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The uninterrupted supply of resources such as oil and certain “strategic” minerals has been traditionally identified as a national security interest. But this focus on nonrenewable resources overshadows the impact scarcities of renewable resources such as cropland and water supplies can have on “Western national interests by destabilizing trade and economic relations, provoking migrations, and generating complex humanitarian disasters that divert militaries and absorb huge amounts of aid.”

Scarcities of critical environmental resources— in particular cropland, freshwater, and forests—are contributing to mass violence in several areas of the world. While these "environmental scarcities" do not cause wars between countries, they do sometimes sharply aggravate stresses within countries, helping stimulate ethnic clashes, urban unrest, and insurgencies. This violence affects Western national interests by destabilizing trade and economic relations, provoking migrations, and generating complex humanitarian disasters that divert militaries and absorb huge amounts of aid.

Policymakers and citizens in the West ignore these pressures at their peril. In Chiapas, Mexico, Zapatista insurgents recently rose against land scarcity and insecure land tenure produced by longstanding inequalities in land distribution, by rapid population growth among groups with the least land, and by changes in laws governing land access. The insurgency rocked Mexico to the core, helped trigger the peso crisis, and reminded the world that Mexico remains—despite the North American Free Trade Agreement (NAFTA) and the pretenses of the country's elites—a poor and profoundly unstable developing country.

In Pakistan, shortages and the maldistribution of good land, water, and forests have encouraged the migration of huge numbers of rural poor into major cities such as Karachi and Hyderabad. The conjunction of this immigration with high fertility rates is causing urban populations to grow at a staggering 4 to 5 percent a year, producing fierce competition and often violence among ethnic groups over land, basic services, and political and economic power. This turmoil exacts a huge cost on the national economy. It may also encourage the Pakistani regime to buttress its internal legitimacy by adopting a more belligerent foreign policy on issues such as Kashmir and nuclear proliferation.

In South Africa, severe land, water, and fuelwood scarcity in the former black homelands 'has helped drive millions of poor blacks into teeming squatter settlements in the major cities. The settlements are often constructed on the worst urban land, in depressions prone to flooding, on hillsides vulnerable to slides, or near heavily polluting industries. Scarcities of land, water, and fuelwood in these settlements provoke interethnic rivalry and violent feuds between settlement warlords and their followers. This strife jeopardizes the country's transition to democratic stability and prosperity.¹

Three Forms of Scarcity

It is easy for the 1 billion or so people living in rich countries to forget that the well-being of about half the world's population of 5.8 billion remains directly tied to local natural resources. Nearly 3 billion people rely on agriculture for their main income; perhaps 1 billion of these are subsistence farmers who survive by eating what they grow. More than 40 percent of the world's people—some 2.2 billion—use fuelwood, charcoal, straw, or cow dung as their main source of energy; 50 to 60 percent rely on these biomass fuels for at least some of their energy needs. Over 1.2 billion people lack access to clean drinking water.

The cropland, forests, and water supplies that underpin the livelihoods and well-being of these billions are renewable. Unlike nonrenewable resources such as oil and iron ore, renewables are replenished over time by natural processes. If used prudently, they should sustain an adequate

standard of living indefinitely. Unfortunately, in the majority of regions where people are highly dependent on renewable resources, these resources are being depleted or degraded faster than they are being renewed. From Gaza and the Philippines to Honduras, the evidence is stark: aquifers are being overdrawn and salinized, coastal fisheries are disappearing, and steep uplands have been stripped of their forests, leaving their thin soils to erode into the sea.

These environmental scarcities usually have complex causes. Resource depletion and degradation are a function of the physical vulnerability of the resource, the size of the resource-consuming population, and the technologies and practices this population uses. The size of the population and its technologies and practices are in turn a result of a wide array of other variables, from the status of women to the availability of human and financial capital.

Moreover, resource depletion and degradation, taken together, are only one of three sources of environmental scarcity. Depletion and degradation produce a decrease in total resource *supply*—that is, a decrease in the size of the total resource "pie." But population growth and changes in consumption behavior can also cause greater scarcity by boosting the *demand* for a resource. Thus, if a rapidly growing population depends on a fixed amount of cropland, the amount of cropland per person—the size of each person's slice of the resource pie—falls inexorably. In many countries resource availability is being squeezed by both supply and demand pressures.

The third cause of scarcity is a severe imbalance in the distribution of wealth and power, which results in some groups in a society receiving disproportionately large slices of the resource pie while others get slices that are too small to sustain their livelihoods. This unequal distribution, which we call structural scarcity, has been a key factor in every case our research team examined. Often the imbalance is deeply rooted in the institutions and class and ethnic relations inherited from the colonial period. Often it is sustained and reinforced by international economic relations that trap developing countries into dependence on a few raw material exports. It can also be reinforced by heavy external debts that encourage countries to use their most productive environmental resources—such as their best croplands and forests—to generate hard currency rather than to support the most impoverished segments of their populations.

How Scarcities Interact

In the past, scholars and policymakers have usually addressed these three sources of scarcity independently. But supply, demand, and structural scarcities interact and reinforce each other in extraordinarily pernicious ways.

One type of interaction is resource capture. This occurs when powerful groups within a society recognize that a key resource is becoming more scarce (due to both supply and demand pressures) and use their power to shift resource access in their favor. This shift imposes severe structural scarcities on weaker groups. In Chiapas, worsening land scarcity (caused in part by rapid population growth) encouraged powerful landowners and ranchers to exploit weaknesses in the state's land laws in order to seize land from campesinos and indigenous farmers. Gradually these peasants were forced deeper into the state's lowland rain forest, further away from the state's economic heartland and further into poverty.

In the Jordan River basin, Israel's critical dependence on groundwater flowing out of the West Bank—a dependence made acute by a rising Israeli population and salinizing aquifers along the Mediterranean coast—encouraged Israel to restrict groundwater withdrawals on the West Bank during the occupation. These restrictions were far more severe for Palestinians than for Israeli settlers. They contributed to the rapid decline in Palestinian agriculture in the region, to the increasing dependence of young Palestinians on day labor within Israel and, ultimately, to rising frustrations in the Palestinian community.

Another kind of interaction, ecological marginalization, occurs when a structural imbalance in resource distribution joins with rapid population growth to drive resource-poor people into ecologically marginal areas, such as upland hillsides, areas at risk of desertification, and tropical rain forests. Higher population densities in these vulnerable areas—along with a lack of the capital and

knowledge needed to protect local resources—causes resource depletion, poverty, and eventually further migration, often to cities.

Ecological marginalization affects hundreds of millions of people around the world, across an extraordinary range of geographies and economic and political systems. We see the same process in the Himalayas, the Sahel, Central America, Brazil, India's Rajasthan, and Indonesia. For example, in the Philippines an extreme imbalance in cropland distribution between landowners and peasants has interacted with high population growth rates to force large numbers of landless poor into interior upland regions of the archipelago. There, the migrants use slash and burn agriculture to clear land for crops. As millions more arrive from the lowlands, new land becomes hard to find, and as population densities on the steep slopes increase, erosion, landslides, and flash floods become critical. During the 1970s and 1980s, the resulting poverty helped drive many peasants into the arms of the communist New People's Army insurgency that had a stranglehold on upland regions. Poverty drove countless others into wretched squatter settlements in cities like Manila.

Of course, many factors unique to the Filipino situation have combined with environmental and demographic stress to produce these outcomes. Environmental scarcity is never a determining or sole cause of large migrations, poverty, or violence; it always joins with other economic, political, and cultural factors to produce its effects. In the Filipino case the lack of clear property rights in upland areas encouraged migration into these regions and discouraged migrants from conserving the land once they arrived. And President Ferdinand Marcos's corrupt and authoritarian leadership reduced regime legitimacy and closed off options for democratic action by aggrieved groups.

Analysts often overlook the importance of such contextual factors and, as a result, jump from evidence of simple correlation to unwarranted conclusions about causation. Thus some commentators have asserted that rapid population growth, severe land scarcity, and the resulting food shortfalls caused the Rwandan genocide. In an editorial in August 1994, *The Washington Post* argued that while the Rwandan civil war was "military, political, and personal in its execution," a key underlying cause was "a merciless struggle for land in a peasant society whose birthrates have put an unsustainable pressure on it." Yet, while environmental scarcities in Rwanda were serious, close analysis shows that the genocide arose mainly from a conventional struggle among elites for control of the Rwandan state. Land scarcity played at most a peripheral role by reducing regime legitimacy in the countryside and restricting alternatives for elite enrichment outside the state.

Despite these caveats, in many cases environmental scarcity powerfully contributes to mass violence. Moreover, it is not possible entirely to subordinate its role to a society's particular institutions and policies. Some skeptics claim that a society can fix its environmental problems by fixing its institutional and policy mistakes; thus, they assert, environmental scarcity's contribution to conflict does not merit independent attention. But our research shows that such arguments are incomplete at best.

First, environmental scarcity is not only a consequence of institutions and policy: it also can reciprocally influence them in harmful ways. For example, during the 1970s and 1980s the prospect of chronic food shortages and a serious drought encouraged governments along the Senegal River to build a series of irrigation and flood-control dams. Because of critical land scarcities elsewhere in the region, land values in the basin shot up. The Mauritanian government, controlled by Moors of Arab origin, then took control of this resource by changing the laws governing land ownership and abrogating the traditional rights of black Mauritians to farm, herd, and fish along the river.

Second, environmental scarcity should not be subordinated to institutions and policies because it is partly a function of the physical context in which a society is embedded. The original depth of soils in the Filipino uplands and the physical characteristics that make Israel's aquifers vulnerable to salt intrusion are not functions of human social institutions or behavior. And third, once environmental scarcity becomes irreversible (as when a region's vital topsoil washes into the sea), then the scarcity is, by definition, an external influence on society. Even if enlightened reform of institutions and policies removes the original political and economic causes of the scarcity, it will be a continuing burden on society.

Resource Scarcity As a Cause of Interstate War

Scarcity-induced resource capture by Moors in Mauritania helped ignite violence over water and cropland in the Senegal River basin, producing tens of thousands of refugees. Expanding populations, land degradation, and drought spurred the rise of the Shining Path guerrillas in the southern highlands of Peru. In Haiti, forest and soil loss worsens a chronic economic crisis that generates strife and periodic waves of boat people. And land shortages in Bangladesh, exacerbated by fast population growth, have prompted millions of people to migrate to India—an influx that has, in turn, caused ethnic strife in the Indian states of Assam and Tripura.

Close examination of such cases shows that severe environmental scarcity can reduce local food production, aggravate the poverty of marginal groups, spur large migrations, enrich elites who speculate on resources, and undermine a state's moral authority and capacity to govern. These long-term stresses can slowly tear apart a poor society's social fabric, causing chronic popular unrest and violence by boosting grievances and changing the balance of power between contending social groups and the state.

The violence that results is usually chronic and diffuse, and almost always subnational, not international. There is virtually no evidence that environmental scarcity causes major interstate war. Yet among international relations scholars, it has been conventional wisdom for some time that critical scarcities of natural resources can produce international conflict. During the 1970s, for example, Nazli Chourci and Robert North argued that countries facing high resource demands and limited resource availability within their territories would seek the needed resources through trade or conquest beyond their boundaries.² Although this "lateral pressure" theory helped explain some past wars, such as World War I, our more recent research highlights a number of the theory's errors. Most important, the theory makes no distinction between renewable and nonrenewable resources.

There is no doubt that some major wars in this century have been motivated in part by one country's desire to seize another's nonrenewable resources, such as fossil fuels or iron ore. For example, before and during World War II, Japan sought to secure coal, oil, and minerals in China and Southeast Asia. But the story is different for renewables like cropland, forests, fish, and freshwater. It is hard to find clear examples from this century of major war motivated mainly by scarcities of renewables.

There are two possible explanations. First, modern states cannot easily convert cropland and forests seized from a neighbor into increased state power, whereas they can quickly use nonrenewables like iron and oil to build and fuel the military machines of national aggression. Second, countries with economies highly dependent on renewables tend to be poor, and poor countries cannot easily buy large and sophisticated conventional armies to attack their neighbors. For both these reasons, the incentives and the means to launch resource wars are likely to be lower for renewables than for nonrenewables.

The exception, some might argue, is water, especially river water: adequate water supplies are needed for all aspects of national activity, including the production and use of military power, and rich countries are as dependent on water poor countries (often they are more dependent). Moreover, about 40 percent of the world's population lives in the 214 river basins shared by more than one country. Thus at a meeting in Stockholm in August 1995, Ismail Serageldin, the World Bank's vice president for environmentally sustainable development, declared that the "wars of the next century will be over water," not oil.

The World Bank is right to focus on the water crisis. Water scarcity and pollution are already hindering economic growth in many poor countries. With global water use doubling every 20 years, these scarcities—and the subnational social stresses they cause—are going to get much worse. But Serageldin is wrong to declare that we are about to witness a surge of "water wars."

Wars between upstream and downstream neighbors over river water are likely only in a narrow set of circumstances: the downstream country must be highly dependent on the water for its national well-being; the upstream country must be able to restrict the river's flow; there must be a

history of antagonism between the two countries; and, most important, the downstream country must be much stronger militarily than the upstream country.

There are very few river basins around the world where all these conditions hold. The most obvious example is the Nile. Egypt is wholly dependent on the river's water, has historically turbulent relations with its upstream neighbors, Sudan and Ethiopia, and is vastly more powerful than either. And Egypt has several times threatened to go to war to guarantee an adequate supply of Nile waters.

But more common is the situation along the Ganges, where India has constructed a huge dam—the Farakka Barrage—with harsh consequences on downstream cropland, fisheries, and villages in Bangladesh. Bangladesh is so weak that the most it can do is plead with India to release more water. There is little chance of a water war here between upstream and downstream countries (although the barrage's effects have contributed to the migrations out of Bangladesh into India). The same holds true for other river basins where alarmists speak of impending wars, including the Mekong, Indus, Parana, and Euphrates.

Pivotal States

The chronic and diffuse subnational strife that environmental scarcity helps generate is exactly the kind of conflict that bedevils conventional military institutions. Around the world we see conventional armies pinned down and often utterly impotent in the face of interethnic violence or attacks by ragtag bands of lightly armed guerrillas and insurgents. As yet, environmental scarcity is not a major factor behind most of these conflicts. But we can expect it to become a far more powerful influence in coming decades because of larger populations and higher resource consumption rates.

The world's population is growing by 1.6 percent a year; on average, real economic product per capita is also rising by 1.5 percent a year. These increases combine to boost the earth's total economic product by about 3 percent annually. With a doubling time of approximately 23 years, the current global product of \$25 trillion should exceed \$50 trillion in today's dollars by 2020.

A large component of this increase will be achieved through greater consumption of the planet's natural resources. Already, as a group of geographers has noted, "transformed, managed, and utilized ecosystems constitute about half of the ice-free earth; human-mobilized material and energy flows rival those of nature."³ Such changes are certain to grow because of the rapidly increasing scale and intensity of our economic activity.

At the level of individual countries, these changes often produce a truly daunting combination of pressures. Some of the worst-affected countries are "pivotal states"—to use the term recently coined in *Foreign Affairs* by historian Paul Kennedy. These countries—including South Africa, Mexico, India, Pakistan, and China—are key to international stability in their regions.

India deserves particularly close attention. Since independence, it has often seemed on the brink of disintegration. But it has endured, despite enormous difficulties, and by many measures India has made real progress in bettering its citizens' lives. Yet, although recent economic liberalization has produced a surge of growth and a booming middle class, India's prospects are uncertain at best.

Population growth stubbornly remains around 2 percent a year; the country's population of 955 million (of which about 700 million live in the countryside) grows by 17 million people annually, which means it doubles every 38 years. Demographers estimate that India's population will reach 1.4 billion by 2025. Yet severe water scarcities and cropland fragmentation, erosion, and salinization are already widespread. Fuelwood shortages, deforestation, and desertification also affect sweeping areas of countryside.

Rural resource scarcities and population growth have combined with an inadequate supply of rural jobs and economic liberalization in cities to widen wealth differentials between the countryside and urban areas. These differentials propel huge waves of rural-urban migration. The growth rates of many of India's cities are nearly twice that of the country's population, which means that cities like New Delhi, Mumbai, and Bangalore double in size every 20 years. Their infrastructures are

overtaxed: New Delhi has among the worst urban air pollution levels in the world, power and water are regularly unavailable, garbage is left in the streets, and the sewage system can handle only a fraction of the city's waste water.

India's rapidly growing population impedes further loosening of the state's grip on the economy: as the country's workforce expands by 6.5 million a year, and as resentment among the poor rises against those castes and classes that have benefited most from liberalization, left-wing politicians are able to exert strong pressure to maintain subsidies for fertilizers, irrigation, and inefficient industries and to keep statutory restrictions against corporate layoffs. Rapid population growth also leads to fierce competition for limited status and job opportunities in government and education. Attempts to hold a certain percentage of such positions for lower castes cause bitter intercaste conflict. The right-wing Bharatiya Janata Party capitalizes on upper- and middle-caste resentment of encroachment on their privileges, mobilizing this resentment against minorities like Muslims.

These pressures are largely beyond the control of India's increasingly corrupt and debilitated political institutions. At the district and state levels, politicians routinely hire local gang leaders or thugs to act as political enforcers. At the national level, kickbacks and bribes have become common in an economic system still constrained by bureaucracy and quotas. The central government and many state governments are widely seen as unable to manage India's rapidly changing needs, and as a result have lost much of their legitimacy. Furthermore, the 1996 national elections dealt a dramatic blow to the Congress Party, which has traditionally acted to aggregate the interests of multiple sectors of Indian society. The parties that gained at Congress's expense represent a profusion of narrow caste, class, religious, and regional interests.

The fast expansion of urban areas in poor countries like India may have the dual effect of increasing both the grievances and the opportunities of groups challenging the state: people concentrated in slums can communicate more easily than those in scattered rural villages, which might reinforce incipient economic frustrations and, by reducing problems of coordination, also increase their power in relation to the police and other authorities. While there is surprisingly little historical correlation between rapid urbanization and civil strife, India shows that the record may be changing: the widespread urban violence in early 1993 was concentrated in the poorest slums. Moreover, although Western commentators usually described the rioting as strictly communal, between Hindus and Muslims, Hindus directed many of their attacks against recent Hindu migrants from rural areas. B. K. Chandrashekar, a sociology professor at the Indian Institute of Management, has noted that "the communal violence was quite clearly a class phenomenon. Indian cities became the main battlegrounds because of massive migrations of the rural poor in the past decades."

Indian social institutions and democracy are now under extraordinary strain. The strain arises from a rapid yet incomplete economic transition, from widening gaps between the wealthy and the poor, from chronically weak political institutions, and—not least—from continued high levels of population growth and resource depletion. Should India suffer major internal violence as a result—or, in the worst case, should it fragment into contending regions—the economic, migratory, and security consequences for the rest of the world would be staggering.

Banking on Ingenuity

Some reading this account of India will say "nonsense!" As long as market reforms and adequate economic growth continue, India should be able to solve its problems of poverty, population growth, and environmental stress.

The most rigorous representatives of this optimistic position are neoclassical economists. They generally claim that few if any societies face strict limits to population or consumption. Properly functioning economic institutions, especially markets, can provide incentives to encourage conservation, resource substitution, the development of new sources of scarce resources, and technological innovation. Increased global trade allows resource-rich areas to specialize in the production of goods (like grain) that are derived from renewables. These optimists are commonly opposed by neo-Malthusians—often biologists and ecologists—who claim that finite natural

resources place strict limits on the growth of human population and consumption both globally and regionally; if these limits are exceeded, poverty and social breakdown result.

The debate between these two camps is now thoroughly sterile. Each grasps a portion of the truth, but neither tells the whole story. Neoclassical economists are right to stress the extraordinary ability of human beings to surmount scarcity and improve their lot. The dominant trend over the past two centuries, they point out, has not been rising resource scarcity but increasing aggregate wealth. In other words, most important resources have become less scarce, at least in economic terms.

The optimists provide a key insight: that we should focus on the supply of human ingenuity in response to increasing resource scarcity rather than on strict resource limits. Many societies adapt well to scarcity, without undue hardship to their populations, and often end up better off than they were before. These societies supply enough ingenuity in the form of new technologies and new and reformed social institutions—like efficient markets, clear property rights, and rural development banks—to alleviate the effects of scarcity.

What determines a society's ability to supply this ingenuity? The answer is complex: different countries, depending on their social, economic, political, and cultural characteristics, will respond to scarcity in different ways and with varying amounts and kinds of ingenuity.

Optimists often make the mistake of assuming that an adequate supply of the right kinds of ingenuity is always assured. However, in the next decades population growth, rising average resource consumption, and persistent inequalities in resource access guarantee that scarcities of renewables will affect many regions in the developing world with a severity, speed, and scale unprecedented in history. Resource substitution and conservation tasks will be more urgent, complex, and unpredictable, increasing the need for many kinds of ingenuity. In other words, these societies will have to be smarter—socially and technically—to maintain or increase their well-being in the face of rising scarcities.

Simultaneously, the supply of ingenuity will be constrained by a number of factors, including the brain drain from many poor societies, their limited access to capital, and their chronically incompetent bureaucracies, corrupt judicial systems, and weak states. Moreover, markets in developing countries often do not work well: property rights are unclear; prices for water, forests, and other common resources do not adjust accurately to reflect rising scarcity; and thus incentives for entrepreneurs to respond to scarcity are inadequate.

Most important, the supply of ingenuity can be restricted by stresses generated by the very resource crises the ingenuity is needed to solve. In Haiti, for example, severe resource shortages—especially of forests and soil—have inflamed struggles among social groups, struggles that, in turn, obstruct technical and institutional reform. Scarcities exacerbate poverty in rural Haitian communities and produce significant profit opportunities for powerful elites. Both deepen divisions and distrust between rich and poor and impede beneficial change. Thus, for example, the Haitian army has blocked reforestation projects by destroying tree seedlings; the army and the notorious Tonton Macoutes fear such projects will bring disgruntled rural people together and threaten their highly profitable control of forest resource extraction.

Similar processes are at work in many places. In the Indian state of Bihar, which has some of the highest population growth rates and rural densities in the country, land scarcity has deepened divisions between land-holding and peasant castes, promoting intransigence on both sides that has brought land reform to a halt. In South Africa, scarcity-driven migrations into urban areas and the resulting conflicts over urban environmental resources (such as land and water) encourage communities to segment along lines of ethnicity or residential status. This segmentation shreds networks of trust and debilitates local institutions. Powerful warlords, linked to the Inkatha Freedom Party or the African National Congress, have taken advantage of these dislocations to manipulate group divisions within communities, often producing violence and further institutional breakdown.

Societies like these may face a widening "ingenuity gap" as their requirement for ingenuity to deal with scarcity rises while their supply of ingenuity stagnates or drops. A persistent and serious ingenuity gap boosts dissatisfaction and undermines regime legitimacy and coercive power, increasing the likelihood of widespread and chronic civil violence. Violence further erodes the

society's capacity to supply ingenuity, especially by causing human and financial capital to flee. Countries with a critical ingenuity gap therefore risk entering a downward and self-reinforcing spiral of crisis and decay.

A focus on ingenuity supply helps us rethink the neo-Malthusian concept of strict physical limits to growth. The limits a society faces are a product of both its physical context and the ingenuity it can bring to bear on that context. If a hypothetical society were able to supply infinite amounts of ingenuity, then that society's maximum sustainable population size and rate of resource consumption would be determined by biological and physical laws, such as the second law of thermodynamics. Since infinite ingenuity is never available, the resource limits societies face in the real world are more restrictive than this theoretical maximum. And since the supply of ingenuity depends on many social and economic factors and can therefore vary widely, we cannot determine a society's limits solely by examining its physical context, as neo-Malthusians do. Rather than speaking of limits, it is better to say that some societies are locked into a "race" between a rising requirement for ingenuity and their capacity to supply it.

In coming decades, some societies will win this race and some will lose. We can expect an increasing bifurcation of the world into those societies that can adjust to population growth and scarcity—thus avoiding turmoil—and those that cannot. If several pivotal states fall on the wrong side of this divide, humanity's overall prospects will change dramatically for the worse.

Endnotes

1. Over the last six years a diverse group of 100 experts from 15 countries has closely studied cases such as these. Organized by the Peace and Conflict Studies program at the University of Toronto and the American Academy of Arts and Sciences in Cambridge, Massachusetts, its research and that of other groups provides a clear picture of how and where environmental scarcity produces social breakdown and violence. This article surveys these findings.

2. Nations *in Conflict* (San Francisco: Freeman, 1975).

3. B. L Turner et al., eds., *The Earth as Transformed by Human Action; Global and Regional Changes in the Biosphere over the Past 300 Years* (Cambridge: Cambridge University Press, 1990), p. 13.