

Environmental Scarcities and Violent Conflict:

Evidence from Cases

Part 1

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Within the next fifty years, the planet's human population will probably pass nine billion, and global economic output may quintuple. Largely as a result, scarcities of renewable resources will increase sharply. The total area of high-quality agricultural land will drop, as will the extent of forests and the number of species they sustain. Coming generations will also see the widespread depletion and degradation of aquifers, rivers, and other water resources; the decline of many fisheries; and perhaps significant climate change.

If such "environmental scarcities" become severe, could they precipitate violent civil or international conflict? I have previously surveyed the issues and evidence surrounding this question and proposed an agenda for further research.¹ Here I report the results of an international research project guided by this agenda.² Following a brief review of my original hypotheses and the project's research design, I present several general findings of this research that led me to revise the original hypotheses. The article continues with an account of empirical evidence for and against the revised hypotheses, and it concludes with an assessment of the implications of environmentally induced conflict for international security.

In brief, our research showed that environmental scarcities are already contributing to violent conflicts in many parts of the developing world. These conflicts are probably the early signs of an upsurge of violence in the coming decades that will be induced or aggravated by scarcity. The violence will usually be sub-national, persistent, and diffuse. Poor societies will be particularly affected since they are less able to buffer themselves from environmental scarcities and the social

crises they cause. These societies are, in fact, already suffering acute hardship from shortages of water, forests, and especially fertile land.

Social conflict is not always a bad thing: mass mobilization and civil strife can produce opportunities for beneficial change in the distribution of land and wealth and in processes of governance. But fast-moving, unpredictable, and complex environmental problems can overwhelm efforts at constructive social reform. Moreover, scarcity can sharply increase demands on key institutions, such as the state, while it simultaneously reduces their capacity to meet those demands. These pressures increase the chance that the state will either fragment or become more authoritarian. The negative effects of severe environmental scarcity are therefore likely to outweigh the positive.

General Findings

Our research was intended to provide a foundation for further work. We therefore focused on two key preliminary questions: does environmental scarcity cause violent conflict? And, if it does, how does it operate?

The research was structured as I proposed in my previous article. Six types of environmental change were identified as plausible causes of violent intergroup conflict:

- greenhouse-induced climate change;
- stratospheric ozone depletion;
- degradation and loss of good agricultural land;
- degradation and removal of forests;
- depletion and pollution of fresh water supplies; and
- depletion of fisheries.

We used three hypotheses to link these changes with violent conflict. First, we suggested that decreasing supplies of physically controllable environmental resources, such as clean water and good agricultural land, would provoke interstate "simple-scarcity" conflicts or resource wars. Second, we hypothesized that large population movements caused by environmental stress would induce "group-identity" conflicts, especially ethnic clashes. And third, we suggested that severe environmental scarcity would simultaneously increase economic deprivation and disrupt key social institutions, which in turn would cause "deprivation" conflicts such as civil strife and insurgency.

Two detailed case studies were completed for each of the three research hypotheses.³ By selecting cases that appeared, *prima facie*, to show a link between environmental change and conflict, we sought to falsify the null hypothesis that environmental scarcity does not cause violent conflict. By carefully tracing the causal processes in each case, we also sought to identify how environmental scarcity operates, if and when it is a cause of conflict. The completed case studies were reviewed at a series of workshops of leading experts; in light of these findings, I revised the original hypotheses, identified common variables and processes across the cases, and

examined the revised hypotheses in light of the case-study evidence. The project's conclusions were reviewed by a core team of experts. The following are four general findings of this research effort.

RESOURCE DEPLETION AND DEGRADATION

Of the major environmental changes facing humankind, degradation and depletion of agricultural land, forests, water, and fish will contribute more to social turmoil in coming decades than will climate change or ozone depletion.

When analysts and policymakers in developed countries consider the social impacts of large-scale environmental change, they focus undue attention on climate change and stratospheric ozone depletion.⁴ But vast populations in the developing world are already suffering from shortages of good land, water, forests, and fish; in contrast, the social effects of climate change and ozone depletion will probably not be seen till well into the next century. If these atmospheric problems do eventually have an impact, they will most likely operate not as individual environmental stresses, but in interaction with other, long-present resource, demographic, and economic pressures that have gradually eroded the buffering capacity of some societies.

Mexico, for example, is vulnerable to such interactions. People are already leaving the state of Oaxaca because of drought and soil erosion. Researchers estimate that future global warming could decrease Mexican rainfed maize production up to forty percent. This change could in turn interact with ongoing land degradation, free trade (because Mexico's comparative advantage is in water-intensive fruits and vegetables), and the privatization of communal peasant lands to cause grave internal conflict.⁵

ENVIRONMENTAL SCARCITY

Environmental change is only one of three main sources of scarcity of renewable resources; the others are population growth and unequal social distribution of resources. The concept "environmental scarcity" encompasses all three sources.

Analysts often usefully characterize environmental problems as resource scarcities. Resources can be roughly divided into two groups: non-renewable, like oil and iron ore, and renewables, like fresh water, forests, fertile soils, and the earth's ozone layer. The latter category includes renewable "goods" such as fisheries and timber, and renewable "services" such as regional hydrological cycles and a benign climate.

The commonly used term "environmental change" refers to a human-induced decline in the quantity or quality of a renewable resource that occurs faster than it is renewed by natural processes. But this concept limits the scope of environment-conflict research. Environmental change is only one of three main sources of renewable-resource scarcity. The second, population growth, reduces a resource's per-capita availability by dividing it among more and more people.⁶ The third, unequal resource distribution, concentrates resource in the hands of a few people and

subjects the rest to greater scarcity.⁷ The property rights that govern resource distribution often change as a result of large-scale development projects or new technologies that alter the relative values of resources.

In other words, reduction in the quantity or quality of a resource shrinks the resource pie, while population growth divides the pie into smaller slices for each individual, and unequal resource distribution means that some groups get disproportionately large slices.⁸ Unfortunately, analysts often study resource depletion and population growth in isolation from the political economy of resource distribution.⁹ The term "environmental scarcity," however, allows these three distinct sources of scarcity to be incorporated into one analysis. Empirical evidence suggests, in fact, that the first two sources are most pernicious when they interact with unequal resource distribution.

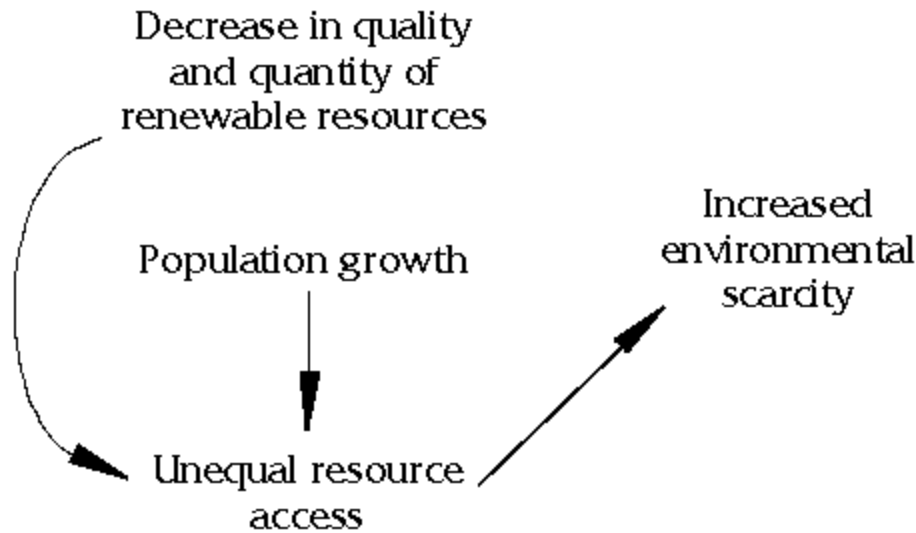
We must also recognize that resource scarcity is, in part, subjective; it is determined not just by absolute physical limits, but also by preferences, beliefs, and norms. This is illustrated by a debate about the role of population growth and resource scarcity as causes of the conflict between the Sandinista government and the Miskito Indians in Nicaragua.¹⁰ Bernard Nietschmann argues that the Nicaraguan state's need for resources to sustain the country's economic and agricultural development caused environmental degradation to spread from the Pacific to the Atlantic coast of the country. As this happened, indigenous Miskitos in the east came into conflict with the central government. Sergio Diaz-Briquets responds that the Sandinistas expropriated Miskito lands because of ideology, not scarcity. The Atlantic coastal region was largely ignored by the Nicaraguan state under Somoza. Following the revolution, the Sandinistas had ample newly expropriated land to distribute to their followers; but the new government -- guided by Marxism -- saw the Miskitos as a backward people with a competing worldview and a precapitalist mode of production, whose land rightfully belonged to a state that was removing impediments to the historical progress of the working class.

The gap between the two views can be bridged by noting that scarcity is partly subjective. Marxist ideology encouraged the Sandinistas to adopt a strategy of state-directed industrialization and resource-use; this led them to perceive resources as more scarce than had the Somoza regime.

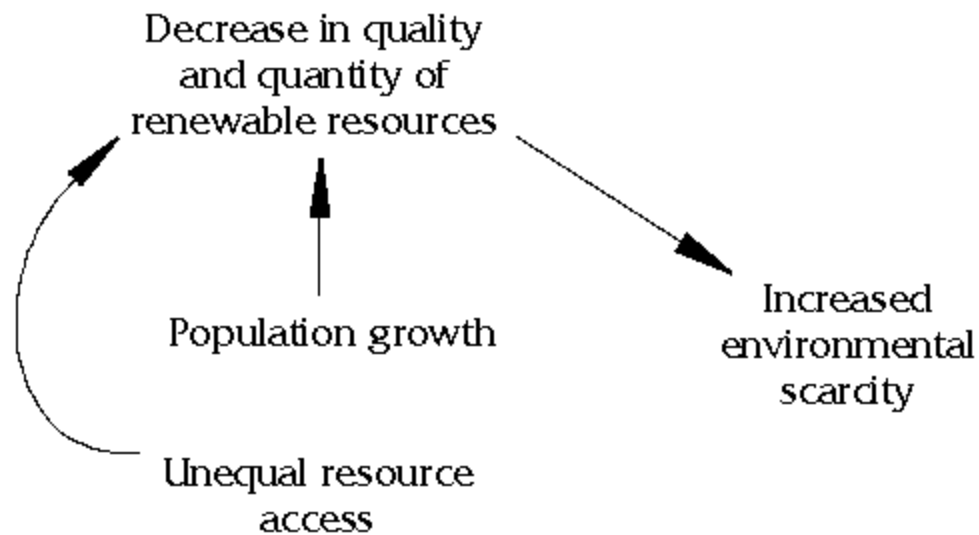
INTERACTION OF SOURCES OF ENVIRONMENTAL SCARCITY

The three sources of environmental scarcity often interact, and two patterns of interaction are particularly common: "resource capture" and "ecological marginalization" (see Figure 1).

Figure 1: Resource Capture and Ecological Marginalization



Resource Capture: Resource depletion and population growth cause unequal resource access.



Ecological Marginalization: Unequal resource access and population growth cause resource degradation and depletion.

A fall in the quality and quantity of renewable resources can combine with population growth to encourage powerful groups within a society to shift resource distribution in their favor. This can produce dire environmental scarcity for poorer and weaker groups whose claims to resources are opposed by these powerful elites. I call this type of interaction "resource capture." Unequal resource access can combine with population growth to cause migrations to regions that are ecologically fragile, such as steep upland slopes, areas at risk of desertification, and tropical rain forests. High population densities in these areas, combined with a lack of knowledge and capital to protect local resources, causes severe environmental damage and chronic poverty. This process is often called "ecological marginalization."¹¹

RESOURCE CAPTURE. Events in the Senegal River valley in 1989 illustrate resource capture. The valley demarcates the border between Senegal and Mauritania in West Africa. Senegal has fairly abundant agricultural land, but much of it suffers from high to severe wind and water erosion, loss of nutrients, salinization because of overirrigation, and soil compaction caused by intensification of agriculture.¹² The country has an overall population density of 38 people per square kilometer and a population growth rate of 2.8 percent; in 25 years the population will double.¹³ In contrast, except for the Senegal Valley along its southern border and a few oases, Mauritania is largely arid desert and semiarid grassland.¹⁴ Its population density is very low at about 2 people per square kilometer, but the growth rate is 2.9 percent. This combination of factors led the Food and Agriculture Organization (FAO) and two other organizations in a 1982 study to include both Mauritania and Senegal in their list of "critical" countries whose croplands cannot support their current and projected populations without a large increase in agricultural inputs, such as fertilizer and irrigation.¹⁵

Normally, the broad floodplains fringing the Senegal River support productive farming, herding, and fishing based on the river's annual floods. During the 1970s, however, the prospect of chronic food shortages and a serious drought encouraged the region's governments to seek international financing for the Manantali Dam on the Bafing River tributary in Mali, and the Diama salt-intrusion barrage near the mouth of the Senegal River between Senegal and Mauritania. These dams were designed to regulate the river's flow to produce hydropower, expand irrigated agriculture, and provide river transport from the Atlantic Ocean to landlocked Mali, which lies to the east of Senegal and Mauritania.

But the plan had unfortunate and unforeseen consequences. Anticipation of the new dams sharply increased land values along the river in areas where high-intensity agriculture would become feasible. The elite in Mauritania, which consists mainly of white Moors, then rewrote legislation governing land ownership, effectively abrogating the rights of black Africans to continue farming, herding, and fishing along the Mauritanian riverbank.¹⁶

There has been a long history of racism by white Moors in Mauritania towards their non-Arab, black compatriots. In the spring of 1989, the killing of Senegalese farmers by Mauritians in the river basin triggered explosions of ethnic violence in the two countries. In Senegal, almost all of the 17,000 shops owned by Moors were destroyed, and their owners were deported to Mauritania. In both countries several hundred people were killed and the two nations nearly

came to war.¹⁷ The Mauritanian regime used this occasion to activate the new land legislation, declaring the Mauritanians who lived alongside the river to be "Senegalese," thereby stripping them of their citizenship; their property was seized. Some 70,000 of the black Mauritanians were forcibly expelled to Senegal, from where some launched raids to retrieve expropriated cattle. Diplomatic relations between the two countries have now been restored, but neither has agreed to allow the expelled population to return or to compensate them for their losses.

We see here the interaction of two sources of human-induced environmental scarcity: degradation of the land resource and population pressures helped precipitate agricultural shortfalls, which in turn encouraged a large development scheme. These factors together raised land values in one of the few areas in either country that offered the potential for a rapid move to high-intensity agriculture. A powerful elite then changed property rights and resource distribution in its own favor, which produced a sudden increase in resource scarcity for an ethnic minority, expulsion of the minority, and ethnic violence.

The water shortage on the occupied West Bank of the Jordan River offers a similar example of how population growth and excessive resource consumption can promote resource capture. While figures vary, Israel's average annual supply of renewable fresh water is about 1,950 million cubic meters (mcm).¹⁸ Current Israeli demand, including that of settlements in the occupied territories and Golan Heights, exceeds this supply by about ten percent. The deficit is covered by overpumping aquifers. As a result, water tables in some parts of Israel and the West Bank have dropped. This can cause the exhaustion of wells and the infiltration of sea water from the Mediterranean.¹⁹ Israel's population growth in the next thirty years, even without major immigration from the former Soviet Union, will probably cause the country's water demand to outstrip supply by at least forty percent.²⁰

Over half of Israel's water comes from aquifers, and the rest from river flow, floodwater, and waste-water recycling. Two of the three main aquifers on which Israel depends lie principally underneath the West Bank, although their waters drain into Israel. About forty percent of the groundwater Israel uses (and therefore about a quarter of its sustainable supply) originates in occupied territory. To protect this important source, the Israeli government strictly limits water use by Jewish settlers and Arabs on the West Bank. But there is a stark differential in water access between the groups: on a per capita basis, settlers consume about four times as much as Arabs. Israel restricts the number of wells Arabs can drill in the territory, the amount of water Arabs are allowed to pump, and the times at which they can draw irrigation water. Since 1967, Arabs have not been permitted to drill new wells for agricultural purposes, although the Mekorot (the Israeli water company) has drilled more than thirty wells for settlers' irrigation.

Arab agriculture in the region has also suffered because some Arab wells have become dry or saline as a result of deeper Israeli wells drilled nearby. These Israeli water policies, combined with the confiscation of agricultural land for settlers as well as other Israeli restrictions on Palestinian agriculture, have encouraged many West Bank Arabs to abandon farming and move to towns.²¹ Those who have done so have mostly become either unemployed or day laborers within Israel. The links between these processes and the recent unrest in the occupied territories are unclear; many political, economic, and ideological factors operate. But it seems reasonable to

conclude that water scarcity and its consequent economic effects contributed to the grievances behind the intifada both on the West Bank and in Gaza.

ECOLOGICAL MARGINALIZATION. The Philippines offers a good illustration of ecological marginalization. There, inequalities in access to rich agricultural lowlands combine with population growth to cause migration to easily degraded upland areas; erosion and deforestation contribute to economic hardship that spurs insurgency and rebellion.

Spanish and American colonial policies in the Philippines left behind a grossly unfair distribution of good cropland in lowland regions, an imbalance perpetuated since independence by a powerful landowning elite.²² Since World War II, green-revolution technologies have greatly increased lowland production of grain for domestic consumption, and of cash crops such as sugar, coconut, pineapple, and bananas that help pay the country's massive external debt. This has raised demand for agricultural labor on large farms, but not enough to compensate for a population growth rate of 2.5 to 3.0 percent per annum. Together, therefore, inequalities in land access and growth in population have produced a surge in agricultural unemployment.

With insufficient rural or urban industrialization to employ this excess labor, there has been unrelenting downward pressure on wages.²³ Economically desperate, millions of poor agricultural laborers and landless peasants have migrated to shantytowns in already overburdened cities, such as Manila. Millions of others have moved to the least productive -- and often most ecologically vulnerable -- territories, such as steep hillsides.²⁴ In these uplands, settlers use fire to clear forested or previously logged land. They bring with them little knowledge or money to protect their fragile ecosystems, and their small-scale logging, production of charcoal for the cities, and slash-and-burn farming often cause horrendous environmental damage, particularly water erosion, landslides, and changes in the hydrological cycle.²⁵ This has set in motion a cycle of falling food production, the clearing of new plots, and further land degradation. There are few new areas in the country that can be opened up for agricultural production, so even marginally fertile land is becoming hard to find in many places, and economic conditions are often desperate for the peasants.²⁶

The situation in the Philippines is not unique. Ecological marginalization occurs with striking regularity around the planet, affecting hundreds of millions of people in places as diverse as the Himalayas, Indonesia, Costa Rica, Brazil, and the Sahel.

SOCIAL AND TECHNICAL INGENUITY

Societies are more able to avoid turmoil if they can adapt to environmental scarcity so that it does not cause great suffering. Strategies for adaptation fall into two categories, and both depend on adequate social and technical ingenuity. First, societies can continue to rely on their indigenous resources but use them more sensibly and provide alternative employment to people who have limited resource access. For example, economic incentives like increases in resource

prices and taxes can reduce degradation and depletion by encouraging conservation, technological innovation, and resource substitution. Family planning and literacy campaigns can ease population-growth induced scarcity. Land redistribution and labor-intensive rural industries can relieve the effects of unequal access to good cropland.

Second, the country might "decouple" itself from dependence on its own depleted environmental resources by producing goods and services that do not rely heavily on those resources; the country could then trade the products on the international market for the resources it no longer has at home. Such decoupling might, in fact, be achieved by rapidly exploiting the country's environmental resources and reinvesting the profits in capital, industrial equipment, and skills to permit a shift to other forms of wealth creation. For instance, Malaysia could use the income from over-logging its forests to fund a modern university system that trains electrical engineers and computer specialists for a high-technology industrial sector.

If either strategy is to succeed, a society must be able to supply enough ingenuity at the right places and times. Two kinds are key. Technical ingenuity is needed to develop, for example, new agricultural and forestry technologies that compensate for environmental loss. Social ingenuity is needed to create institutions and organizations that buffer people from the effects of scarcity and provide the right incentives for technological entrepreneurs. Social ingenuity is therefore often a precursor to technical ingenuity. The development and distribution of new grains adapted for dry climates and eroded soils, of alternative cooking technologies to compensate for the loss of firewood, and of water conservation technologies depend on an intricate and stable system of markets, legal regimes, financial agencies, and educational and research institutions.

In the next decades, the need for both technical and social ingenuity to deal with environmental scarcities will rise sharply. Population growth, rising average resource consumption, and persistent inequalities in access to resources ensure that scarcities will affect many environmentally sensitive regions with a severity, speed, and scale unprecedented in history. Resource substitution and conservation tasks will be more urgent, complex, and unpredictable, driving up the need for technical ingenuity. Moreover, solving these problems through market and other institutional innovations (such as changes in property rights and resource distribution) will require great social ingenuity.

At the same time that environmental scarcity is boosting the demand for ingenuity, however, it may interfere with supply. Poor countries start at a disadvantage: they are under endowed with the social institutions -- including the productive research centers, efficient markets, and capable states -- that are necessary for an ample supply of both social and technical solutions to scarcity. Moreover, their ability to create and maintain these institutions may be diminished by the very environmental stress they need to address, because scarcity can weaken states, as we shall see, and it can engender intense rivalries between interest groups and elite factions.²⁷