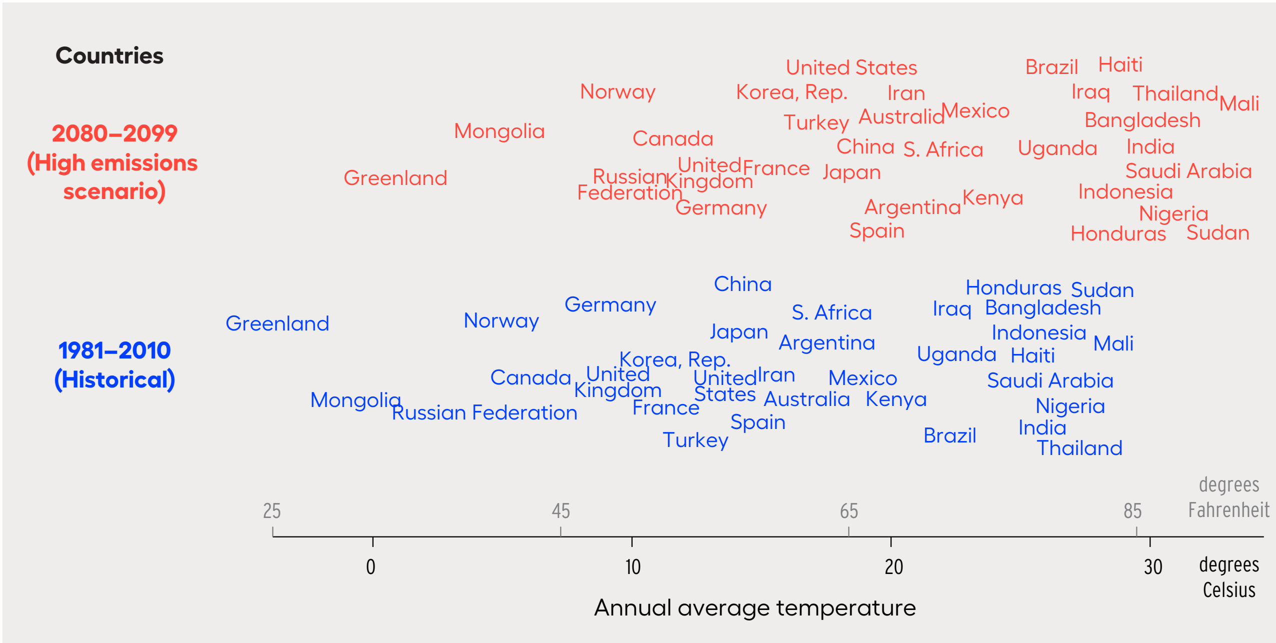
What is essential for achieving sustainability is properly valuing natural resource assets that might be affected by decisions today. In the language of economics, we need to think about planetary resource management "on the margin." If a resource might be used or polluted by humans, we need to ask whether the benefits of that decision outweigh the costs, both direct and indirect. If we can ensure that we satisfy this sustainability criterion at every decision point, we are guaranteed to achieve long-term sustainability as a global society.[2] In this way achieving sustainability is like following a compass on a journey: Each time you choose a path, if you check that you are traveling north, you are guaranteed to keep moving northward. Similarly, if we ensure that each economic project is increasing the wellbeing of future generations, we will achieve sustainability.

New empirical research is illuminating how environmental conditions affect economic outcomes. If human activities alter the environment, the environment may in turn alter the economy. For example, recent findings illustrate how industrial pollution lowers the productivity of workers,[3] how changes in sunlight—either by pollution or intentional geoengineering—affect crop yields,[4] how living forests increase the value of real estate,[5] how fisheries provide labour opportunities for would-be pirates,[6] how groundwater depletion drives poverty,[7] how windblown dust increases child mortality,[8] how El Niño droughts increase the risk of civil conflict,[9] how rainfall during early life improves women's long-term health outcomes[10] and how hurricanes slow GDP growth.[11] All these data-driven insights result from innovations in how environmental science is integrated with more traditional economic analyses.

Among these findings the role of temperature has stood out as a major environmental factor influencing human development around the world.[12] High temperatures have been found to cause crop failures;[13] increase violence,[14] suicide,[15] all-cause mortality[16] and asylum applications;[17] reduce cognitive performance,[18] learning,[19] industrial productivity[20] and economic growth;[21] and strain the basic functioning of governance systems[22] and infrastructure.[23] Taken together, this collection of findings suggests that climate change, through its direct effect on increasing temperature alone, may be a major obstacle to future development. For context, in a high greenhouse gas emissions scenario, temperatures are projected to climb to unprecedented levels throughout the developing world by the end of the century, with future Mexico hotter than historical Iraq and future Bangladesh hotter than historical Mali (figure S5.4.1). Future Sudan will be so hot that there is no historical country it can be compared to. Figure S5.4.2 depicts the projected global mortality consequences of this warming.

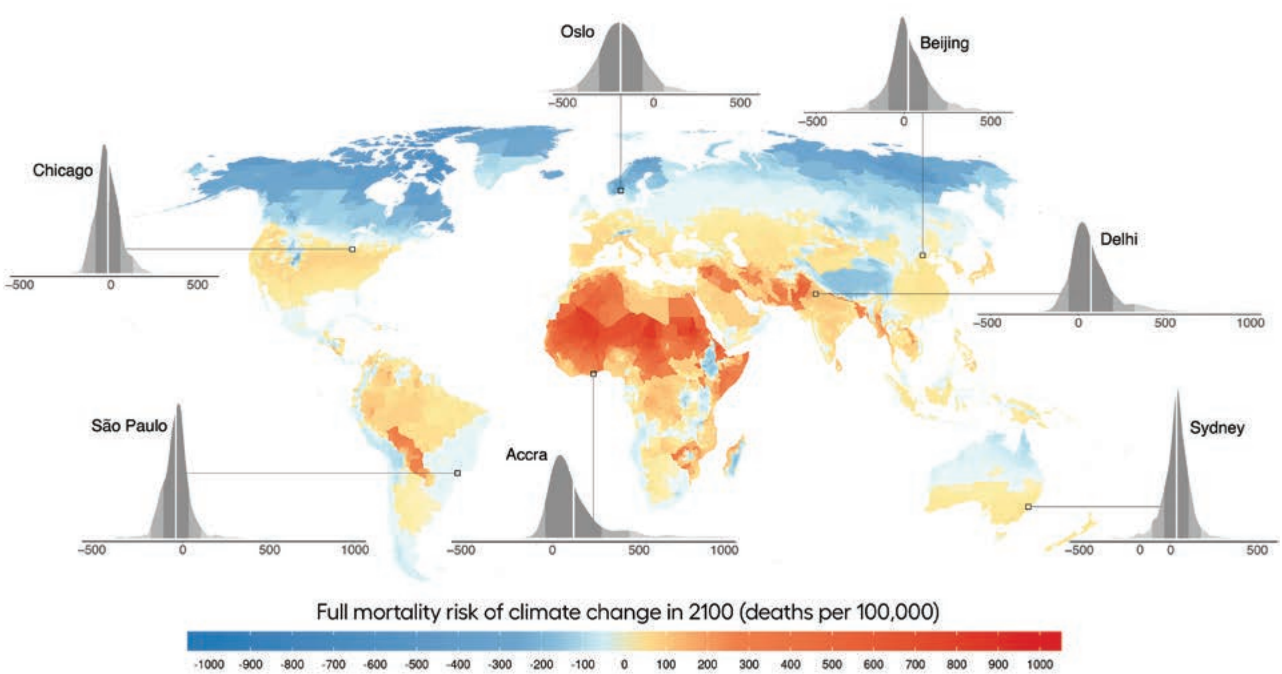
The explosion of empirical findings have raced ahead of our theoretical understanding of how

Figure S5.4.1 In a high greenhouse gas emissions scenario, temperatures are projected to climb to unprecedented levels throughout the developing world by the end of the century



Source: Reproduced from Hsiang and Kopp (2018).

Figure S5.4.2 Average mortality risk due to climate change in 2100, accounting for both the costs and the benefits of adaptation



Note: Density plots for select regions indicate the full probabilistic distribution of estimated impacts across simulations.
Source: Reproduced from Carleton and others (2020).

environmental changes should be integrated into development planning and economic decisionmaking. Achieving the sustainability criterion means that the human influence on these numerous environmental conditions, and their subsequent impact on wellbeing, should be accounted for in major projects. Researchers are now developing the methods necessary to "price" these externalities using the rapidly growing body of empirical findings, so that these impacts can be easily integrated into decisionmaking.[24] This pricing effort allows decisionmakers to explicitly weigh these externalities against the benefits of development projects, provided those benefits are also monetized. These approaches can be further adjusted to account for the unequal costs and benefits of different projects, incorporating equity and justice.[25] Furthermore, as new links are uncovered, our ability to account for the multidimensional impact of environmental changes will strengthen.

The final piece of the puzzle is monitoring how human actions are altering the environment around the world in real time, so that the impacts can be fully accounted for. At present the global community has no system for measuring the comprehensive wealth of countries—that is, tracking changes to environmental assets alongside humanmade assets—so even if we were achieving the sustainability criterion, we would not know. Developing such a system is a major challenge, but it is an essential step towards building global institutions that can account for global environmental changes while balancing the economic interests of current and future generations.

The dual obstacles to assembling such a system are that it must be sensitive and granular enough that small and local environmental changes can be detected but comprehensive enough in both scale and scope that it meaningfully captures the extent of environmental changes that could threaten future human wellbeing. For this task, innovations in machine learning are likely to be a game changer, enabling automated systems to sift through vast quantities of unstructured data to develop structured measurements that are environmentally and economically relevant. For example, applying machine learning to satellite imagery has been fruitful for gathering development-related metrics over large regions,[26] and recent advances suggest that these approaches could be extended to study many environmental and development outcomes simultaneously using current satellite systems.[27]

Just as integrating environmental science with economics revolutionized our understanding of environmental impacts, integrating machine learning will likely revolutionize real-time monitoring of global environmental systems. Together, these elements will empower decisionmakers to integrate the sustainability criterion into their everyday decisionmaking, guiding us towards true sustainable development.

NOTES

1 For example, Costanza and others (1997).
2 Dasgupta 2009; Hartwick 1977; Solow 1986.
3 Graff Zivin and Neidell 2012.
4 Burney and Ramanathan, 2014; Proctor and others 2018.
5 Druckenmiller 2020.
6 Axbard 2016.
7 Blakeslee and others 2020.
8 Heft-Neal and others 2020.
9 Hsiang and others 2011.
10 Maccini and Yang 2009.
11 Hsiang and Jina 2014.
12 Carleton and Hsiang 2016.
13 Schlenker and Lobell 2010.
14 Hsiang and others 2013.
15 Burke and others 2018; Carleton 2017.
16 Carleton and others 2020.,
17 Missirian and Schlenker 2017.
18 Graff Zivin and others 2018.
19 Fishman and others 2019; Park and others 2020.
20 Zhang and others 2018.
21 Burke and others 2015; Hsiang 2010.
22 See Obradovich and others (2018) for an analysis of both extremely hot and cold temperatures
23 See Aufhammer and others (2017) for the case of electricity infrastructure.
24 Bell and others 2020; Carleton and others 2020; Deryugina and Hsiang 2017; Fenichel and Abbott 2014; Hsiang and others 2017; Muller and others 2011.
25 For example, Anthoff and others (2009), Hsiang and others (2017) and Hsiang and others (2019).
26 Blumenstock 2018; Burke and others 2020.
27 Rolf and others 2020.