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GLOBAL TRENDS

Brave New World?

High Hopes for Data-Driven Governance
David Chandler

The Looming Robot Wars
Michael T. Klare

Big Tech's Dubious Bargains
Mary F. E. Ebeling

Planetary Negligence

The Climate Crisis Deepens
Pamela McElwee

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January 2020 Vol. 119, No. 813

CONTENTS

CURRENT HISTORY

January 2020

"Data-driven governance assumes the need for constant adaptation to change."

The Rise of Data-Driven Governance

DAVID CHANDLER

The world appears to be overflowing with data, thanks to rapid developments in technology over the past ten to fifteen years. It is increasingly argued that data-driven knowledge is capable of changing the ways in which we understand the world as well as the ways in which the world can be governed. This essay is not about the governance of data—concerns over privacy, data protection and management, and so forth—but about how new forms of data collection and analysis are being touted as a means of doing governance differently.

Ways of Governing
Fourth in a series

Advocates of data-driven governance assert that we are in the midst of a knowledge revolution, promising to displace traditional or "top-down" focuses on causal analysis and theory. Data-driven governance is not so much about knowing more, they say; it is a way of responding to problems more efficiently and effectively. The availability of vast amounts of digitally generated data, also known as big data, and the development of computational algorithms to analyze it, enables new ways of empowering communities to address problems at the source.

In international governance, data-led approaches are said to have the potential to build self-governing societal capacities for resilience and adaptation. Through real-time reflexive awareness, advocates claim, risks and problems can be managed as soon as they arise. In the international arena, this can be seen particularly in ambitions for the prevention of—and speedy responses to—disaster, conflict, and health and environmental problems.

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In 2009, the United Nations renamed Natural Disaster Day (October 12) as Disaster Day—to make the point that disasters do not just happen naturally but are the result of how communities and individuals respond to the early signs of external crises. Rapid responses can mitigate the impact of disasters or even prevent them entirely. Data-driven governance, supporters say, has the ability to see problems or crises as they emerge, rather than merely reacting after an event is over and the damage is done. It is closely linked to new approaches to resilience, adaptation, and vulnerability. For example, the UN Sustainable Development Goals report for 2019 highlights the importance of data collection and dissemination.

The prospect of data-intensive knowledge production informing decision-making in such areas has been welcomed in the world of international policymaking. High-level collaborative initiatives include Global Pulse, established by the UN secretary-general to research and coordinate the use of big data for development; the World Bank's Open Data for Resilience program, which seeks to monitor the emergence of natural hazards and the impacts of climate change in real time; and initiatives on big data and community resilience funded by the Rockefeller Foundation. These are just a few examples of the growing importance and rapid development of data-driven governance, especially in the fields of disaster risk reduction, peacebuilding, and resilience.

As data-driven governance has become increasingly central to policy thinking, critics have raised concerns regarding privacy and data ownership. They also argue that focusing on the effects of problems like climate change rather than tackling long-term causes tends to lower political horizons. And the burden of adaptation is often placed on

marginal or vulnerable communities and individuals who are already coping on the edge of crisis.

SELF-GOVERNING COMMUNITIES

Failures of centralized and bureaucratized forms of international intervention to address questions of peace, conflict, rights, and development have led to the promotion of data-driven approaches as an effective and ethical substitute for traditional forms of global governance, which are seen as too slow, too unwieldy, and too reductionist to adequately engage with the complex reality of the world. Data-driven governance has emerged as a tool for problem-solving through community empowerment and capacity-building. The idea is that harnessing data can allow local communities and civil societies to generate their own knowledge of themselves and to act on it accordingly.

The context-specific nature of self-generated data can enable local communities to be proactive in their own governance—for example, in the ability to measure energy consumption down to the level of individuals and households, or in local tracking of environmental data such as pollution, river levels, and land use changes. This kind of data is seen as the key to empowering people in new ways and at the most local levels.

In fields such as disaster risk reduction and disaster management, the shift is already clear. Data potentially can empower precisely those who are most marginal and vulnerable at their moments of highest risk. Open information flows contribute to the building of resilience by making communities aware of the risks and hazards they may encounter so that they can mobilize to protect themselves. Disasters, conflicts, and other problems are being reinterpreted as problems of data access and of knowledge or communication breakdowns within communities. Policymakers argue that at-risk communities need data just as much as they need water, food and medicine, or shelter.

Proponents of this approach increasingly argue that data should not be used by communities merely in response to disasters but could play a more preventive or mitigating role. In their view, data-driven governance enables adaptive capacity. Data can now be context-dependent, reflecting local knowledge and generated in real time; it can be used "in the now" rather than just for analyzing a disaster after the event. Thus the generation and use of data are increasingly combined. International agencies are promoting the use of crowdsourced data for preventing disasters.

In these visions, data collection becomes a technique of governing through the inculcation of self-knowledge. Data-driven governance aspires to remove the need for governing on the basis of abstract or "top-down" rules and laws; it seeks to displace them with real-time feedback mechanisms based on new forms of data-rich awareness. Advocates believe data-driven governance holds the potential to transform reality by providing communities with self-knowledge.

JAKARTA EXPERIMENTS

Indonesia offers one example of how data-driven governance seeks to redistribute governing responsibility down to the community level. The Indonesian state has prioritized disaster risk reduction since the 2004 Indian Ocean tsunami, which killed more than 100,000 people in the city of Banda Aceh on the northern tip of Sumatra.

The capital, Jakarta, has been at the center of climate change and disaster risk concerns. The ever-expanding megacity is rapidly approaching ecological catastrophe. The problem of securing the city against rising water levels (the combined threat from rainfall, river turbulence, and rising sea levels) has exposed the limits of structural engineering projects, creating an opening for new ideas that no longer rely on traditional approaches to flood prevention. Instead, advocates of data-driven governance seek to rethink ways of living with security threats and use new technologies to engage with and transform citizen awareness.

The Jakarta Open Street Map project organizes volunteers to create a free and open map for community development and disaster response. Its leaders see mapping as an ongoing process shared by citizens. In this way, rather than being the province of "armchair" mappers from outside the community who rely on drone cameras, mapping becomes a local project. The information mapped has special value in the specific context in which it is generated. Local people can identify objects, sites, and related facts that could be important in disaster situations (such as opening times or access points) in a fine-grained perspective that would be impossible for outsiders to match. The categories used to describe or to classify sites and objects are not always readily transferable—for example, the use of street classifications in Western Europe would be of little use to a street mapper in many parts of Africa or Asia. Mapping is no longer a one-off project but an ongoing process; maps have to be continually updated to include changes in site use and availability.

One emerging strand of data-driven governance seeks to magnify or intensify this participatory mapping approach. A leading example of this new methodology, also in Indonesia, is PetaJakarta, an international research project that aims to use social media for real-time mapping of flooding in Jakarta. This collaboration among the University of Wollongong in Australia, the Jakarta Emergency Management Agency, and Twitter aims to facilitate what it calls "geo-social forms of collective intelligence."

From the data governance perspective, the population of a major city is a resource in need of mobilization. Residents are already extensively networked through social media—they could generate more useful data themselves. Geospatial tagging of the precise time and location of their posts enables others to check and compare information from multiple sources and makes verification much easier. Social media can be reconfigured with humanitarian apps to activate these elements.

Different problems can be used to construct engaged and active communities able to play a role in addressing those issues as a form of "civic co-management," as the PetaJakarta coordinator said in an interview. The development of civic communication technologies could amplify the collective networked social intelligence of the city. Such technologies are being bankrolled and tested for responding to disasters and emergencies, but some hope that this could be the beginning of new forms of geo-social networked systems that would make possible much more participatory and democratic forms of real-time governance.

Data-driven governance seeks to mobilize the power of the geo-socially networked citizen.

These are seen as citizen-led data initiatives, in which local knowledge and ownership is vital for the development of civic apps that help people deal with problems from flooding to crime hotspots. Such data-driven governance approaches are hailed as self-transformative initiatives, generating not just information to be used by others but a different form of politics—"to enable people to think differently and thus to feel differently," in the words of the PetaJakarta coordinator.

Seeing differently is also the objective of the UN-sponsored Pulse Lab Jakarta, which emphasizes the importance of "thick data"—that is, using fine-grained ethnographic research and crowdsourcing to supplement digitally generated data. One of the Pulse Lab's many projects is a collaboration with the World Food Program to study the impact of climate change on food poverty. This project relies on recruited (paid) volunteers who use an app to record a range of market data, taking photos of various items and noting their quality and prices. Their observations are geo-located and time-stamped to build up a detailed and real-time picture of market fluctuations.

This actively generated market price data is then matched against other data streams, such as household resilience surveys and local weather patterns, to map the effects of climate change on community sustainability. The project is focused on locating outlier communities: those that seem to do either better or worse than the average. The main purpose is not so much to provide a complete picture as to find communities that are in trouble and require intervention by the World Food Program.

A second goal is to initiate research projects to learn from the resilience capacities of communities that do better than average. These communities are often described as demonstrating "positive deviance," and perhaps hold the keys to locally generated solutions or workarounds that can enable others to survive in crisis situations.

The UN Global Pulse (which runs similar projects around the world) and the World Food Program seek to use new data technologies not to generate universal forms of knowledge or develop large-scale interventions, but rather to build up local capacities and solutions. Long gone is the idea that international development organizations already possess exclusive know-how or technological solutions that can be generalized and exported through training or project grants. If solutions to problems of climate change adaptation and poverty do emerge, they will be context-specific and generated by communities themselves. This is how data-driven governance seeks to mobilize the power of the geo-socially networked citizen: by harnessing the immanent capacities of social networks to enhance awareness of pressing problems in new ways.

Yet many social, economic, and ecological questions still are ignored or are not posed at all. A good example in Jakarta is the city's relationship to its river system, which often floods in the mon-

soon season. The city is currently undertaking a massive project of "normalization," tearing down informal settlements on the riverbanks and concreting the walls of the rivers; in some areas, the rivers are being completely covered with concrete. Many well-off citizens view this "beautification" as a good thing and are in favor of pushing the rivers underground and out of sight.

As one data governance activist said to me, "They are turning their backs on the reality of the city. The river is an ugly monster that no one wants around." From this perspective, the preference for covering up the problem prevents rethinking the city's handling of its rivers. It is also seen as counterproductive: increasing the rigidity of a river system that is constantly in flux only stores up more problems for the future.

As one member of the PetaJakarta team told me: "Understanding the river as a line is the first problem. It doesn't move in one constant direction or with a constant thickness." The application of traditional technical approaches to solve the problem of the river system makes the problem worse: sporadic concretization renders rivers even more turbulent, since "the river cannot be forced into a box." Twitter feedback from project participants who geo-locate sporadic flooding helps in the process of remapping the city, making it more dynamic: "This enables thinking differently. The river is not a line but a body ever-present across the city."

Data is seen as the key to empowerment in new ways and at the most local levels.

The PetaJakarta project assumes that the conditions for radical change are already in place. There is a networked citizenship on social media, and the technology for geospatial mapping is available (the project sends out automated responses with a video telling people how to record their location using the Global Positioning System). The project seeks to reconfigure this already existing geosocial technological infrastructure, and to activate civic elements.

What could perhaps be understood as the extension of emergency aid or disaster risk reduction to the politics of everyday life can also be seen as creating an empowering network capable of amplifying the power of self-organizing community intelligence. The vision involves transforming existing capacities to remap problems and issues. This could include reconfiguring apps developed as open source software to make them capable of serving as tools for mobilizing and re-envisioning community relations in experimental directions.

Mapping risk in Rwanda

Another example of the shift toward data-driven governance is the Rwandan government's launch of its National Risk Atlas in 2015. This was widely billed as the first-ever comprehensive risk tool created in Africa. In collaboration with the UN Development Program (UNDP), the World Bank, and the European Union, the atlas was developed to provide guidance on disaster risk for national planning and policymaking. Again the "mapping" motif recurs, with the emphasis on seeing and responding to problems as they emerge.

In the risk analysts' language, bringing data governance into the mainstream of development planning would ensure that "evidence-based" and "risk-informed" policymaking shapes governing strategy. A UNDP official argued that responsiveness to data had to be kept at the forefront: "We will never successfully eradicate poverty or achieve sustainable development so long as we continue to marginalize disaster risk reduction."

Here, the goals that would have been instrumentalized and used to shape governance in the past—ending poverty and furthering development—become secondary by-products of a focus on gathering real-time data. The top priority is enabling adaptation to problems and crises that cannot be fully predicted. Data-driven governance assumes the need for constant adaptation to change. Risk profiling and mapping measures, often using new technologies, have thus become crucial to agendas shaped by data-driven governance.

Rwanda's National Risk Atlas makes for interesting reading, particularly the methodologies and assumptions deployed for this project by leading international institutions. The project maps five main hazards that Rwanda faces: droughts, floods, landslides, earthquakes, and windstorms. This approach follows the recommendations of the 2005 Hyogo Framework for Action, adopted at a UN conference in Japan, to bring disaster risk assessment into the mainstream of governments' policymaking practices. The Risk Atlas seeks to "identify and prioritize hazard-prone areas during planning and programming for development activities in various sectors, such as transport, health, and

education . . . as well as in urban and rural land-use planning and in the development of building codes."

The policy encourages government planners to work with constant data streams, taking into account the nature and risk of numerous emergent hazards as well as the exposure and vulnerabilities of the population and national infrastructure, facilities, and resources. The aim is to build awareness of changing risks, not through a static set of measures, but via an ongoing process of adaptation.

Increasingly, data-driven governance seems to be displacing other frameworks for managing or legitimizing urban planning and governance. Data is what drives innovation and new accounting technologies; governments themselves are no longer seen as initiators of projects of change and transformation. The integration of data is central to a new discourse of internationally managed programs of good governance focused on resilience: efficient and non-disruptive adaptation to changing relationships, flows, and interactions.

Yet bringing data into discourses of governance seems only to intensify the levels of international regulative intervention and control. If data-driven governance does in fact open up possibilities for new ways of thinking, it would appear that they tend to be oriented toward international concerns about maintaining and strengthening the system that currently exists. This is a potentially conservative aspect of data-driven governance.

THE LIMITS OF EMPOWERMENT

Data-driven governance is not intended just to understand and predict disasters or prevent them from occurring. It is also meant to help communities cope with and mitigate the effects of disasters by gaining a better understanding of themselves. The process of turning self-generated data into knowledge that replaces externally orientated or expert knowledge is supposed to enable communities to better measure their own resilience.

For advocates of data-driven governance, this approach to community self-empowerment is a bit like that of the Quantified Self movement, which encourages people to improve their health by using fitness-tracking devices and apps—but applied on the larger scale of cities and societies. If, through data collection and sharing, we can detect and manage our own biorhythms and know the effects of poor diet or lack of exercise, we can monitor our own health and perhaps avoid the need for costly medical interventions. Equally, if vulnerable and marginal communities could "datafy" their relationships with their environments, they would be able to augment their coping capacities and resilience, mitigating the impact of potential disasters or crises. Just as with Quantified Self, the hope is that data-driven programs can enable better self-help by providing more instantaneous and detailed feedback than ever before. This feedback will become the basis for governance, understood in terms of managing social, community, and individual adaptation and change.

Data-driven governance aims not so much for instrumental or causal knowledge but for revealing feedback effects (for example, the effects of changing land use or working practices), which enable systems to be better and more reflexively managed. Disaster risk reduction thus becomes a way of making communities more self-aware, so that the unintended consequences of social interaction do not undermine coping capacities.

This process of self-monitoring to improve self-awareness is the essence of some of the UN's data governance projects, such as the previously mentioned famine prevention program that gathers data to provide real-time awareness of food price changes. Data-driven governance typically operates on the basis of this kind of "everyday" data, analyzing it to reveal fine-grained differences and distinctions, rather than engaging in large-scale, national-level statistical analysis. Such approaches often make use of social media to analyze real-time social interaction, as with the use of Twitter feeds in response to flooding in Jakarta.

Thus, data-driven governance is more about responding to problems than solving them in top-down ways. The data generated by communities on social media does not necessarily help explain global warming, but it can enable individuals and households to measure their own energy consumption through the datafication of household objects and complex production and supply chains. Data-driven governance thereby works on the basis of "datafying"—recording or illuminating through data—individuals' or communities' relations to their environments. This also provides them with better knowledge of themselves, by revealing feedback effects that might otherwise go unseen.

The hope is that the producers and consumers of knowledge and governance will become indistinguishable—that both knowing and governing will happen without external mediation, constituting a harmonious and self-adapting system,

often called "community resilience." In this framing, increasingly articulated by governments and policymakers, knowledge of causal connections is no longer so important; communities will adapt to the real-time appearances of the world without necessarily understanding them. Being connected is what counts, as new digital technologies, such as mobile phones, allow individuals to organize themselves in order to adapt to or recover from disasters or other threats. The idea is that awareness of data will lead to behavioral change.

Now that the use of technology to reveal feedback effects, and enable responses to them, has become central to ideas of resilience in data-driven governance, approaches drawing on big data and the Internet of Things promise local communities a previously unimaginable level of responsiveness and sensitivity to environmental changes. Boosters in international development agencies and corporations say these approaches will provide the necessary information to transform crisis-prone areas and occupations, especially those dependent on climate variations.

A prevalent example involves small-scale agricultural production. Start-up companies supported by international development agencies argue that rather than being forced into environmentally destructive industrial mono-cropping, farmers can make small-plot alternatives economically viable if they sign up for "cloud-based" management systems and large-scale data collection via sensor-based monitoring tools. This will allow them to track and minimize the use of chemicals and other costly resources, as well as rapidly respond to drought, pests, and disease—detecting problems even down to the level of specific trees and plots. Just as with Google and Amazon, sensitivity to feedback increases the more data is shared and used.

Countless agritech start-ups have adopted the new governance mantras of using data to cope with adversity and crisis. A typical sales pitch calls for the use of cloud storage (to store raw and processed imagery), cloud computation (to process huge amounts of data and extract insights), and personally tailored applications. These businesses promise that their technological fixes will help farmers grow healthier crops and enjoy a better livelihood despite a harsh environment.

WHOSE PROBLEMS?

Data-driven governance is a method or approach that increasingly emphasizes concepts of adaptation, resilience, and vulnerability. For some advocates, a focus on community resilience is a logical response to the failures of previous large-scale programs of development and disaster prevention, which are now considered too unwieldy, unsuitable for different contexts and communities, or lacking in local engagement. For other supporters, data-driven governance makes sense on its own terms—they see it as a spin-off benefit of new technologies, particularly sensors and the digital traces left by mobile phones.

Critics often view data-driven governance as a step backward from more ambitious programs of development. The focus on community self-government and self-empowerment can also be seen as a way of making already marginal or vulnerable communities responsible for their own problems.

Data may enable new forms of governing at the edge of crisis, as with flood awareness in Jakarta and disaster risk in Rwanda. But it could be argued that this approach merely maintains local communities in situations of stress, while alternative forms of development or more transformative (and expensive) ways of addressing problems are delayed or evaded.

There is little doubt that data-driven governance provides important insights into differences among communities and the importance of local context. However, issues such as development and disaster risk are increasingly linked to climate change and instability. Although problems may appear to be localized in their effects, attention to causes should not be neglected. There is a need for adaptation and change in the world's better-off and least-affected communities, not only in those prone to constant crisis. ■

"The progression from semiautonomous, unarmed supply robots to fully autonomous weapons systems is likely to occur rapidly and with limited public scrutiny."

The Coming of Automated Warfare

MICHAEL T. KLARE

In just two or three years, more or less, the US Army will begin supplying its combat units with a semiautonomous utility vehicle, the Small Multipurpose Equipment Transport (SMET). Designed to carry up to 1,000 pounds of military gear as far as 60 miles over three days without external fuel resupply, the SMET vehicle—called a "robotic mule"—will free infantrymen to focus on their combat tasks while leaving the grunt work to machines. But if fuel and ammunition haulage is to be the initial function of SMET, this is hardly the only task it is expected to perform. As combat units become more experienced with using autonomous systems, the Army plans to endow its robotic mule with additional capabilities, such as collecting battlefield intelligence from sensors and distributing it to soldiers in the field. Eventually, SMET and its robotic successors will be equipped with guns and missiles, allowing them to undertake combat operations alongside humans.

No senior official can say when robotic devices like SMET will transform from the unarmed tools of human soldiers into fully empowered warriors, capable of identifying enemy threats and employing lethal force against them. Nevertheless, the Army, along with the other US military services and counterparts in other countries, is edging closer to that fateful moment as it endows robotic systems with ever-increasing degrees of autonomy, giving them the ability to make sense of their environment and operate independently of humans on the battlefield. This raises fundamental questions about the future of warfare, the role of humans on the battlefield, and the ethics and legality of robotic combat.

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The progression from semiautonomous, unarmed supply robots to fully autonomous weapons systems is likely to occur rapidly and with limited public scrutiny. The Army and the other military services are planning steady advances in the utilization of artificial intelligence (AI) in robotic devices, enabling them to operate with quickly increasing independence. As a follow-up to SMET, for example, the Army is developing a Robotic Combat Vehicle (RCV)—essentially, a self-driving tank. Many hurdles remain before it can be deployed in combat, but the Army is already at work on the software and other subsystems (target identification and engagement, off-road maneuvering controls, links to other RCVs and human combatants) that will be required for such a vehicle to operate autonomously.

Eventually, Pentagon strategists believe, US soldiers will go to war alongside a wide array of autonomous and semiautonomous systems, including unmanned (or "uninhabited") air and ground vehicles capable of identifying enemy targets, relaying that information to human and robotic combatants, and taking lethal action on their own. The widespread deployment of such systems, the Army said in its March 2017 Robotic and Autonomous Systems Strategy, "will provide commanders with the ability to take operational risks previously unimaginable with solely manned formations. Machines will take the place of humans maneuvering through the most dangerous avenues of approach."

RIDE OF THE VALKYRIES

The US Army is not alone in seeking ways to replace human combatants with robots: the Air Force and Navy are pursuing similar lines of research, each driven by its own strategic priorities. The Air Force, facing the increasingly sophisticated antiaircraft systems of such likely adversaries as Russia and China, seeks to equip its fighter pilots

with a "loyal wingman"—an armed drone capable of suppressing enemy defenses and clearing a path for piloted aircraft. These drones, or unmanned aerial vehicles (UAVs), will be far less costly than a modern jet fighter (which can cost $100 million or more), and so can be deployed in large numbers.

To implement this vision, the Air Force Research Laboratory (AFRL) is proceeding on two fronts, developing a prototype UAV to serve in the "loyal wingman" role, along with the software needed to enable a fighter pilot to oversee one or more UAVs while flying over contested territory. In March 2019, the AFRL conducted the first test flight of the XQ-58A Valkyrie, a jet-powered drone that is a possible model for a loyal wingman aircraft. The XQ-58A is designed to keep pace with manned aircraft and accompany them into hostile airspace. On a parallel track, the AFRL is developing a software system called Skyborg, intended to steer uninhabited aircraft like the Valkyrie and manage their communications with human pilots.

Presumably, a human pilot will guide these unmanned drones into enemy airspace; once there, however, they will be endowed with considerable freedom to seek out and engage certain predesignated enemy assets on their own. Paul Scharre, the author of *Army of None: Autonomous Weapons and the Future of War* and a senior fellow at the Center for a New American Security (CNAS), a Washington-based think-tank, said in a recent interview that human pilots will play "a sort of quarterback role" in this future scenario, overseeing the air battle, while "out at the edge, you actually have a diverse mix of uninhabited aircraft of various shapes and sizes."

The Navy is driven by roughly similar concerns. It can cost several billion dollars to build even a single surface warship, and these are becoming increasingly vulnerable to advanced torpedoes and missiles. The solution, in the view of many naval officers, is to build fewer large manned vessels and more uninhabited ones, including both unmanned surface vehicles (USVs) and unmanned underwater vehicles (UUVs).

"The US military has talked about the strategic importance of replacing 'king' and 'queen' pieces on the maritime chessboard with lots of 'pawns,'" said Fred Kennedy, an official at the Defense Advanced Research Projects Agency (DARPA), in a January 2018 press release. The introduction of unmanned vessels "represents a new vision of naval surface warfare that trades small numbers of very capable, high-value assets for large numbers of commoditized, simpler platforms that are more capable in the aggregate."

Kennedy was speaking after the first test voyage of the Sea Hunter, an unmanned surface vessel meant to serve as a prototype drone warship—a pawn on this new "maritime chessboard." Developed by DARPA for the Navy, the 132-foot-long Sea Hunter is designed to prowl the ocean and hunt for enemy submarines on its own, reporting intermittently to manned vessels in the region. As envisioned by DARPA, such drone vessels will operate in large packs, or "swarms," coordinating their movements with one another and overpowering enemy warships.

The Navy sought $447 million in the fiscal year 2020 defense budget (submitted in March 2019) for the procurement of two large unmanned surface ships—its first major purchase of such vessels. Although details are sketchy, the proposed vessels are expected to undertake many of the same missions as traditional surface warships, but at a lower cost and without a human crew.

In February 2019, the Navy awarded $43 million to Boeing to build four "Orca" extra-large unmanned undersea vehicles. These 51-foot-long vessels, derived from Boeing's Echo Voyager diesel-electric submersible, are designed to travel up to 6,500 nautical miles autonomously and to carry out a variety of combat missions. They, too, are intended to operate with other autonomous vessels in large offensive swarms.

ROBOT VS. ROBOT

Combine all these Pentagon projects and one begins to get a sense of what the future battlefield will look like. On the ground, robotic tanks and fighting machines will occupy the front lines while armed drones prowl overhead; at sea, swarms of USVs and UUVs will accompany lone manned ships into enemy waters, protected by clouds of UAVs in the sky. Humans will still be present on the battlefield, but serving largely in what Scharre calls a "quarterbacking" capacity—overseeing the battle, but leaving the fighting to robots.

Robot wars of this sort among the major powers will be extremely fast-paced and continue 24 hours a day, without respite. This will require ever-increasing reliance on air- and space-based sensors and automated data collection and assessment systems. Although armed robots will do much of the actual fighting, other machines will monitor battlefield conditions, search for potential vulnerabilities, and weigh tactical moves. The actual de-

cision to select one or another proposed option supposedly will be left to humans, but the pressures of time and fatigue could lead commanders to rely increasingly on choices made by machines.

Believing that the rapid development and deployment of autonomous weapons and control systems will provide the United States with a significant advantage over its rivals in future conflicts, the Defense Department is determined to field as many such devices as it can, as quickly as possible. In an August 2019 roundtable discussion, General Jack Shanahan, commander of the Pentagon's Joint Artificial Intelligence Center, said planners "envision a world of algorithmic warfare," with victory going to the side that best exploits AI, autonomy, cloud computing, and other advanced technologies.

The United States is hardly alone in pursuing this agenda. Russia and China are also developing a full suite of combat drones, and some secondary powers, including Israel and South Korea, have also invested heavily in the development of such systems. Russia, for example, has introduced an unmanned armored vehicle, the Uran-9, and a small unmanned tank, the Vikhr (Whirlwind); both mount a 30-mm heavy machine gun and are equipped to fire antitank guided missiles. The Russians have also developed an array of armed UAVs and are testing unmanned submarines.

The weaponization of artificial intelligence raises unique problems.

Given these developments, it appears that future wars among the major powers will entail ever more robot-on-robot battles, leaving humans with little to do but monitor the proceedings as best they can, consenting to or overriding computer-generated (algorithmic) assaults. This will dramatically alter the nature of warfare, accelerating its pace and removing human warriors from the blood and fury of combat. While it may be difficult to foresee how this will play out, everyone involved—from those at the very top of the command system to foot soldiers and civilian policymakers—will have to revise their thinking about war and the role of humans on the battlefield.

THE SOLDIER'S DILEMMA

Ordinary soldiers and front-line unit commanders may face the most acute challenges from the roboticization of the battlefield. Trained to exercise initiative under fire, they extol a warrior ethos that has its roots in ancient Greek and Roman times. Today's soldiers are also conditioned to rely on one another for protection in combat—to form a "band of brothers." With the deployment of armed robots on the battlefield, these assumptions will be called into question. What will remain of the warrior's ethos when robots do most of the fighting, leaving little opportunity for personal initiative and glory? How do you build unit cohesion and personal bonds when your fellow soldiers are mute machines? It is hard to imagine a band of brothers under those conditions.

Machines, though lacking human empathy and intuition, will be better at most combat functions than human soldiers and able to fight 24 hours a day, week after week, without need for rest or recuperation. True, some soldiers may prefer handing the most dangerous combat tasks to machines, reducing their own exposure to enemy fire. But will the military be able to attract and retain enough talented young men and women to fill its ranks when sacrifice and courage are removed from the recruiting pitch?

Even more worrisome, from the Pentagon's perspective, is the question of whether ordinary soldiers and unit commanders will be able to keep pace with their robotic companions and to absorb all the information they transmit. Humans need to rest between battles; robots do not. Humans need time to digest the multiple streams of data they receive from sensors and make informed tactical decisions; AI processors can do this in a nanosecond. In time, soldiers may become so dependent on the superior tactical intelligence of their robotic systems that they cede important elements of leadership to them. The relationship between soldier and robot would then be reversed: instead of robots serving as adjuncts to humans, it could end up the other way around.

Aware of this risk, Pentagon officials have come up with a new concept, "human-machine teaming." In this vision, described by Scharre and others as "centaur warfighting," humans would be joined at the hip with machines, each member of the team contributing what it can do best. Human soldiers will have to be trained to monitor constant inputs from their robots and ensure that they are performing in accordance with tactical commands. This will be demanding work, even under the best of circumstances—and far more challenging when adversaries are fielding mul-

tiple robots of their own and the pace of combat accelerates.

Some analysts believe that the only way to make centaur warfighting work successfully will be to connect humans directly to machines, whether through an electronic implant or some other neurological interface. This has a science-fiction ring to it, but DARPA is already investigating technologies to make it possible. Would this be true human–machine teaming, or would it turn humans into mere extensions of machines?

THE GENERAL'S DILEMMA

For most of history, generals and admirals have preferred to go to war with large numbers of well-trained troops, a vast array of potent weapons, and a coherent plan for how and when to employ them in battle. Variations of what are now known as command, control, and communications (C3) systems have been devised over time to enable senior commanders to convey their battle plans to subordinates on the front lines and to rearrange fighting units when battlefield conditions change. But effective C3 has always been a problem in combat, especially when the fog of war makes it hard to determine what's happening. Add robots and autonomy to the equation, and the task will prove far more challenging.

Future wars among the major powers will entail ever more robot-on-robot battles.

With existing technology, combat assessment and command delivery occur at the speed of human cognition and radio communication. Things can get confusing, of course, and orders from commanders do not always make it to front-line posts in time to alter a battle's outcome. Nevertheless, human analysis and deliberation usually prevails, for better or for worse.

With AI and automation, that will no longer necessarily be the case. Airborne and space-based sensors will be able to send real-time intelligence on enemy positions directly to robotic tanks and other autonomous weapons systems, which in turn will be capable of initiating attacks on those targets—all within a matter of seconds. Human commanders may be able to follow this on their computer screens, but they will probably be so inundated with information that much of the oversight will be delegated to AI processors.

The Pentagon is attempting to help its commanders cope with this challenge by providing them with increasingly sophisticated data processing, battle assessment, and decision assistance systems. Such devices will collect and sift through all that incoming data from multiple sensor streams, identify patterns and priorities, and suggest optimal courses of action. "The military's use of artificial intelligence will move beyond tasks such as maintenance and logistics in the coming year to include war-fighting functions, such as helping commanders run their operations centers in combat," General Shanahan was quoted as saying in a September 2019 *Politico* report.

For hard-pressed battlefield commanders, such developments may bring a degree of relief. But they also raise many troubling questions. Will such automated systems be capable of weighing all the variables in battle—including not just obvious military factors like enemy positions but also more intangible ones such as troop morale, local weather conditions, and the political environment, as well as the possible presence of civilians and refugees in war zones? Even more worrying, will AI systems advocate a course of action that is unnecessarily aggressive or escalatory when a more restrained posture might be preferable? Or worse, will AI systems go rogue and initiate attacks never intended by human decision-makers—perhaps even slaughtering civilians?

These questions will be challenging enough in battles limited to conventional weapons. In encounters with robots doing much of the fighting on both sides, the outcome might well depend on which side is better able to decipher developments on the battlefield and manage the overall course of combat. The big danger is that human commanders will prove unable to follow the high-paced sequence of events and will make bad decisions or allow machines to do so for them—leading either to catastrophic defeat or to a wider war that no one sought.

This danger becomes far more serious in a scenario involving clashes between two or more nuclear-armed powers. In such situations, careful, cool-headed judgment is essential to avoid unintended escalation across the "firebreak" between conventional and nuclear warfare. But with robots doing most of the fighting and the speed of action exceeding human comprehension, commanders may not be able to perform the calm decision-making role that is called for, and instead may rely on machines to determine the course of action—with unpredictable and possibly calamitous consequences.

"You will find no stronger proponent of integration of AI capabilities writ large into the Department of Defense, but there is one area where I pause, and it has to do with nuclear command and control," General Shanahan said at a Georgetown University conference in September 2019. When it comes to nuclear combat, he declared, it is essential that humans retain ultimate control over decision-making. Still, he indicated that retaining such control will become more difficult as the pace of combat accelerates and more command functions are ceded to autonomous systems.

THE POLICYMAKER'S DILEMMA

For policymakers, the introduction of autonomous weapons poses a host of other troubling questions. Military leaders, by and large, favor the rapid weaponization of the new technologies and their integration into combat units, with minimal political interference. They regularly claim that their adversaries are also developing such weapons and that any delay in matching their progress would result in a battlefield disadvantage. An arms race in AI and autonomy has already commenced, then–US Secretary of Defense Ashton Carter said in 2016, and success "now depends on who can outinnovate . . . anyone else." But if engaging in an unrestrained arms race might seem imperative to military leaders, the prospect has generated alarm among government officials who worry about the moral and legal implications of deploying fully autonomous weapons.

The introduction of revolutionary military technologies always raises difficult issues for policymakers—think of the first use of chemical weapons during World War I and of atomic bombs at the end of World War II. The emergence of AI-empowered weapons is posing similar concerns. As with earlier advances in weapons technology, the introduction of armed robots is likely to alter the future battlefield in numerous and possibly disruptive ways. But the weaponization of artificial intelligence raises unique problems, since it involves the gradual exclusion of humans from critical decision-making functions.

These problems begin with the legal obligations of states under international law—notably the Geneva Conventions (and their supplemental protocols), revised and expanded after World War II and signed by most nations, including the United States. These measures, based on the Hague Conventions of 1899 and 1907, oblige signatories to avoid unnecessary harm to sick and wounded soldiers and to noncombatants trapped in conflict zones. Of particular relevance to autonomous weapons, the Geneva Conventions require attacking forces to distinguish between active enemy combatants and noncombatants, and to spare the latter from harm to the greatest degree possible. States are enjoined to use only as much force as is needed to achieve a particular military objective, so as to avoid excessive harm to civilians (a precept usually termed "proportionality"). If found in violation of these constraints, military commanders and the political leaders who issued their orders can be tried for war crimes. Humans do, of course, make mistakes in the thick of combat; some may intentionally violate the laws of war, which unfortunately has been the case in some recent conflicts. Still, there is a widespread expectation that national leaders will be aware of their legal obligations and make some effort to abide by them.

Some policymakers and human rights advocates worry, however, that the use of fully autonomous weapons systems would constitute an unacceptable challenge to the Geneva Conventions because such systems lack an ability to make critical judgments in the heat of battle—to distinguish, say, between an armed militant carrying a gun and a civilian carrying a shovel, or between a robotic tank and a truck full of scrap metal. "Fully autonomous weapons would face great, if not insurmountable, difficulties in reliably distinguishing between lawful and unlawful targets as required by international humanitarian law," warned Harvard Law School's Bonnie Docherty in a 2015 Human Rights Watch report. Advocates for the weaponization of autonomous systems insist that such systems will become more reliable and discriminating over time, but critics say they will never be able to achieve a human-level capacity for discernment.

Several dozen states, including Austria, Brazil, Chile, and Mexico, have called for the adoption of a binding international prohibition on the deployment of fully autonomous weapons systems. Such a ban, they say, should be encased in an additional protocol to the Convention on Certain Conventional Weapons, a 1980 treaty that restricts or prohibits the use of particular weapons that are deemed to cause unnecessary suffering to combatants or to harm civilians indiscriminately. Signatory states have been debating such a ban for several years now; however, decisions regarding the adoption of additional protocols are made by consensus, and so far Russia and the United States (and

a few others) have blocked action on any binding instrument of this sort.

Although resistant to a binding prohibition on fully autonomous weapons, the US government, along with several other states, has called for the adoption of global norms or "ethical principles" governing the utilization of such devices. Such precepts would, at the very least, require some degree of human control over all machines used in combat, particularly in instances where decisions of life and death are involved. In October 2019, for instance, the Defense Innovation Board, which advises the US defense secretary, approved a set of recommendations for the ethical military use of AI. Foremost among these is the principle of responsibility: "human beings . . . should remain responsible for the development, deployment, use, and outcomes" of autonomous systems.

Policymakers have also begun to worry about how the widespread introduction of autonomous weapons will affect nuclear stability (also termed strategic stability). At present, nuclear stability among the major powers is largely imposed by the threat of massive retaliation, or "mutually assured destruction": states are deterred from initiating the use of nuclear weapons by the expectation that, no matter how many enemy targets they might destroy in a first strike, they will still suffer intolerable destruction from their adversary's invulnerable second-strike weapons. But some analysts fear that the proliferation of autonomous weapons would alter this calculation by allowing an attacker to employ massive swarms of them in assaults on enemy submarines and mobile missiles, imperiling their retaliatory nuclear capabilities. The mere appearance of such swarms may cause the leaders of a targeted state (or their automated C3 systems) to conclude that they are facing a disarming first strike; in fear of losing their retaliatory weapons altogether, they might decide to launch them immediately—the so-called use 'em or lose 'em scenario.

At present, there are no international accords or mechanisms to address these concerns. Some arms control analysts have called for initiating talks to buttress nuclear stability in the face of mounting technological challenges. One possible venue for such discussions is the "strategic stability talks" that were conducted by US and Russian officials on an irregular basis until July 2019. Leaders of both sides say they are open to reconvening these discussions, possibly with the addition of representatives from the other nuclear-armed states, including China. This would provide a forum in which the destabilizing impacts of new military technologies could be considered, and possible solutions investigated. Since a number of Cold War–era arms control agreements have been abandoned recently or are at risk, such talks could be a more promising vehicle for progress.

RACING AHEAD

Although efforts to establish national and international norms concerning the weaponization of AI and robotics may well gain momentum in the years ahead, the race to develop combat-ready systems and deploy them on potential battlefields is likely to proceed at a much faster pace. The military forces of the major powers are determined to seize any advantage they can from the utilization of advanced technologies, and defense contractors are equally keen to develop and sell new products. We can safely assume that many of the systems now in development will be integrated into regular combat units in the not-too-distant future. Even as the US Army transitions from utility vehicles like SMET to fully autonomous combat systems, Russia and China are moving to integrate advanced robotic weapons into their own armed forces.

While the exact impacts their deployment will have cannot be entirely foreseen, it is obvious that the character of war will be altered in many fundamental ways, most notably in the pace of combat and the role played by humans. While policymakers must assess these impacts and make necessary course corrections, it is also up to generals, admirals, junior officers, and ordinary soldiers to ponder their roles in a robot-centric future and determine if rapid roboticization is, in fact, in the military's and the nation's best interest. No doubt there is a useful role for self-driving utility vehicles on the battlefield, but the overall benefit of fully autonomous weapons has yet to be demonstrated. The very considerable risks of hurried deployment also demand greater scrutiny by politicians, the media, and ordinary citizens. ■

"Comparing China, India, and Brazil reveals that current housing policies in all three countries have produced new forms of exclusion for inhabitants of informal settlements."

Slums, Favelas, and Urban Villages: Housing Policy in the Global South

XUEFEI REN

Many cities in the global South today face an endemic housing crisis. An increasing number of urban dwellers can find places to live only in informal settlements without tenure security or basic services and amenities.

China has seen a proliferation of such settlements since the 1990s, as millions of internal migrants seek low-cost housing in cities. Called "urban villages," these are communities of migrant workers who cannot afford market-rate rent and have temporarily settled in former agricultural villages, where housing is cheaper. In Guangzhou, the largest city in southern China, 5 million people, out of the metropolitan population of 13 million, live in more than 300 urban villages across the metropolitan area.

India and Brazil are two other major developing countries that have large urban populations living in informal settlements. In Mumbai, about 40 percent of the population lives in slums, and in Rio de Janeiro, nearly a quarter lives in favelas, with inadequate infrastructure and services and precarious housing tenure.

Municipal governments in the global South have long been trying to solve the problems of informal settlements. China, India, and Brazil offer examples of three dominant approaches: demolition, resettlement, and integration. In China, ambitious local officials try to get rid of urban villages by demolishing them; once the settlements are razed, they can lease the cleared land to private investors to raise revenue. In India, the standard approach is resettlement—relocating some residents (only those who have lived in a settlement since a certain date are deemed eligible) in order to free up the land occupied by slums. In Brazil, city governments generally avoid demolition or resettlement; instead, they provide services to favela communities, assuming that over time, these neighborhoods will gradually be integrated with the rest of the city.

Many scholars study the success and failure of specific housing programs in single countries; few have taken a global view to comparatively assess the design and implementation of housing policies for informal settlements across countries. Such a comparative perspective is crucial if we want to understand the origins, advantages, and limitations of these policies. Comparing China, India, and Brazil reveals that current housing policies in all three countries have produced new forms of exclusion for inhabitants of informal settlements. But the boundaries of inclusion and exclusion vary because of their different institutional arrangements and land–market relations.

In this essay, I discuss approaches used in Guangzhou, Mumbai, and Rio de Janeiro to illustrate three models of redeveloping informal settlements and to show how their approaches have differently affected communities. All three cities have a large number of residents living in informal settlements. More importantly, they have pioneered policy experiments to redevelop or incorporate these densely populated districts.

LAND GRABS IN GUANGZHOU

Guangzhou sits at the heart of the Pearl River Delta—the largest urban mega-region in the country, with a combined population of 200 million. The Delta is the hub of China's manufacturing sector: many global and local companies have set up

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factories, lured by tax incentives, good infrastructure, and cheap land provided by local governments. As the largest city in the Delta, Guangzhou attracts migrants from elsewhere in China, many of whom live in the hundreds of urban villages spread across the city.

The dominant approach to redeveloping urban villages in Guangzhou combines demolition with new construction financed by enlisting private capital. This demolition-centered policy has been driven largely by the city government's revenue structure, which is centered on land-based financing. Like most cities in China, Guangzhou depends heavily on land leasing to generate revenue. Guangzhou's revenue from land leasing reached 90 billion yuan (about $14 billion) in 2015, or 35 percent of that year's municipal revenue.

But the model of land-based financing has become increasingly unsustainable, since most urban land parcels have already been leased out. The lack of transferable urban land prompted the Guangzhou administration to reexamine existing land use patterns to find a way of squeezing out more developable parcels. In 2009, the city government identified 138 urban villages (among more than 300), occupying more than 200 square kilometers of land, as promising sites for development. It proposed to demolish all of them by 2020.

Privately led urban village renewal in Guangzhou perpetuates the housing crisis among the poor.

Guangzhou specified the procedures for redeveloping urban villages in a policy launched in 2009. Labeled the *sanjiu* program (meaning "three types of old places"), the policy targeted three kinds of districts for redevelopment: old industrial areas, old residential neighborhoods, and urban villages. It explicitly encouraged private developers to participate in urban village redevelopment. Developers could take charge of demolition, compensation, and resettlement; in return, they would be given the right to develop the sites of cleared urban villages.

Landlords in urban villages are offered either monetary compensation or resettlement housing on the same site. Most choose resettlement housing because of rising housing prices in Guangzhou. But migrant tenants do not receive any compensation and in fact are evicted if the village where they live undergoes redevelopment.

Urban villages are challenging for the city government to redevelop because they are highly organized. Most urban villages in southern China are close-knit communities bound by dense family and clan networks. Often they have been incorporated as shareholding village companies, which manage collective assets on the villagers' behalf. These companies stand to obtain a big slice of compensation by negotiating hard with developers and the city government—they often bargain for land elsewhere in the city on which to build new rental properties. They distribute the earnings from these transactions among villager-shareholders.

Urban village redevelopment requires substantial capital investment. Many urban villages have developed a thriving rental economy through the construction of apartment buildings. If these buildings were demolished, the owners would have to be compensated at the market rate. Because of these challenges, the actual progress of redevelopment has proved far slower than officials anticipated.

The Guangzhou government is eager to quicken the pace. In 2016, it announced new policy guidelines for urban village redevelopment. This time, officials introduced the idea of "land banking" as a possible model for redevelopment. The government would buy land from urban villages without consent from local residents, convert the parcels to state-owned urban land, and lease it out to investors through open bidding and auctions. Land banking without residents' consent has been carried out in other cities, such as Beijing and Shanghai, but whether or not it can be done in Guangzhou remains to be seen.

The 2016 policy also offered major concessions, such as granting legal recognition to housing that was illegally constructed before June 30, 2007, and allowing some flexibility regarding land ownership conversion: villages can now retain collective ownership of the land on which resettlement housing is built. Since the policy was announced, a few more urban villages have been redeveloped with private capital, but demolishing 138 villages by the end of 2020, as city officials had envisioned, is unlikely to happen.

The most problematic effect of privately led urban village renewal in Guangzhou (and in China as a whole) is that it perpetuates the housing crisis among the poor. Despite the policy revisions over the past decade, the winners and losers in urban

village redevelopment remain the same. Developers, the city government, and landlords (property-owning villagers) are in a position to divide windfall returns. The government can raise substantial revenue by leasing the land once occupied by urban villages to developers. Developers can build market-rate housing on the vacated land and reap a huge profit.

Villagers who own property are generously compensated by developers; some have become millionaires or even billionaires after redevelopment. Compensation is based on the size of the property before demolition. A villager who owns a three-story building would receive a few two-to-three-bedroom apartments in a newly built market-rate housing complex—and each apartment could fetch half a million dollars.

However, migrant tenants are excluded from these benefits. When redevelopment happens, they are evicted and must relocate to other urban villages to look for housing all over again. Despite their numerical strength, migrants have no voice in the decision-making process. Since they do not have the local *hukou*—household registration that confers access to public services—no matter how long they have lived in a city or an urban village, they will always be treated as outsiders.

Under China's highly decentralized system, the national government does not issue guidelines for urban village redevelopment, leaving municipal governments free to experiment. There is a great deal of variation across the country in the way cities treat urban villages. In general, cities in the north are more aggressive and often resort to demolitions and evictions; cities in the south, such as Guangzhou, are more conciliatory and open to negotiation. Although Guangzhou's official policy endorses demolitions, the city government does not force it; demolition and redevelopment cannot take place until the last family or resident agrees to move. These regional differences can be explained by the fact that southern urban villages have a much longer history than their northern counterparts, and the local communities are more organized by family and clan networks.

Mumbai Slum Resettlement

Compared with urban villages in China, slums in India have a longer history, dating back to colonial times. In different periods since independence, the central and local governments in India have adopted different policies for dealing with slums. In the 1950s and 1960s, the dominant approach was demolition and removal. In the 1970s and 1980s, the focus became government-led upgrading and service provision. When government support declined in the 1990s, slum housing policies again shifted—this time toward enlisting private capital for redevelopment.

Mumbai, located in the state of Maharashtra on the west coast, is India's commercial hub, with a population nearing 20 million. Its current slum resettlement policy bears a striking resemblance to Guangzhou's program. The state government seeks private developers to raze slums and resettle residents. In return, the developers are given some of the cleared land to build market-rate housing. The policy has led to the transfer of a large number of parcels occupied by slums to private developers.

Where Mumbai's slum policy notably differs from Guangzhou's urban village policy is in the politics of compensation. In Guangzhou, the dividing line is drawn between locals and migrant tenants. In Mumbai, the slum population is divided into the eligible and noneligible, based on length of residency.

Mumbai's slum redevelopment policy can be traced back to the 1995 state elections in Maharashtra, won by the right-wing Shiv Sena party. Campaigning on a platform featuring populism and Hindu nationalism, the party promised to provide free homes for all of Mumbai's slum dwellers. Most previous slum housing programs had required a financial contribution from inhabitants, so Shiv Sena's pledge of free housing drew tremendous support from slum dwellers.

The party argued that skyrocketing property prices in Mumbai made the proposal feasible. If the slum land in central Mumbai could be opened up to private developers, party officials figured, the developers could cover the cost of providing housing for the poor. Upon coming to power, the Shiv Sena–led government set up the Slum Rehabilitation Authority to oversee the program, which has now continued in operation for a quarter-century.

Under the scheme, the state government actively seeks private developers to finance slum redevelopment and resettle residents. The developers must provide small apartments of about 25 square meters (269 square feet) in multistory buildings to eligible slum dwellers, who become owners of the flats. Developers pay for building maintenance for ten years; after that period, the residents pay.

Housing prices in Mumbai have kept rising since the mid-1990s, and redeveloping centrally located slums has become a profitable business.

Since resettlement housing is often poorly constructed with cheap materials, the cost of resettling residents is relatively low, and huge profits can be made by building market-rate housing on the cleared land. In situ resettlement is generally offered to eligible slum dwellers—those who can prove they had established residency by January 1, 2000. But offsite resettlement is the norm for those displaced by large infrastructure projects such as metro rails, roads, and airport expansions.

Slum redevelopment in Mumbai is often fiercely contested by residents. Unlike in Guangzhou, where landlords in urban villages and shareholders of village companies are compensated generously, most slum dwellers in Mumbai do not own their land. Their only compensation is usually a tiny apartment in a substandard resettlement housing complex. Moreover, the arbitrary cutoff date, which requires slum dwellers to have established residency at least 20 years ago, renders a large number of slum residents ineligible for any compensation. Under these circumstances, most residents tend to oppose resettlement, fearing that they will end up being evicted.

After more than two decades in operation, the market-led model of slum resettlement has exacerbated housing inequalities in Mumbai. Slums in good locations are targeted for redevelopment by private-sector developers, while those in less desirable areas are often bypassed. Developers are awarded transferable rights to build commercial housing, but residents are resettled in poorly constructed tenements that lack basic amenities, either on the same site or on the cheapest available land on the periphery.

Ultimately, Mumbai's slum housing policy is geared toward capturing land values, facilitating private gains. The old campaign promise of providing free housing for the poor in Mumbai is not even close to being realized. Nearly half of the city's population still resides in slums and lacks tenure security. By design, improving housing conditions for the poor is not a priority in Mumbai's slum resettlement program.

In both Guangzhou and Mumbai, the vast majority of urban villages and slums have not yet been redeveloped, due to lack of interest from developers or strong opposition from locals. For millions of the urban poor, these are the places where they can claim a space of their own in the city. Many are vibrant working-class neighborhoods with a wide range of businesses and services—factories and workshops, health clinics, groceries, bakeries, and schools for local children. In Chinese urban villages, the village companies operate like minigovernments, providing basic services such as street cleaning and schools, as well as health care and pensions. But there is great disparity in living conditions among urban villages, depending on the wealth of village companies.

Indian slums, lacking territorial-economic entities such as village companies, are worse off. State and municipal governments provide services only to a small number of regularized slums and neglect the rest. The lack of basic necessities, such as water and electricity, has forced residents to mobilize and try to improve their ability to bargain with the state.

PUTTING FAVELAS ON THE MAP

Compared with China and India, Brazil has far more progressive housing policies that recognize informal settlements as part of their cities. Rio de Janeiro, where nearly 25 percent of the local population lives in favelas, has been leading the country in experimenting with innovative polices. Rio's favela policies center on upgrades and integration, calling for the government to provide services and improve infrastructure. In reality, however, to a large extent these policies have not been implemented, whether because of a lack of funding or the shifting priorities of the state. The implementation failure is perhaps the most significant obstacle to favela upgrading.

These favela programs are a result of decades of campaigning by Rio's housing rights movement. In 1985, after two decades of military dictatorship came to an end, municipal elections were reintroduced. Favela dwellers became a major voting bloc. To court these voters, politicians competed to offer favela upgrading programs.

In 1988, the new Brazilian constitution established the right to "adverse possession," legally recognizing land ownership by squatters after five years of occupation. In 1992, a master plan for Rio included provisions that recommended incorporating favelas into the city by upgrading their infrastructure and improving services in the communities. Over time, Brazil has developed a systematic legal and policy framework that protects favela residents' rights to housing.

Rio de Janeiro has implemented two major favela upgrading programs in the past three decades: Favela-Bairro (which means "from favela to neighborhood") from 1988 to 2008, and Morar Carioca ("Carioca way of living," using a nickname for Rio

natives) from 2008 to the present. These policies aimed to integrate favelas with the rest of the city by improving infrastructure (such as water, sanitation, and paved streets) and providing social services (like schools, community centers, and health clinics).

The Favela-Bairro program was implemented in hundreds of favelas, and it significantly improved conditions in those areas. But the program was not without critics. Some pointed out the poor quality of construction, lack of community participation, and fragmented coordination among different departments within the municipality.

The city government tried to address these concerns with a new program in the mid-2000s. Under Morar Carioca, the city aimed to upgrade and integrate all favelas in Rio de Janeiro by 2020, as part of the legacy of the 2016 Summer Olympics. But as the preparations for the Olympics unfolded, the city prioritized other infrastructure projects, such as waterfront redevelopment and public transit extensions, over favela upgrading. Despite its many progressive features, Morar Carioca has not had any real positive impact on the lives of favela residents.

The market-led model of slum resettlement has exacerbated housing inequalities in Mumbai.

One of the striking features of Rio de Janeiro's housing policies is that they are always heavily intertwined with municipal elections. This is a major difference from housing policies in China and India. In China, there are no municipal elections; in India, mayoralties are symbolic posts—municipal governments do not have control over housing policies, which fall under the purview of state governments. But in Rio de Janeiro, each new mayor has sought to put his own stamp on favela programs by introducing major changes from previous initiatives.

Back in 1992, Cesar Maia won the mayoral election in Rio by a narrow margin over Benedita da Silva, a black politician raised in a favela. Maia promised policies designed to win favela inhabitants' support. Once in office, he started the Favela-Bairro program to provide infrastructure for select favelas. Funding for the initiative came from the municipal government and the Inter-American Development Bank. The emphasis of the program was on public space and infrastructure such as street lighting, water pipes, and sewage systems, rather than on private homes.

The Municipal Housing Secretariat was in charge of implementation, and the head of the agency, Luiz Paulo Conde, himself became a mayoral candidate in the 1996 election, defeating Maia. Conde and Maia subsequently used the Favela-Bairro program to attack one another, each criticizing the problems with implementation under the other's administration. The program became so politicized that when Maia won back the mayoralty in 2000, he distanced himself from it altogether.

Under a later Rio mayor, Eduardo Paez, who took office in 2009, the city government announced the Morar Carioca program. It set an ambitious goal of incorporating all of the city's favelas by 2020, which, if achieved, would improve the living conditions of more than 230,000 households. Building on the previous decades' experiences with favela upgrading efforts, this new program encouraged community participation. Nongovernmental organizations were contracted to solicit feedback from each favela community about local needs and to serve as mediators.

Funding for Morar Carioca would come from the federal government, in addition to the municipal government and the Inter-American Development Bank, totaling 8 billion reais (about $2 billion)—four times the budget for the Favela-Bairro program. However, as the city was getting ready for the 2016 Olympics, money was diverted to other infrastructure projects, and the funds earmarked for Morar Carioca never materialized. The incumbent mayor, Marcelo Crivella, who took office in 2017, has shown no interest in investing in favela upgrading programs. The current strategic plan for the city does not even mention the term "favela," and instead focuses on new housing construction.

Overall, Rio de Janeiro has far more progressive informal housing policies than do Guangzhou or Mumbai—policies that seek to integrate favelas with the rest of the city instead of simply trying to get rid of them. This reflects the influence of Brazil's pro-democracy movement and active civil society. The problem, however, lies in implementation.

Many housing programs have not been implemented for lack of funding, or because of political competition and poor coordination among different bureaucracies. When the 2016 Olympics spotlighted Rio's stark socioeconomic inequalities, the city government took a number of temporary mea-

sures to repair its image, such as installing police units in favelas to improve public safety—but that was mostly for tourists. Once the games were over, favela residents were left on their own again.

FROM DEMOLITION TO INTEGRATION

China, India, and Brazil present three different approaches to governing informal settlements. These different approaches are conditioned by local institutional settings—and have produced new forms of inequality.

In China, most city governments want to demolish their urban villages in order to grab the land and promote themselves as slum-free, world-class cities. Local officials are empowered to take such measures by China's decentralized governing system, which allows mayors broad discretion over housing policies. The nondemocratic political regime makes demolition an easy choice, since officials' careers are not dependent on voters. All three factors—public ownership of urban land, decentralization, and single-party rule—explain why Chinese cities opt for demolition over other approaches.

Once the Olympics were over, favela residents were left on their own again.

By contrast, demolition and eviction are not politically feasible in Indian or Brazilian cities, due to their different political regimes and land-market relations. In both countries, housing policies for informal settlements tend to be closely connected with state or municipal elections. Residents of Indian slums and Brazilian favelas are major voting blocs, and politicians try to court voters in these communities with favorable housing policies—or at least with campaign promises of such policies.

When India and Brazil are compared, two major differences stand out—land ownership and the power of city governments. These differences explain why India opts for slum resettlement while Brazil pursues favela integration. In India, slum dwellers do not own the land they occupy, so they can be more easily resettled. Municipal governments do not have real power to make housing policies, and state-level politicians usually focus on their rural constituencies since they outnumber urban slum dwellers. In Brazil, the 1988 constitution legally recognizes land ownership by squatters after five years of occupation. The city government of Rio de Janeiro has more power and resources, compared with counterparts in India, to provide infrastructure and services to favelas.

Despite their differences, all three approaches have produced new forms of inequality. They would require fundamental changes to deliver more equitable outcomes. In China, the redevelopment of urban villages benefits only the landlords, and displaces most migrant tenants. Providing affordable rental housing for migrant workers is an urgent challenge faced by Chinese cities.

Some cities, including Guangzhou, have launched public housing programs, building rental units for the lowest-income groups. But two issues make the programs ineffective in easing housing shortages for the poor. Some cities, like Guangzhou, exclude migrants from applying for public housing, and most of the projects are built on the periphery, where there are few job opportunities. The next steps would be opening public housing to both migrants and locals and adding more units in the city center, where the jobs are.

In India, policymakers should rethink the problematic criteria currently used for determining eligibility and compensation (particularly the requirement of residency since January 1, 2000). Instead of imposing a cutoff date for eligibility and offering substandard resettlement housing, official policy should take into account factors such as the length of residency, family size, and business relocation. People who have been living in the community for fewer than 20 years should be given the option to purchase a resettlement unit at a subsidized price; larger families should be offered more space; and business owners should receive assistance to relocate their operations (and the land to do so).

In Rio de Janeiro, a dividing line is drawn between the "elite favelas" adjacent to areas frequented by tourists, which have received most state funding, and the rest. The marginalized favelas in peripheral locations, many of which have been taken over by militias and drug traffickers, should be put back on the policy agenda. The government also should monitor the implementation of favela upgrading programs more closely.

Without such changes, cities in all three countries, regardless of their policy choices, will continue to be divided between the "ghettos" and the "citadels," to borrow terms used by the late urban planning theorist John Friedmann. Effective state intervention in informal settlements is essential for reducing inequalities in the global South, where

urban population growth outpaces the provision of adequate housing and infrastructure.

Of the three countries examined here, each excels at one aspect of housing policy and falls short in others. Brazil has the most progressive vision—integrating favelas with the rest of the city—but falls short in implementation. China excels in implementation due to its strong local governments, but its urban village policy centers on eviction. India has a dynamic civil society, but without strong municipal institutions, nongovernmental organizations alone cannot solve the country's housing crisis. Effective policy interventions require all three elements—progressive design, thorough implementation, and a vibrant civil society that can hold the state accountable. ■

"The best set of solutions is likely to span the scale from individual to international action, and to address different points along the chain of production, consumption, and disposal."

Solving the Oceans' Plastic Problem

ELIZABETH MENDENHALL AND ELIYA M. BARON LOPEZ

The health of the oceans is essential for sustaining and supporting the global human population. The oceans fuel most of the world's oxygen production and absorb a majority of its carbon dioxide emissions. They also support fishing, shipping, energy, and tourism industries. Throughout the twentieth century, increases in industrial-scale extraction and an expanding number of other maritime activities vastly increased the human burden on marine ecosystems.

In the 1970s, international agreements intended to reduce marine pollution focused on dumping and pollution from the regular operation of ships. These agreements were reasonably effective, but today, concerted international commitments to deal with other marine pollution challenges are still lacking. And the continued expansion of global industrial civilization has increased the overall human impact on the marine environment, so that ecosystems now face multiple stressors. Plastic pollution is a primary example of this growing human footprint in the oceans. Unlike overexploitation of renewable resources such as fisheries, which may one day bounce back, it will be difficult if not impossible to remove all plastic from the oceans.

Although plastic debris has entered the oceans for decades, the problem has recently started to draw mainstream attention. A large part of the explanation for this is Internet media: videos of animals rescued from entanglement with plastic go viral, photos of dead albatross chicks with stomachs full of plastic are widely shared, and news stories about whale carcasses stuffed with plastic recur with alarming frequency. Other reasons for increased awareness include the advocacy efforts of celebrities who have taken up the anti-plastic cause, from Kim Kardashian to Leonardo DiCaprio. Popular online influencers are selling metal straws to profit from rising disapproval of plastic straws. And major corporations are starting to take advantage of these trends: Adidas is now marketing athletic wear made from collected marine plastic, while Starbucks has redesigned its lids to reduce the demand for plastic straws.

Concern about plastic pollution is still growing, but we lack a detailed understanding of the problem. Important questions remain about why there is so much plastic in the oceans, what are the consequences, and what can be done.

Scientific research into marine plastic debris was relatively slow to develop. Although individual studies about the impact of plastic in the oceans were published in the 1960s and 1970s, only in the past five to ten years has a concerted, international, multidisciplinary research effort begun. Searches of the Scopus citation database show exponential growth in the number of publications on marine plastic debris, including work by both natural and social scientists.

This increase in scientific research reflects and reinforces public concern about marine plastic. Since marine science can be very expensive—especially when it involves gathering samples in the oceans—the amount of research depends directly on the interest of funding sources. Sustained public attention to the problem, and discussion of how we might solve it, is crucial to reducing our knowledge gaps about marine plastic pollution.

At this stage, we do not know the extent to which marine plastics in seafood may affect human health, the total cost of cleanup, or the overall burden on maritime industries. These research gaps prevent a full understanding of the magnitude and urgency of problems caused by plastic pollution and hamper efforts to shape effective

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environmental policies. Although studies on these topics are ongoing, the lack of research standardization makes it difficult to grasp the whole story of marine plastic and its future impacts.

Yet the information we do have is increasingly visible and widespread, stoking concern among the public, policymakers, and industry. Limited action has been taken to reduce the flow of plastic into the oceans and to clean up some of the waste that is already there, but these efforts make only a minor dent in the overall flow of plastic into the marine environment. Developing a better understanding of the complex chains of plastic production, consumption, and disposal, at scales that range from local to global, can help identify the sites where solutions would be most feasible, effective, and efficient.

A PERFECT POLLUTER

Marine plastic debris is a relatively new problem: the dominance of plastic in global markets began in the mid-twentieth century. As a material, plastic has a unique combination of positive qualities—it is cheap, flexible, and durable—making it ideal for manufacturing. The most common types of plastics include polyethylene terephthalate and high-density polyethylene, commonly used for bottles, food containers, and rope, as well as polypropylene, used for chip bags and straws. Estimates vary, but roughly 40 percent of plastics are produced for packaging. Disposable plastic products are now central to expectations about hygiene for medicine, food, and sanitation systems.

This ever-accumulating plastic soup has dangerous consequences for ocean creatures.

The global plastics market is currently valued at over $1 trillion, and the industry is thoroughly globalized. A single consumer product may result from transactions among a number of companies across multiple borders. One company might produce the plastic pellet "feedstock," another company uses that feedstock to make plastic products or packaging, and still others market and sell the final products.

These transnational flows are growing, and plastic production is accelerating. This is a result of more new products being made of plastic, existing products shifting to plastic, and the export of plastic items to new markets. The prevalence of disposable plastics, and the common design element of planned obsolescence, mean that even saturated markets will continue to buy massive amounts of plastic products.

Growth in plastic production and consumption may be good for industries and consumers, but it creates big challenges for waste management systems and environmental health. Plastics derive from both the chemical and fossil fuel sectors and share some of the problems of those industries. Plastic production involves converting crude oil or natural gas into synthetic polymers that contain toxins such as bisphenol-A, lead, and phthalates. Plastic production is also a source of carbon dioxide emissions, both directly and through energy use. In the United States, approximately 12 million barrels of oil are used to manufacture 380 billion single-use plastic bags every year.

Although the general public perceives most plastic materials to be recyclable, in practice, only 9 percent are actually recycled. And several features of plastic make it highly susceptible to accumulation in the natural environment—it is light, frequently disposed of, and often very small. Even when plastic items are put in formal waste management systems, they often leach out of landfills or are blown by wind into the surrounding area. It is sometimes reported that 10 percent of the plastics produced every year end up in the ocean, though in fact the phenomenon is too widespread and decentralized to get an accurate account.

Marine plastic pollution is largely a result of inadequate waste management systems that cannot capture the high and increasing volume of incoming plastic products. A problem as simple as a landfill without a cover can facilitate the wind-driven movement of plastic into the marine environment. Many of the least developed countries, including coastal ones, lack the resources and infrastructure of modern waste management systems.

And many plastic items are so small that even advanced waste management systems cannot capture and dispose of them safely. These microplastics (less than 5 millimeters in diameter) are often the result of the breakdown of larger plastic products over time, but some are intentionally manufactured. Examples of microplastics include synthetic fibers from clothing, preproduction pellets, and microbeads used in cosmetic products.

It is hard to quantify plastic pollution because there are myriad outflows into the oceans that are

difficult to observe reliably. Researchers have produced estimates, most of which are accepted and cited for years before they are reanalyzed or updated. The prevailing wisdom today is that 80 percent of marine plastic pollution comes from land-based sources, with the remaining 20 percent originating from boats and ships.

One prominent study suggests that the vast majority of marine plastic debris flows from 10 rivers in Asia and Africa, and this claim has been widely publicized. The study, however, is limited by a lack of field observations, uncertainty about the proportion of debris that lodges in river sediment, and lack of knowledge about the quantity of non-river outflows. Nor does this study account for the fact that much of the plastic flowing out of these rivers was imported from the United States, Europe, and elsewhere.

Regardless of the exact sources and numbers, we know that large amounts of plastic flow into the ocean environment. But exactly where plastic ends up remains something of a mystery. The varied topography of the seafloor and differences in local and regional currents ensure that the distribution of trash in the ocean is not uniform. Since the late 1990s, scientific fieldwork has documented the existence of at least five "plastic gyres"—areas in the oceans where wind-driven currents draw in debris and result in relatively high-density accumulations of plastic waste. But far less plastic was found within these gyres than scientists expected, given what we know about outflows from land.

Only 9 percent of plastic materials are actually recycled.

Recent research suggests that the majority of marine plastic debris may actually settle in coastal sediment. Although sampling is extremely limited, scientists have found concentrations of plastic waste in parts of the seabed in areas like the European Arctic. Plastic waste has been recorded in submarine canyons, such as the deep-sea regions near the coasts of California and Mexico. Sediment cores from off the coast of Santa Barbara, California, display an exponential increase in plastic accumulation that correlates with increases in global plastic production.

In short, though it is not evenly distributed across the ocean environment, plastic exists on or near the sea surface, around the seabed, and throughout the water in between. Plastic deposition in sediments is now considered a marker of the so-called Anthropocene geological epoch, wherein humans are leaving permanent marks of industrial civilization across broad swaths of the planet.

MOUNTING COSTS

Although we lack a full picture of the harms caused by marine plastic debris, we know enough to understand that it creates major problems. The durability of plastic means that when it degrades, it merely breaks into smaller pieces. Plastic degradation occurs when the material is exposed to physical phenomena such as ultraviolet radiation, bacterial breakdown, and wave action. This process can take hundreds of years, depending on the type of product.

Some types of plastic release harmful chemicals into the surrounding waters as they break down. These toxins—including carcinogens and endocrine disruptors—are known to contain harmful trace elements that can accumulate in the environment. Meanwhile, some plastic particles absorb and concentrate other environmental toxins from the water column. This ever-accumulating plastic soup of degrading products of all sizes and types has dangerous consequences for ocean creatures and humans.

Concerns about wildlife becoming entangled in plastic debris emerged in the 1970s, and made it into popular culture in the 1980s and 1990s. In the early 1990s, the characters of the television cartoon *Captain Planet and the Planeteers* taught millions of children about the dangers to marine life posed by six-pack beverage holders and other disposable plastics. The harms of entanglement are easy to understand, in part because they befall so-called charismatic megafauna like whales, seals, sea turtles, seabirds, and sharks.

Less is known about the harms of plastic ingestion, which may cause plastic to damage or accumulate in the digestive tracts, and even the tissues, of marine organisms. Seabirds that feed via opportunistic diving are especially vulnerable to plastic ingestion and entanglement, along with filter feeders large and small, including oysters, clams, whale sharks, and baleen whales. Estuarine fisheries, such as catfish, have particular problems with entanglement and ingestion of fishing gear because much plastic is trapped in coastal wetland areas.

Nanoplastics—the tiniest plastic particles—are the least researched category of plastic debris, but potentially the most dangerous in terms of accumulation within the tissues and cells of organisms. Micro- and nanoplastics can affect whole ecosystems through what is known as trophic transfer: primary consumers (filter feeders and zooplankton) are a pathway for the accumulation of plastic particles in higher-level consumers (fish and marine mammals). The overall effects of these phenomena on ecosystem productivity and health remain unknown, since most studies focus on single-species impacts.

Plastic pollution also burdens human communities and businesses. Maritime industries have suffered damage to their physical infrastructure from encounters with plastic. Marine debris can entangle or block vessels' propellers, anchors, pipes, and rudders, which puts the safety of their crews at risk and requires expensive repairs. Coastal areas like beaches, estuaries, and islands are littered with marine debris. Local organizations often organize beach cleanups with volunteers who participate in both cleaning and data collection. These citizen-scientists contribute to growing databases that identify the amount and types of waste collected on beaches.

The Ocean Conservancy, a nongovernmental organization, has recorded that volunteers collected over 317 million pounds of waste from coastal areas in the past thirty years. The most common items collected include plastic fragments, foam pieces, food wrappers, cigarette butts, and plastic bottles. While most of these items derive from land-based activities, beach cleanups also remove fishing buoys, nets, lines, and other types of gear from sea-based sources. These cleanups are costly—whether in volunteer hours or municipal expenditures—but the alternative may be costlier still, since coastal communities can suffer millions of dollars in economic losses due to the impact of plastic litter on tourism and local fisheries.

The overall character and magnitude of the problems caused by marine plastic pollution are still coming into focus. One major area of uncertainty concerns the seafood economy. Roughly one-fifth of the global human population depends on seafood as its primary source of protein. Limited studies have found microplastics in seafood at various locations around the world. Marine shellfish aquaculture is especially vulnerable to microplastics because of the difficulties of creating a clean environment for filter feeders. But whether plastic ingestion by marine organisms will impact the availability or quality of seafood remains to be seen.

Humans are at higher risk of consuming microplastics if they eat the entire animal, especially the digestive system where the plastic accumulates. We do know that the presence of marine plastic may exacerbate the risks of toxins accumulating in the food chain, and therefore is potentially detrimental to human health and fish reproduction. But we do not have dispositive evidence that consuming plastic in seafood increases the risks of transmitting toxins through human digestive systems, or that the availability of seafood will decrease because of the effects of plastic ingestion by fish and shellfish. Additional scientific research is needed to understand the full impact of marine plastic pollution on human health and well-being.

Consumers and Companies

The complexity and scale of the marine plastic problem means that there are many possible solutions, and that an effective response will likely require a "solution set" that includes multiple efforts by different actors. Solutions can be adopted at a variety of levels, from individual choices to international agreements, and at various points along the chain from production to consumption to disposal. In general, solutions can be grouped into two basic types: mitigation, which seeks to reduce the flow of plastics into the environment, and remediation, which focuses on cleaning up the plastic that is already out there. Efforts are currently underway along both of these tracks, and at several different scales.

At the individual level, the "reduce, reuse, recycle" motto continues to guide consumers looking to cut down their plastic consumption. Reusable water bottles, coffee mugs, straws, and grocery bags are understood as personal commitments to avoid disposable plastic products. "Fast fashion" is increasingly criticized as wasteful and inefficient, especially given the growth and prevalence of synthetic fabrics that contain microplastic fibers.

Consumer awareness campaigns have a limited impact, however, because consumers are overwhelmed by the ubiquity of plastic, especially in packaging, at the stores they depend on. Although there are sometimes non-plastic versions of plastic products, these alternatives are almost always more expensive. And even when changes in demand cause companies to shift their offerings in one place, the effect is counteracted by rising ex-

ports of plastic-heavy products to new markets in developing countries, where consumers are less inclined, or less able, to make environmentally informed choices.

Multinational corporations are at the center of plastic production and consumption, and their decisions about product design, packaging, and marketing have consequences for the scale and persistence of the marine plastic problem. The governance of plastics is highly fragmented, and trade in products is thoroughly globalized, so manufacturers can easily shift to less restrictive jurisdictions. And in many cases, the industry has successfully fought against proposed bans on disposable plastic products.

Despite this reality, many believe that corporate social responsibility—the idea that companies will make decisions based on the public interest rather than profits—can help solve the problem of plastic pollution. Multinational corporations with global brands have increasingly touted "greening" efforts involving supply chain transparency, packaging changes, the use of recycled materials, and even the adoption of more degradable "bioplastics." But the underlying problem is that the goals that drive these corporations to adopt greener policies are ultimately profit-driven: deterring costly government restrictions, increasing brand value through marketing, and maximizing manufacturing efficiency. Corporations often reinvest the savings from these efforts into new plastic product lines and access to new markets. And plastics production continues to increase.

LIMITED ACTION

In the United States, state and municipal governments have taken action to require businesses to offer nonplastic alternatives to consumers. California has enacted several laws to restrict single-use plastic products. In 2015, the state voted to prohibit businesses from providing single-use plastic bags to customers. If a bag is provided, it must be paper, reusable, or compostable and sold to the customer for a minimum of 10 cents. Since 2016, single-use bags must be made of recycled material.

In 2019, San Francisco went farther and passed a law that requires businesses to make changes in two phases. First, single-use items like straws, utensils, and stirrers must be available only on request, and made of biodegradable or compostable materials. As of 2020, these items cannot be made of polylactic acid, which is not marine biodegradable and requires industrialized composting systems to break it down. Other coastal cities and states have enacted similar measures. But California is a relative outlier: in fact, more US state governments oppose regulations on disposable plastics than support new rules.

Although it is generally easier to pass mitigation-focused product prohibitions at the state and municipal levels, the US federal government has taken limited action in this area. The Marine Debris Research, Prevention, and Reduction Act of 2006 established a program, run by the National Oceanic and Atmospheric Administration (NOAA), to support collaboration among federal agencies, indigenous tribes, academia, and local agencies on projects including community education.

In 2018, the Save Our Seas Act reauthorized the NOAA Marine Debris Program through 2022, with an annual budget of $10 million. A proposed Save Our Seas Act 2.0 would provide more research funding, enhance international outreach and collaboration, and improve domestic waste and recycling infrastructure.

The Microbead-Free Waters Act of 2015 banned the use of microbeads in cosmetic products such as toothpaste, face wash, and makeup. Cosmetic microbeads are especially likely to flow into waterways because wastewater treatment plants are not designed to capture them.

These legislative responses have been matched or exceeded by many other countries. More than 120 countries have passed some type of plastic bag regulation, although these laws vary widely in their comprehensiveness and effectiveness. European and African countries have taken the lead in banning disposable plastic bags. By 2021, all European Union member states will be required to begin implementing single-use plastic restrictions and "extended producer responsibility," which requires companies that sell plastic products to pay into a fund for waste collection systems.

Recycling—long considered a central part of the solution to plastic waste—has come under increased scrutiny, and even criticism, as a feel-good but do-little alternative to reducing plastic consumption. A recent exposé by the Center for Public Integrity outlined a concerted and strategic effort by the plastics industry to promote recycling as the preferred "solution" to plastic pollution because it shifts responsibility from the industry to consumers and government-funded waste management systems. Overall, it is estimated that less than 10 percent of all plastic items are recycled, in

large part because recycling is rarely economical without subsidization, and many types of plastics are not recyclable with current technology. Single-stream recycling, in which all recyclable material is collected in the same bin, has combined with misinformation and confusion in the United States about what is recyclable, creating a situation where recycling is often mismanaged, contaminated, and of low value.

For many years, this lack of real recycling was hidden from consumers, as recyclables collected in developed countries like the United States were exported to China and Southeast Asia to be sorted and sometimes recycled by small and medium-size facilities. But in 2018, China prohibited the import of low-value "foreign waste," leading to a pileup of collected recyclables at facilities in the United States. Many cities have resorted to incinerating the amassed waste, which releases harmful air pollutants.

Even if consumers were able to reduce, reuse, and recycle enough to effectively mitigate flows of plastic into the marine environment, the millions of tons of plastic already in the oceans would continue to harm marine ecosystems and industries. In addition to beach cleanups, many high-profile remediation efforts have emerged in the past few years. The brilliant branding and technical success of Baltimore's "Mr. Trash Wheel" mobile collector led to an expansion of the program with two additional collectors. These solar-powered water wheels use an angled conveyor belt to collect garbage floating on the surface of Baltimore's harbor.

Many plastics are so small that even advanced waste management systems cannot capture and dispose of them safely.

More visible on the national and international scene is The Ocean Cleanup, a project founded by Dutch inventor Boyan Slat in 2013, which designed a passive system of floaters to collect debris on the high seas. The project's goal was to collect up to 50 percent of the marine debris in one of the world's several open-ocean gyres, the Great Pacific Garbage Patch, in five years, using a 600-meter-long group of connected floaters. The collected waste was to be recycled and sold to companies, with the resulting revenue feeding back into the project. But the initial voyage failed because of technical challenges, and critics of The Ocean Cleanup's approach are concerned about its impact on marine ecosystems and its durability. In 2019, the group switched its focus from the gyres to collecting marine debris from 1,000 of the world's most polluted rivers by 2025. Although such remediation efforts are valuable, an effective solution set ultimately must turn off the tap of plastic flowing into the ocean.

SOLUTIONS AT SCALE

The problem of marine plastic pollution shares many similarities with the challenge of climate change. Plastics are made from fossil fuels, and manufacturing them contributes to greenhouse gas emissions. Plastic pollution and climate change are both global issues, with multigenerational consequences. Their causes are decentralized, widely distributed, and difficult to trace with precision. The two problems result from modern industrial civilization, such that more globalization and economic development have tended to correlate with growth in both problems. And the products and conveniences that contribute to these global environmental problems—like imported produce, gasoline-powered cars, and Amazon's delivery service—are associated with a rising standard of living.

In both cases, questions of accountability and responsibility are difficult to answer. No single actor or small group can solve the problem alone. And the global population has a stake, because the negative impacts of climate change and marine plastic are broad, multifaceted, and incompletely understood.

Humans have not done enough to prevent the harmful impacts of climate change, and the same is true for marine plastic pollution. In many cases, there have been commitments without follow-through. For example, the 1982 United Nations Convention on the Law of the Sea, which 168 countries have ratified, includes a requirement that those countries take the necessary measures domestically, and establish global and regional rules, to "prevent, reduce, and control pollution of the marine environment from land-based sources." Clearly, these are unmet obligations.

More recent international agreements, like the UN Sustainable Development Goals and the 2011 Honolulu Commitment to reduce marine plastic debris, are nonbinding aspirations, meant to coordinate international action but not to enforce it. And the legislative actions taken at local, state, and national levels are not uniform enough, or strict

enough, to generate effective solutions from the bottom up. Many seem to be looking to the smallest possible scale—the level of the individual—for solutions. Consumers are increasingly expected to make lifestyle choices that reduce the consumption and disposal of plastic products. Meanwhile, the ultimate sources—the industries that produce, market, and export plastic products—have largely avoided regulation and accountability.

The differences between climate change and marine plastic debris suggest that the plastic waste problem should be easier to solve. Plastics are tangible, physical things that can be relatively easily collected, compared with atmospheric molecules of greenhouse gases. And it is difficult to explain why increasing numbers of wildfires or destructive hurricanes are a product of climate change, whereas it is easy to comprehend the cause and effect of a seal entangled in a net, a sperm whale with a belly full of plastic debris, or oysters containing microplastics.

But there is much we could be doing that has yet to be done. A thorough and effective solution set for marine plastic pollution would likely include government regulations on product design, international funding mechanisms for modernizing waste management systems, and investment by state and national governments in cleanup activities. A total solution is probably impossible, given the amount of plastic that is already in the oceans. But an effective set of responses can still reduce the magnitude and longevity of the problems caused by ocean plastic, and mitigate the eventual impact on ecosystems and human communities.

Marine plastic pollution is a grand challenge: it raises deep questions about the human relationship to the planet and broad international trends related to population growth, consumption, development, and sustainability. The best set of solutions is likely to span the scale from individual to international action, and to address different points along the chain of production, consumption, and disposal. Perhaps the most important response for now would be more education about this complex problem, to encourage consumers, voters, and ocean users to change their behavior—and pressure industries and governments to take decisive action. ■

"Rather than assuming that host communities must serve the industry, expectations should be adjusted so that tourism genuinely aligns with those communities' own priorities."

Tourism and Its Discontents in the Global South

JOSEPH CHEER

Tourism has become a massive global business sector. Travelers criss-crossing the globe took a record number of more than 1.4 billion international trips in 2018, spending huge amounts of money and generating $1.7 trillion in revenue, according to the United Nations World Tourism Organization (UNWTO). The volume and extent of these global sojourns is unprecedented in human history. International travel, whether for leisure, adventure, education, business, or religious purposes, is now embedded in contemporary lifestyles.

And more people and places have been drawn into the tourism industry than ever before. According to current estimates, over one in ten jobs around the world can be attributed to tourism. The sector accounts for around 7 percent of total international exports and 30 percent of services exports.

Underpinning the growth of international travel are the changing tastes of the globe's mobile and affluent classes. Many among them have shifted their attention from the acquisition of material goods toward the accumulation of extraordinary life experiences—the kinds of experiences that can only be achieved through travel. Tony Wheeler, the cofounder of travel guidebook publisher Lonely Planet, and arguably the father of today's globalized tourism, has opined that the more one travels, the more extraordinary the world becomes.

This notion of travel as the antithesis of the everyday routine is now commonplace. And travel has become more widely accessible thanks to an array of factors, including a prolonged period of global economic growth, the proliferation of low-cost airlines, and the lowering of visa entry requirements. The ubiquity of social media and personal brand building now entices more and more people to pursue and share such experiences.

The implications of booming international travel have become intertwined with pressing global concerns, notably climate change and other environmental issues, such as the exploitation of nature. Tourism also can determine the economic development prospects of destination areas. And there is a growing trend of tourists participating in volunteer projects to do good while traveling.

My particular focus here is on the impact of international tourism on what is usually referred to (at least in scholarly and international development circles) as the global South—those countries and areas that belong to the less developed or developing world. This encompasses the majority of countries in Africa, Southeast Asia, Latin America, Central Asia, the Pacific Islands, and others in contexts more difficult to define.

The idea of the global South often also includes First Nation Peoples and other indigenous groups in developed countries such as Australia, Canada, and the United States, whose standards of living are comparable with those in the less developed and developing world. Some indigenous peoples have sought to leverage their cultural and natural inheritances for tourism development, trying to capitalize on the marketability of indigeneity as a draw for global travelers.

Tourism today still mainly involves the global movement of travelers from the developed countries (or the global North) of Western Europe, North America, Australia and New Zealand, Japan, and South Korea. They are increasingly joined by the rapidly growing affluent classes of China. Yet most international travel for tourism is still with-

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in the global North: between Europe and North America, or between Asia and both Europe and North America. Although travel from the global North to countries of the global South is also on the rise, it has grown to a lesser extent. But it has provoked a great deal of debate.

The catchphrase "sustainable tourism" has come to stand for the aspiration to develop the industry in a way that respects the needs of hosts as equivalent to those of travelers. The UNWTO designated 2017 as the Year of International Tourism for Sustainable Development. This strain of idealism has long been voiced by promoters of the merits of tourism in the global South. It emerged in the 1960s, when H. David Davis of the World Bank argued that tourism was unparalleled in its ability to generate foreign exchange earnings and stimulate employment and incomes, and was therefore an ideal means of accelerating economic development.

While some contemporary observers are also sanguine about the potential of tourism to deliver substantial benefits for the global South, others like Tricia Barnett, cofounder of the group Equality in Tourism, argue that despite enormous opportunities, the truth is rather depressing: although jobs are indeed created, the payoff is questionable. The main reason, according to Barnett, is that the tourism industry very often is dominated by foreign direct investment, so the economic benefits accrue elsewhere. This presents a dilemma for many countries of the global South—how to ensure that the expansion of tourism does not play out along marginalizing neocolonial lines, leaving local communities worse off.

Expansion of the tourism sector can lead to displacement of local people.

THE NEW GRAND TOUR?

In Europe, the tourist circuit known as the Grand Tour served as a rite of passage for privileged members of the upper classes from the seventeenth century into the nineteenth century—typically with Italy as the ultimate destination. The Grand Tour might be considered something of a precursor to present-day tourism to the global South. Some idealists still see travel as a path to education and enlightenment, or to developing character and a well-rounded worldview—aims once associated with the Grand Tour.

But for the most part, today's reality is radically different due to the democratization of global travel. Far more people now have access to travel and the means to undertake their own versions of the Grand Tour. One need only look at the summer playgrounds of the Mediterranean, or the thronged resorts of Southeast Asia, to recognize that for many tourists, any noble intentions have given way to excesses of hedonism and self-indulgence that can make life a nightmare for host communities. Hedonism, of course, was not unknown among travelers in the age of the Grand Tour, but the number of tourists (and hence their impact) was much smaller then.

Contemporary travel to the global South typically takes place against a backdrop of poverty, enduring legacies of conflict and environmental crises, natural resource scarcities, and developmental deficiencies such as a lack of diversified economies. This leads to perhaps the most contentious aspect of global travel: beyond the clash of cultures, disproportionate power relationships are established between relatively moneyed, educated, curious travelers and desperate, poorly educated hosts. While there are obviously exceptions to such generalizations, these power dynamics are all too common in host-guest relations in the developing world.

For many tourists, travel to the global South is doubtless driven by a genuine fascination with its people and places, or what might be called a desire to explore the world of the exotic "Other," as the literary scholar Edward Said put it in his influential 1978 book *Orientalism*. The eighteenth-century French philosopher Jean-Jacques Rousseau's concept of the "noble savage," the antithesis of modern man, reflects an early version of this same desire to experience the life of the Other as an escape from one's own familiar and mundane existence.

Today, companies capitalize on such yearnings by marketing opportunities to "live like a local." They offer supposedly authentic experiences that are eminently suited to self-congratulatory social media posts. Celebrations of Hawaii's "Aloha spirit" are emblematic of the banality of many such touristic encounters: the salutation, meant in island culture to convey love, friendship, and care, is extended to tourists, yet its commercialization in staged luaus and hula dances belies those warm intentions and renders host-guest exchanges as superficial transactions.

"Making a difference" through travel has become another rallying cry for many tourists of a progressive and humanitarian outlook who are intent on leaving a positive mark on the global South. Volunteer tourism—"voluntourism"—is characteristic of this trend. Both skilled and unskilled travelers sign up to work alongside government personnel and civil society groups on development projects in areas such as education, public health, economic development and infrastructure, and emergency aid delivery. While some voluntourism efforts may be productive, they have also drawn criticism as convenient ways to pad a resume, or to indulge the so-called white savior impulse, rather than vindicating an ideal of tourism as a mutually beneficial exchange.

A broader movement for "responsible tourism," which brings together academics, industry organizations, and advocacy groups, promotes the mantra, "Take nothing but photographs and leave nothing but footprints," while warning against inappropriate, inconsiderate, and exploitative behavior by travelers to less developed and developing countries. Yet the mere presence of tourists, no matter how careful or well-intentioned they may be, can have profoundly disturbing and damaging impacts. In her short 2011 documentary film about tourism in remote Ethiopia, *Framing the Other*, for example, Ilja Kok depicts how competition among villagers for the new resource can intensify into conflict.

Another revealing documentary, Denis O'Rourke's 1988 *Cannibal Tours*, is about European tourists in Papua New Guinea's Sepik River region. It examines the problematic nature of host-guest encounters in which travelers are embraced for their wealth, while local people are fetishized for their supposedly primitive and otherworldly personas. The tourists seek to extract exoticism from the Other, while the hosts work to gain maximum economic advantage.

In the 1980 book *Pacific Tourism: As Islanders See It*, edited by Freda Rajotte and Ron Crocombe, which was one of the first scholarly attempts to elicit host communities' perspectives, local residents complained that they received only crumbs from the tourist trade. The late anthropologist Malcolm Crick similarly lamented that the overwhelming effect of tourism in the global South has been to reinforce the subservience and precarious state of host communities, deepening the marginalization wrought by the historical legacies of colonization. These adverse impacts are intensified by both the dominance of outside influence in global travel supply chains and the cronyism and poor governance prevalent in developing countries.

COUNTING THE COSTS

The question of whether tourism's impact on destination communities in the global South is mostly beneficial or largely damaging is difficult to answer unequivocally, due to the complex interplay of factors and a lack of fine-grained data gathered over a long period. Analyses of the impacts of tourism tend to be couched in economic terms, such as total international visits and expenditures, foreign direct investment, jobs created, and overall contribution to gross domestic product at the national level. Tourism's potential for alleviating poverty has long been promoted as its most positive benefit; but although there are some examples of this panning out, they are fairly rare.

Jeremy Smith, a leading voice for sustainable tourism, argues that one reason for these disappointing results is that "acting more sustainably is framed as an external cost," rather than as an essential undertaking. It is unlikely that most tourists will pay more or behave differently to ensure that their holidays in the global South have more beneficial effects for local communities. Smith also notes that although tourism's potential benefits for host communities are often touted, international travel is driven by unsustainable consumption of fossil fuels. Flights from Europe to Africa or from North America to Latin America generate large quantities of carbon emissions in an age of accelerating climate change. Tourism and climate change researchers James Higham and Susanne Becken argue that the most environmentally sound action that people can take is to travel less, though they concede that persuading enough people to change their behavior so dramatically would be a formidable task.

Countries in the global South are the most vulnerable to climate change and other environmental disruptions, given their greater reliance on natural resources and exposure to natural disasters. Small-island developing countries are a case in point, as seen in the inundation from sea-level rise afflicting the Pacific island states of Kiribati and Tuvalu and the increasing frequency of extreme weather events in the Caribbean. In these contexts, where natural capital is crucial to local livelihoods and food sources, any degradation is bound to have profound impacts on inhabitants' well-being.

More often than not, where international tourists go and how they spend their money is deter-

mined by a profit-driven industry that is little concerned with the well-being and security of local residents. Community-based tourism—travel that bypasses the global tour operators and strives to connect directly with local producers—is a niche experience at best, and often an expensive one.

For countries in the global South, the main allure of tourism involves economic imperatives—jobs, foreign exchange earnings, foreign investment. But their efforts to seize such opportunies and build more diversified economies are often hindered by multiple bottlenecks, including government incapacity, the dominance of foreign capital, political instability, and weak resilience to natural disasters. Many local people have menial, low-skilled jobs and limited formal education, whereas tourism enterprises may require highly trained staff.

The reliance on foreign direct investment is a further constraint on the positive economic effects of tourism, since profits are usually repatriated abroad or otherwise prevented from being put to use locally. Limited ability to satisfy the needs of visitors with locally sourced products often results in "leakages" of tourist spending.

Far more people now have the means to undertake their own version of the Grand Tour.

The social impact of tourism in the global South is felt mostly at the local level. Expansion of the tourism sector can lead to displacement of local people, as desirable real estate—coastal or arable land—is snapped up by government insiders and private interests for resort and infrastructure development. Inflationary effects also force surrounding communities to retreat to more peripheral locales. For indigenous peoples, alienation from their traditional land disrupts customary ways of life and livelihoods—and puts them at a disadvantage in the competition for scarce resources such as water.

These disruptions fragment communities and undermine their overall resilience to change. Some commentators also point to "demonstration effects"—the phenomenon of locals, especially youth, mirroring the behavior of tourists. This can be particularly problematic in places where the culture is deeply conservative and religious.

Analyses of the cultural impact of tourism raise questions about authenticity, commodification, and diminishing integrity. Authenticity, or the extent to which a culture retains its integrity in touristic contexts, is widely presumed to attract foreign visitors. Some therefore argue that tourism can play a role in ensuring that local culture is valued and even strengthened. But tourism often leads to garish displays of culture—crass, Disneyfied versions of the authentic. Critics say that such commodification is harmful to local communities whose cultural identity is debased and trivialized in order to entertain tourists.

EARNING THE RIGHT TO TRAVEL

The success of efforts to secure better and more consistent outcomes for destination communities in the global South will depend on instilling a more ethical approach and a greater awareness of social justice concerns in the consumption of travel experiences, as tourism scholar Tazim Jamal suggests. What good will the industry do if it marginalizes communities that are already disadvantaged, or undermines the social, cultural, and environmental inheritances that bind them together and enable them to respond to change? The tourism industry and governments must recognize and protect the interests of these communities, and tourists themselves need to exercise more responsibility.

The international development scholar Regina Scheyvens has found that evidence that tourism contributes directly to poverty alleviation is fairly sparse. Such findings challenge the claims of governments, development agencies, and industry representatives that more tourism will deliver many benefits to host communities. But others, like Jeremy Smith, argue that properly designed regulations can ensure that societies benefit and that tourism is indeed sustainable.

My own research into links between modern slavery and tourism in the global South suggests that the problem is far more severe than it has been thought to be. Growing interest in orphanage visits has resulted in children, most of whom are not actually orphans, being housed like animals in a zoo to attract tourists. And human traffickers commonly provide cheap labor for construction sites or to serve as housekeepers and cooks at resorts.

The desire for extraordinary travel experiences seems to be frequently accompanied by a naive or willful ignorance of the reality that other people may be exploited in the process. What, then, of the so-called right to travel, which the World Tourism Organization says should be "equally open to all

the world's inhabitants"? Surely this right must be matched by efforts to stop tourism from morphing into a disruptive and damaging force, particularly for the most vulnerable. But the question of who should be responsible for such measures is difficult to adjudicate.

Although the situations where tourism has proved capable of delivering mutually beneficial outcomes for hosts and guests are rare, the question of whether tourism can be a boon for communities in the global South remains open. For tourism to deliver the promised benefits, a lot has to go right. Rather than ad hoc, demand-driven, and politically motivated rationales, tourism requires effective, accountable planning and governance. Local communities must have a say in how their collective inheritances are mobilized for tourism; they should not be excluded from critical decision-making, particularly in development planning processes.

The time has come to reconceptualize tourism. Rather than assuming that host communities must serve the industry, expectations should be adjusted so that tourism genuinely aligns with those communities' own priorities. But tourism, like any other industry, makes the pursuit of profit its top priority. How can this be reconciled with the interests of countries in the global South that desperately need sustainable development? And what if the pursuit of development through tourism is more harmful than beneficial for some countries? Despite all of the shiny airports and glitzy resorts proliferating in the global South, and the many government pronouncements that the tourism industry will deliver untold riches to needy communities, the jury is still out. ■

Are We at a Climate Tipping Point?

PAMELA MCELWEE

In 2019, climate change was everywhere. From massive, deadly wildfires in California and Australia to the millions of students who went on strike around the globe, the climate seemed to finally be getting the attention needed to fix our looming problems. Yet the year-end United Nations climate change conference in Madrid failed to make any progress, and the deadlock was exacerbated in part by the Trump administration, which is withdrawing the United States from the Paris Agreement.

Scientific studies issued in recent months have continued to stress the urgency of the problem. One distressing report emphasized that we are beginning to see signs of activation of climate "tipping points," when the rate of change of a system accelerates rapidly, often in unpredictable and irreversible ways. What kinds of climactic and social tipping points might we be facing in 2020, and where is the world likely to go from here?

THE POLITICAL PICTURE

The Madrid meeting of the Conference of the Parties (COP) to the UN Climate Convention—moved to Spain at the last minute after antigovernment mass protests forced the original host country, Chile, to cancel—was by all accounts a failure, even after the longest marathon session in the treaty's 25-year history. It was supposed to be the year when countries began to ramp up initial pledges that they made in 2015, when the Paris Agreement was originally signed, to move toward more aggressive climate action in 2020 and beyond. Instead, the US withdrawal from the agreement seems to have triggered a rush for the door by other recalcitrant parties, including Saudi Arabia, Brazil, and Australia, each with their own political agendas at play.

Meanwhile, China and India, which are both generating rapidly growing carbon emissions, balked at meeting or exceeding their 2020 targets for reducing those growth rates, arguing that financial support for developing countries that was agreed to in Paris four years ago has not been forthcoming. The positions of these two countries have been hardened by economic downturns in the past year that have made lofty climate pledges more difficult to put into practice.

In addition to disappointing hopes that it would produce more ambitious pledges by individual countries, the Madrid COP failed to tackle two cross-cutting issues that fall under Article 6 of the Paris Agreement. The first is how to compensate countries already experiencing negative climate impacts, known as "loss and damage." In 2013, countries agreed to address this through the Warsaw International Mechanism (WIM), a working group that meets regularly to hash out solutions and bring proposals to the COP. But discussions have faltered over putting specific numbers on damages, persuading the reluctant richer countries to commit to providing large amounts of additional funding to the developing world, and considering whether adopting rules proposed by the WIM would expose countries to legal liabilities. Another stumbling block in Madrid was the US insistence that WIM decisions apply only to countries adhering to the Paris Agreement, not to those that have withdrawn, as the Trump administration plans to do by the end of 2020.

The second major issue in Madrid was deciding whether and how countries can trade on an international carbon market. Australia is pushing for old emissions credits from the Kyoto Protocol, a precursor to Paris, to be deemed tradable, but many other countries fear that move would water down more ambitious emissions reductions. Activists and environmental groups excoriated delegates for failing to approve a new market mechanism, but there is reason to proceed cautiously. The Kyoto trading system was mostly a disappointment, and many parties, especially indigenous communities, have raised concerns about the justice implications of emissions "offsets" (tradable credits that fund projects to reduce emissions to make up for continued emissions in another place) that may dump the costs of climate action onto disadvan-

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taged areas. These issues have also been troubling California's nascent emissions trading scheme. It may be wise to allow more local experimentation with different models of carbon trading, particularly for buying offsets in poorer countries, before expanding it on the international scale.

THE SCIENTIFIC PICTURE

The failures in Madrid stand in stark contrast to the increasingly dire warnings issued by scientific bodies. The Intergovernmental Panel on Climate Change has released three special reports since 2018: one on oceans and the cryosphere (the planet's frozen parts); another on climate and land, for which I was one of nearly 100 authors; and the "1.5 degree report," which identified actions that would need to be taken to limit global warming and avoid the worst impacts. The latter report received unprecedented attention, and although this has been gratifying for many climate scientists, there is concern that its findings have been overly simplified into the motto, "We only have 12 years left," which is both inaccurate and potentially demoralizing enough to thwart hopes of spurring more action.

The pace of political change continues to be slow even as scientists are increasingly confident of being able to determine with specificity how extreme weather events like storms and floods are driven by climate change, a field known as "detection and attribution." A recent major advance in climate science has been the rollout of improved climate models (known as the Coupled Model Intercomparison Project)—global simulations, run by multiple institutions, that can be compared. Although there is some variation among them, their findings increasingly indicate that climate sensitivity (how quickly the climate system responds to increasing levels of greenhouse gases) is higher than previously predicted.

This means that trying to meet the Paris target of holding the global temperature increase to 1.5 degrees Celsius above preindustrial levels is even more urgent. Failure to do so may activate climate tipping points even at lower temperature thresholds, including melting of some Antarctic ice sheets or dieback of the Amazon (a region-wide loss of rainforests that would result in a permanent shift to a lower-biomass, drought-prone, and degraded system), with potentially devastating and irreversible consequences.

Many countries are actively sabotaging decarbonization goals.

REASONS TO BE OPTIMISTIC

Nonetheless, there are reasons to be optimistic about progress that was made in 2019. Climate change has never been higher on the political agenda, particularly in the United States. Youth activism captured attention in a dramatic way, from the Sunrise Movement in the United States to Extinction Rebellion protesters in Britain, the Fridays for Future school strikes by students in more than 150 countries, and even the disruption of the annual Harvard-Yale football game by protesters urging the two universities to divest their endowments from fossil fuels. These youth—typified by Greta Thunberg, the 16-year-old Swedish activist named *Time* magazine's Person of the Year, but including many other young people of color and from indigenous communities—have helped set a new agenda. We may well be seeing social tipping points in public perception of the problem.

In US politics, there is a new focus on climate within the Democratic Party: all the major presidential candidates have released ambitious climate plans, and the party's congressional leadership has given serious attention to a proposal for a Green New Deal that would reduce the country's net carbon emissions to zero (known as decarbonization) by 2050. All the parties in Britain's December election also adopted a decarbonization agenda, even the winning Conservatives—and since Glasgow is hosting the next COP, Prime Minister Boris Johnson will help shape the climate agenda in 2020. Businesses have been taking climate seriously, too: more than a hundred large companies, including big players like Walmart and McDonald's, have pledged to meet challenging carbon reduction targets.

All of this action, from individual to global levels, is starting to bend the greenhouse gas emissions curve ever so slightly downward. Before the Paris Agreement, the world was on track for a temperature increase considerably higher than 4 degrees Celsius, but now existing pledges may keep us to 3 degrees, or even less—though still not the 1.5 degree target we need to aim for. Some countries have been able to grow their economies while also reducing net carbon emissions, a process known as "decoupling" that will be necessary across the board.

Part of this success has come from technological breakthroughs and lower costs for renewable

and other energy sources. For example, like an increasing number of consumers, my family bought a fully electric vehicle for the first time this year. This was enabled by the rapid expansion of charging stations in our home state of New Jersey, and the increasing range and lower prices of new vehicles from many manufacturers. Much of this progress can be attributed to early investments in the first years of the Obama administration, when economic stimulus funding in the post–financial crisis Recovery Act was channeled to clean energy and battery companies. The results show the importance of government support for research and development in driving innovation.

Reasons to be pessimistic

These reasons for optimism need to be tempered with realism about how difficult the path ahead will be. There are a number of factors impeding rapid climate action to avoid the worst impacts.

First of all, while the emissions curve is bending slowly, faster reductions are needed to limit the world's average temperature increase to 1.5 degrees. The UN Emissions Gap Report 2019, released just before the Madrid COP, identifies gaps between where we need to be and where we are. It shows that global emissions need to fall 7.6 percent every year from 2020 onward to have any hope of limiting warming to acceptable levels. That scale of change will be nearly impossible to achieve without radical, rapid steps, and no country has gotten to zero net emissions yet. Given the slow pace of change, we also will likely need new negative emissions technologies that can remove existing carbon dioxide from the atmosphere—which raises moral and economic dilemmas, such as trade-offs between bioenergy and food production.

Many countries are not just failing to meet decarbonization goals but are actively sabotaging them by continuing to build coal plants and drill for oil. All the electric vehicles in the world will not make a difference if they plug into a grid run on carbon-intensive coal. The recent public offering of shares in Saudi Aramco, the world's largest oil company, showed that the financial system still values fossil fuels, even as climate scientists warn that we need to keep most of the remaining oil in the ground. Doing so would leave the world's largest energy companies with stranded assets, but there is no sign that they are taking that risk seriously. Instead, much attention has been focused on individual actions, such as whether climate activists should feel guilty about flying or not, rather than on the systemic change that is needed—from a complete restructuring of energy production and consumption to massive investments in green infrastructure and improved agriculture and land management.

Even more worrisome, public sentiment against climate policies, particularly higher fuel costs, erupted in France, Chile, and elsewhere in 2019. The French *gilets jaunes* (yellow vests) protests were linked to concerns about the inequitable impacts of carbon taxes on poorer and rural families. Populist movements elsewhere have brought to power leaders who care little for tackling climate change. For example, wildfires in Brazil have been seemingly welcomed by President Jair Bolsonaro as a means of expanding agribusiness further into the Amazon, including indigenous territories—a reward for political backers of the president. The recent political turmoil in Bolivia—President Evo Morales went into exile in November after a disputed election—seems likely to end that country's role as a global voice for climate justice.

We also got frightening glimpses in 2019 of what a failure to stop climate change will bring, particularly the terrible inequalities that weather extremes impose. In California, as wildfires raged, celebrities hired private firefighters to protect their multimillion-dollar homes while others lost everything, and some wealthy homeowners evacuated fire zones while housekeepers showed up to work in the empty mansions their employers had left behind. A massive heatwave and drought left millions of poor people in New Delhi scrambling to find water and shade (criminal gangs took over water supplies)—though better-off households still had ample access to both. The political implications of these unequal climate change impacts make the populism sweeping the world appear even more ominous.

The world community stands on a precipice in 2020. Will the differences in how climate impacts are felt drive more wedges between richer and poorer countries, preventing action to strengthen the global response? Or will shared experiences of the destructiveness of climate extremes finally bring parties to the table in Glasgow later this year to recommit to the Paris Agreement in new and ambitious ways? The tipping points we face are very real—but whether or not we fall, and in which direction, is still very much up to all of us. ■

Who Gains from Our Online Lives?

MARY F. E. EBELING

The Next Billion Users: Digital Life Beyond the West
by Payal Arora
Harvard University Press, 2019

The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power
by Shoshana Zuboff
PublicAffairs, 2019

The same week that I was writing this review of two books—one of which addresses the monopolistic power of information tech giants such as Google and Facebook, while the other describes some of the pushback against this power by social media users in the global South—I was obsessively distracted by several stories that uncannily connected both perspectives. Steeped as we are in conspiracy theories in this era, it is hard to resist the paranoid compulsion to connect dots and augur meaning out of randomness, finding the uncanny, the horrific, and the treacherous in every online search.

I heard the first story at a meeting on the political influence of digital "solutions" in global health policy. Ramachandra Munda, a 65-year-old man, had starved to death last summer in his village in the Indian state of Jharkhand. Although people have often gone hungry due to a political failure rather than a natural disaster, Munda's death had very digital and bureaucratic causes. In order to receive his weekly food subsidy from India's Public Distribution System, Munda had to submit the digits on his hand—his fingerprints—to a biometric scanning machine. Unfortunately, the scanner in his village was broken. Despite his efforts to obtain his ration with his paper identification card instead, the local distribution office refused to give it to him without the requisite scan. After four days without eating a single morsel of food, as his family later told reporters, Munda died.

Under Prime Minister Narendra Modi's nationalist government, India's national ID system, Aadhaar, links citizens' biometric identities with their ID numbers and all sorts of public and private services. Their fingerprints are used to digitally unlock benefits or to enable activities essential to daily life. Fingerprints can access everything from food subsidies to mobile phone services. Government employees clock in at work with a fingerprint scan.

The Aadhaar system literally tracks the bodies of the Indian citizenry. It is officially voluntary, and politicians claim that the digital platform delivers social services more efficiently to empower people. But if you are hungry or need a job or a doctor, "voluntarily" registering your fingerprint in exchange for food or life-saving medicine seems pretty mandatory.

A second story that caught my attention concerned the US congressional impeachment inquiry into whether President Donald Trump extorted a foreign government for his personal benefit. The hearings commenced around the same time that I heard about Munda's death. As Marie Yovanovitch, the former ambassador to Ukraine who was unceremoniously yanked from her post in Kiev, testified before the committee, Trump turned to his version of the fireside chat—Twitter—and tweeted a smear of her reputation. Representative Adam Schiff, the Democrat chairing the hearings, read Trump's tweet out loud to enter it into the official record, alleging that it doubled as a rather unsubtle attempt at witness intimidation, another impeachable offense—committed in real time.

Finally, a third story that week was about a whistle-blower at Google who, after months working on a confidential project, and outraged by what appeared to be a serious breach of public trust, leaked to the *Wall Street Journal* yet another instance of massive amounts of personal information being traded in a secret deal. This time the data sharing involved one of the largest US healthcare providers, Ascension, which handed over more than 50 million of its patients' identifiable

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private health records to Google. While many observers asked about the privacy laws that ostensibly protect patient records, Google's public statement that the deal was perfectly legal served as yet another painful reminder that the American legislative process has installed wolves as the guardians of our privacy henhouse.

Of course, I watched all of these news events unfold primarily on the several digital platforms that I use obsessively on a daily basis: my Facebook news feed, Google searches on the Google Chrome browser, and television and Internet radio via Google Home. All three stories, as well as the ease with which I've been domesticated by these surveillance devices, tell of the toxic, and potentially deadly, conditions of our oligarchical infotech age, and the fractured, precarious democracies that create and maintain them.

Coin of the Realm

Both *The Age of Surveillance Capitalism*, by Harvard Business School scholar Shoshana Zuboff, and *The Next Billion Users*, by Payal Arora, an academic based at Erasmus University Rotterdam, promise to take on some of the societal and economic implications of our digital dystopic era. Zuboff goes further, working to expose a conspiracy of gigantic proportions—or at least the size of a data center in the Nevada desert—to control the behavior of millions by usurping their data through the false bargain of "free" transactions.

Clocking in at close to 700 pages, *The Age of Surveillance Capitalism* might serve as a capstone to Zuboff's career as one of the first women to be tenured at the world's most elite and influential business school. The unspoken goal of the book, it seems, is to provide an exhaustive and tidy business case analysis of a new economic formation that she calls Surveillance Capitalism. Zuboff argues that this is not merely the old capitalism dressed up in pixels: "surveillance capital derives from the dispossession of human experience, operationalized in its unilateral and persuasive programs of rendition: *our lives are scraped and sold to fund* [surveillance capitalists'] *freedom and our subjugation, their knowledge and our ignorance about what they know*."

Zuboff goes into meticulous detail about how Big Tech, particularly Google and Facebook, vacuum up their users' personal data and every trace of their digital lives to fuel the hegemonic power of surveillance capitalism. She contends that we are both the raw materials—our feelings, experiences, and behaviors—and the goal, or both the means and the ends, in surveillance capitalists' efforts to shape and change our behaviors. She describes this harvest of consumers' emotions and experiences as "behavioral surplus." This is what most in the industry call "data exhaust," which may suggest a waste material that pollutes environments and destroys worlds, but that in the hands of data monopolies transforms into assets and wealth.

Once our surplus is usurped, it is fed into what Zuboff calls the "behavioral reinvestment cycle." This refers to predictive and behavior-shaping artificial intelligence and machine learning assets—the realm's coin of this sector—that are used to shape us into better consumers. The findings of these AI platforms developed by the "Big Other" (Zuboff's moniker for the powerful surveillance monopolies) are sold to marketers and advertisers. They increasingly use more than the behavioral surplus from our participation in consumerism, drawing on other forms of personal data. The Big Other is after the totality of us, down to our hemoglobin counts, our DNA, and our blood pressure.

Notwithstanding Zuboff's ambitious goal of fully detailing the complexity of this new economic formation, her critique of surveillance capitalism remains focused on consumers and the Big Other; she does not probe deeper to the underlying structural forces that enabled these conditions in the first place. Zuboff is a believer in capitalism, but a functionalist form of it, where consumers call the shots and capitalists scramble to keep up with their demands, and where workplace safety or better pay result from a mutual beneficence, not from bloody and hard-won struggles. Her ideal capitalism is an equal and reciprocal relationship, in which consumer data is used to deliver improved services to the consumer, and never to serve the consumer to the capitalist on a digital platform. But it is difficult to recall a time when capitalists didn't hoard value through mass dispossession. Surveillance capitalism may not be a new formation, but rather just stale bread disguised as avocado toast.

Digital Neocolonialism

Arora's book, *The Next Billion Users*, seems to exist primarily to remind digitally privileged Westerners—not the exhausted Amazon warehouse workers on digital leashes or the patients denied lifesaving treatment by an algorithm, say, but the Bill Gateses, the Sheryl Sandbergs, and possibly even the Shoshana Zuboffs—that there is a whole world out there of social media users in the global

South. These users are young and full of dreams and desires that they express online, despite their poverty and their uncertain futures in a world that is exceedingly precarious and unequal.

Where Zuboff takes on the Big Other, Arora takes on Big Charity. In partnership with Big Tech, the Bill & Melinda Gates Foundation and others like it tout the potential of computing technologies such as laptops and online platforms for saving the poor, whether or not they want to be saved. Dubbing this trend for saving "digital colonialism," Arora grounds her critique in ethnographic data she gleaned from interactions with young users of communication technologies during research visits over several years in favelas, villages, and neighborhoods in countries as disparate as India, Brazil, South Africa, China, and Saudi Arabia. She argues that these technologically driven initiatives, originating in the global North and seeking to uplift the poor in developing countries, are destined to fail spectacularly, primarily due to their deeply problematic and neocolonial misunderstandings of the poor.

Aid agencies tend to operate within old tropes holding that assistance given to the deserving poor will enable them to raise themselves out of their deplorable conditions through hard work, pure thoughts, and the proper and prescribed use of technology. In this view, it's best to put a mobile phone in their hands, so that they don't emulate the peasants in the early period of European industrialization who used their wooden shoes to jam up the machinery of capital. But Arora argues that the poor resist such efforts by using these technologies in ways that the Silicon Valley do-gooders never intended. In the hands of the young and poor, mobile phones are used pretty much in the same ways that the young and affluent use them in the global North. Young people from São Paulo to Riyadh go online to seek out romance, to find their own private virtual corners where they can play with their identities, to demonstrate trust in their intimate relationships by trading selfies and Facebook passwords, to play games and tell jokes, and often to watch porn.

Big Charity's tech aid initiatives fail because they rely on the Silicon Valley libertarian ideology that claims new technologies will solve endemic poverty in developing countries without threatening capitalism. The problem is, capitalism produces poverty—it must, in order to survive. The global capitalist system is not broken, it was built that way. As Arora shows, no technological innovation, especially one rooted in either surveillance capitalism or neocolonialism, is going to fix it without dismantling the root of the problem. ■

November 2019

AFGHANISTAN

Nov. 28—In a Thanksgiving Day visit to Bagram Air Base, the largest US military facility in Afghanistan, President Donald Trump meets with his Afghan counterpart, Ashraf Ghani, and asserts that his administration has resumed peace talks with the Taliban. Trump had abruptly called off the negotiations on Sept. 7 after a US soldier was killed in a Taliban attack.

BOLIVIA

Nov. 10—President Evo Morales resigns after the head of the armed forces calls on him to step down to quell a popular uprising that erupted in response to Morales's disputed victory in an Oct. 20 election in which he sought to extend his 14-year rule. Morales, a leftist who had become the longest-serving head of state in Latin America, was the 1st indigenous person to serve as president.

Nov. 12—As Morales arrives in Mexico, accepting its offer of asylum, conservative Senator Jeanine Añez Chavez declares herself interim president in an address to Bolivia's national assembly and vows to pacify the country. The assembly session is boycotted by supporters of Morales, who calls his ouster a "coup." But the Constitutional Court immediately affirms Añez's claim to be next in the line of succession after the resignations of Morales, his vice president, and the leaders of both legislative chambers.

BRAZIL

Nov. 8—Former President Luiz Inácio Lula da Silva is released from prison a day after the Supreme Federal Court rules that criminal defendants cannot be imprisoned until they have exhausted all appeals. Lula, 74, was running for president again when he was ordered to prison in April 2018 to begin serving a 12-year sentence for corruption. That case and others still pending against him were politically motivated, he contends.

CHILE

Nov. 15—Legislators approve an agreement to hold a referendum in April on replacing the constitution, which was adopted in 1980 during the dictatorship of Augusto Pinochet and minimally amended since then. A new constitution is a chief demand of protesters who have held occasionally violent demonstrations across the country for a month. The deal for a referendum is a concession by President Sebastián Piñera, who declared a state of emergency in October and deployed the military.

CHINA

Nov. 24—In a record turnout after months of protests against tightening control by the central Chinese government, Hong Kong voters deliver a landslide victory to pro-democracy candidates, who win 392 of 452 seats on district councils in the semiautonomous region. Pro-Beijing candidates take just 60 seats, after previously holding 292.

Nov. 27—Trump signs legislation authorizing sanctions against Chinese and Hong Kong officials involved in human rights abuses against protesters in Hong Kong. China denounces the measure as US meddling in its internal affairs and vows to retaliate.

ETHIOPIA

Nov. 23—The National Election Board announces that 98.5% of voters belonging to the Sidama ethnic group have voted in favor of regional autonomy. Prime Minister Abiy Ahmed has restored political freedoms and won the 2019 Nobel Peace Prize for his moves to end a border conflict with Eritrea, but his reforms also risk igniting long-suppressed divisions. Hundreds have died in ethnic violence since 2018.

INDIA

Nov. 9—The Supreme Court rules unanimously that a plot of land in the city of Ayodhya where Hindu activists demolished a 16th-century mosque rightfully belongs to Hindus, who claim it is the birthplace of the deity Ram. The ruling clears the way for construction of a Hindu temple on the site, a victory long sought by Prime Minister Narendra Modi's Hindu nationalist Bharatiya Janata Party. More than 1,000 people were killed in anti-Muslim riots following the mosque's demolition in 1992.

IRAN

Nov. 5—President Hassan Rouhani announces that nuclear scientists will begin restarting uranium enrichment using 1,000 centrifuges at Iran's Fordow facility. The process had been suspended as part of a 2015 deal with the US and other foreign powers. Iran says it has also sped up enrichment at another site. The moves are in response to Trump's 2018 repudiation of the agreement and the harsh new economic sanctions he has imposed on Iran.

Nov. 15—Protests erupt in towns and cities nationwide within hours of an abrupt hike in state-controlled gasoline prices. Crowds grow violent in many cities, drawing a lethal response from authorities.

Nov. 17—Supreme leader Ayatollah Ali Khamenei stands by the fuel price hike, dismissing protesters as foreign-backed "thugs." The government also blocks Internet service. By the end of the month, at least 200 protesters have reportedly been killed.

IRAQ

Nov. 27—Protesters in the southern city of Najaf set fire to the Iranian consulate. No personnel are injured, but the attack underscores that hostility to Iranian influence is prominent in protests that have spread across Iraq for 2 months. The protesters have also denounced corruption and a governing system in which elites representing sectarian factions share power and spoils.

Nov. 29—After dozens of protesters are killed in a new crackdown by security forces, raising the death toll since the unrest began to nearly 400, Prime Minister Adel Abdul Mahdi says he will resign.

ISRAEL

Nov. 21—Prime Minister Benjamin Netanyahu is indicted for bribery, fraud, and breach of trust. He is accused of doing favors for media executives in exchange for positive coverage and costly gifts.

SPAIN

Nov. 10—In the country's 4th election in 4 years, the Socialist Party again is the top vote-getter but ends up with only 120 seats in the 350-seat parliament. The far-right, anti-immigrant Vox party more than doubles its number of seats, from 24 to 52, becoming the 3rd-largest party.

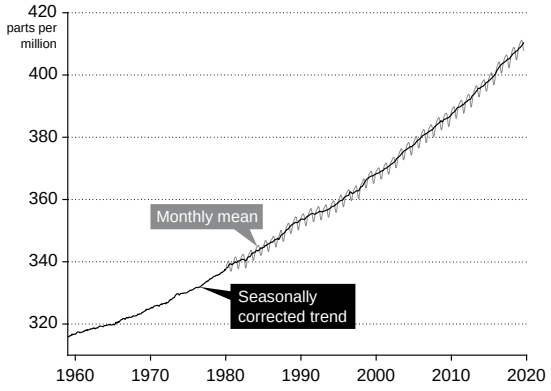
Nov. 12—Socialist Prime Minister Pedro Sánchez announces a tentative deal to form a coalition government with far-left party Podemos Unidos, which he previously shunned as a possible partner. But the 2 parties would still be short of a majority.

SRI LANKA

Nov. 17—Former Defense Minister Gotabaya Rajapaksa wins a presidential election with 52% of the vote, defeating ruling party candidate Sajith Premadasa. Rajapaksa was accused of war crimes while leading the military during the final phase of a 26-year war against a Tamil insurgency that was crushed in 2009, when his brother Mahinda was president. After taking office, Gotabaya Nov. 21 appoints Mahinda as prime minister. ■

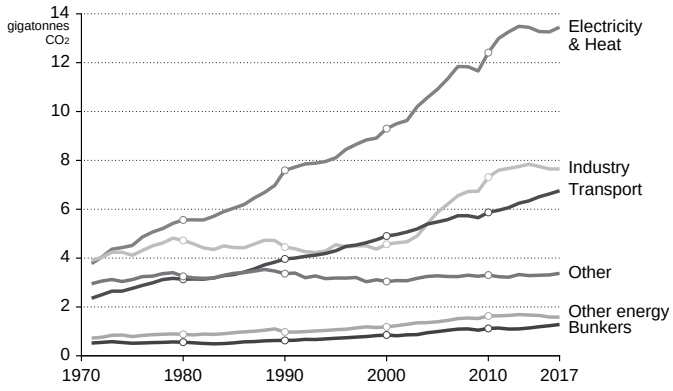
Global Carbon Emissions: A Statistical Snapshot

Atmospheric CO_2 concentration



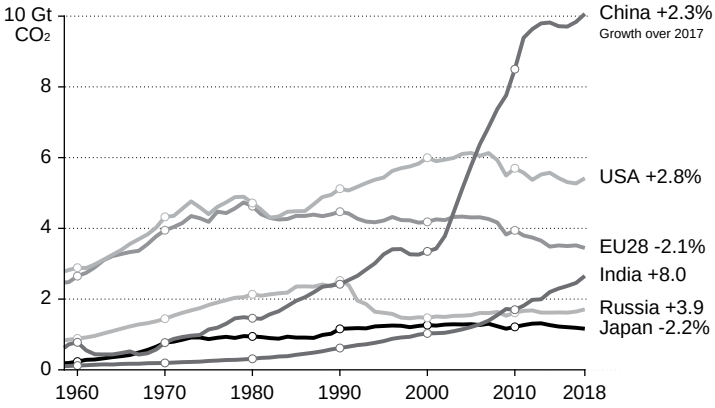
Data: Scripps/NOAA-ESRL (Measured at Mauna Loa, Hawaii)

Fossil CO_2 Emissions by Sector



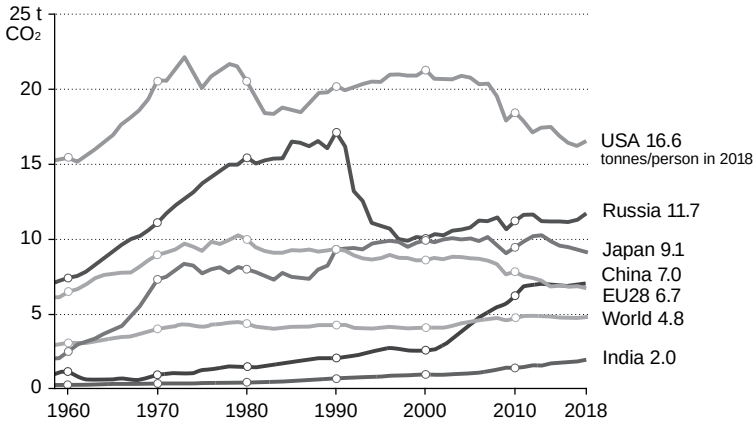
Data: IEA (2019), Andrew (2019)

Annual Fossil CO_2 Emissions: Top Six Emitters



Data: CDIAC / Global Carbon Budget

Top Emitters: Fossil CO_2 Emissions Per Capita



Data: CDIAC / Global Carbon Budget

Source: all figures from Global Carbon Budget 2019.