

On the Threshold: Environmental Changes as Causes of Acute Conflict

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# On the Threshold

## Environmental Changes as Causes of Acute Conflict

Thomas F.  
Homer-Dixon

A number of scholars have recently asserted that large-scale human-induced environmental pressures may seriously affect national and international security.<sup>1</sup> Unfortunately, the environment-security theme encompasses an almost unmanageable array

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1. See, for example, Janet Welsh Brown, ed., *In the U.S. Interest: Resources, Growth, and Security in the Developing World* (Boulder, Colo.: Westview, 1990); Neville Brown, "Climate, Ecology and International Security," *Survival*, Vol. 31, No. 6 (November/December 1989), pp. 519–532; Peter Gleick, "Climate Change and International Politics: Problems Facing Developing Countries," *Ambio*, Vol. 18, No. 6 (1989), pp. 333–339; Gleick, "The Implications of Global Climatic Changes for International Security," *Climatic Change*, Vol. 15, No. 1/2 (October 1989), pp. 309–325; Ronnie Lipschutz and John Holdren, "Crossing Borders: Resource Flows, the Global Environment, and International Security," *Bulletin of Peace Proposals*, Vol. 21, No. 2 (June 1990), pp. 121–33; Jessica Tuchman Mathews, "Redefining Security," *Foreign Affairs*, Vol. 68, No. 2 (Spring 1989), pp. 162–177; Norman Myers, "Environment and Security," *Foreign Policy*, No. 74 (Spring 1989), pp. 23–41; Michael Renner, *National Security: The Economic and Environmental Dimensions*, Worldwatch Paper No. 89 (Washington, D.C.: Worldwatch Institute, 1989); and Arthur Westing, ed., *Global Resources and International Conflict: Environmental Factors in Strategic Policy and Action* (Oxford: New York, 1986). For a skeptical perspective, see Daniel Deudney, "The Case Against Linking Environmental Degradation and National Security," *Millennium*, Vol. 19, No. 3 (Winter 1990), pp. 461–476.

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of sub-issues, especially if we define “security” broadly to include human physical, social, and economic well-being.<sup>2</sup>

We can narrow the scope of this research problem by focusing on how environmental change affects *conflict*, rather than security, but still the topic is too vast. Environmental change may contribute to conflicts as diverse as war, terrorism, or diplomatic and trade disputes. Furthermore, it may have different causal roles: in some cases, it may be a proximate and powerful cause; in others, it may only be a minor and distant player in a tangled story that involves many political, economic, and physical factors. In this article, I accept the premise that environmental change may play a variety of roles as a cause of conflict, but I bound my analysis by focusing on *acute* national and international conflict, which I define as conflict involving a substantial probability of violence.

How might environmental change lead to acute conflict? Some experts propose that environmental change may shift the balance of power between states either regionally or globally, producing instabilities that could lead to war.<sup>3</sup> Or, as global environmental damage increases the disparity between the North and the South, poor nations may militarily confront the rich for a greater share of the world’s wealth.<sup>4</sup> Warmer temperatures could lead to contention over new ice-free sea-lanes in the Arctic or more accessible resources in the Antarctic.<sup>5</sup> Bulging populations and land stress may produce waves of environmental refugees<sup>6</sup> that spill across borders with destabilizing effects on the recipient’s domestic order and on international stability. Countries may fight over dwindling supplies of water and the effects of upstream pollution.<sup>7</sup> In developing countries, a sharp drop in food crop production could lead to internal strife across urban-rural and nomadic-sedentary cleavages.<sup>8</sup> If environmental degradation makes food supplies increasingly tight,

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2. Readers interested in a careful argument for an expanded notion of security that includes environmental threats to national well-being should see Richard Ullman, “Redefining Security,” *International Security*, Vol. 8, No. 1 (Summer 1983), esp. pp. 133 and 143.

3. For example, see David Wirth, “Climate Chaos,” *Foreign Policy*, No. 74 (Spring 1989), p. 10.

4. Robert Heilbroner, *An Inquiry into the Human Prospect* (New York: Norton, 1980), pp. 39 and 95; William Ophuls, *Ecology and the Politics of Scarcity: A Prologue to a Political Theory of the Steady State* (San Francisco: Freeman, 1977), pp. 214–217.

5. Fen Hampson, “The Climate for War,” *Peace and Security*, Vol. 3, No. 3 (Autumn 1988), p. 9.

6. Jodi Jacobson, *Environmental Refugees: A Yardstick of Habitability*, Worldwatch Paper No. 86 (Washington, D.C.: Worldwatch Institute, 1988).

7. Peter Gleick, “Climate Change,” p. 336; Malin Falkenmark, “Fresh Waters as a Factor in Strategic Policy and Action,” in Westing, *Global Resources*, pp. 85–113.

8. Peter Wallensteen, “Food Crops as a Factor in Strategic Policy and Action,” Westing, *Global Resources*, pp. 151–155.

exporters may be tempted to use food as a weapon.<sup>9</sup> Environmental change could ultimately cause the gradual impoverishment of societies in both the North and South, which could aggravate class and ethnic cleavages, undermine liberal regimes, and spawn insurgencies.<sup>10</sup> Finally, many scholars indicate that environmental degradation will “ratchet up” the level of stress within national and international society, thus increasing the likelihood of many different kinds of conflict and impeding the development of cooperative solutions.<sup>11</sup>

Which of these scenarios are most plausible and why? In the following pages, I review some reasons for the current salience of environmental issues, and I note several examples of good research on links between environmental change and acute conflict. I then suggest a preliminary analytical framework that lays out a research agenda for exploring the issue. Using this framework, and drawing on the literature of conflict theory, I suggest hypotheses about the likely links between environmental change and acute conflict.

I propose that poor countries will in general be more vulnerable to environmental change than rich ones; therefore, environmentally induced conflicts are likely to arise first in the developing world. In these countries, a range of atmospheric, terrestrial, and aquatic environmental pressures will in time probably produce, either singly or in combination, four main, causally interrelated social effects: reduced agricultural production, economic decline, population displacement, and disruption of regular and legitimized social relations. These social effects, in turn, may cause several specific types of acute conflict, including scarcity disputes between countries, clashes between ethnic groups, and civil strife and insurgency, each with potentially serious repercussions for the security interests of the developed world.

I do not hypothesize that the causal links between these variables will be tight or deterministic. As anti-Malthusians have argued for nearly two centuries, numerous intervening factors—physical, technological, economic, and social—often permit great resilience, variability, and adaptability in human-environmental systems.<sup>12</sup> I identify a number of these factors in this article;

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9. Ibid., p. 146–151.

10. Ted Gurr, “On the Political Consequences of Scarcity and Economic Decline,” *International Studies Quarterly*, Vol. 29, No. 1 (March 1985), pp. 51–75.

11. “The disappearance of ecological abundance seems bound to make international politics even more tension ridden and potentially violent than it already is. Indeed, the pressures of ecological scarcity may embroil the world in hopeless strife, so that long before ecological collapse occurs by virtue of the physical limitations of the earth, the current world order will have been destroyed by turmoil and war.” Ophuls, *Ecology*, p. 214.

12. In his classic formulation, the economist Thomas Malthus claimed that severe human

in particular, I examine whether free-market mechanisms may permit developing countries to minimize the negative impacts of environmental degradation. But I suggest that, as the human population grows and environmental damage progresses, policymakers will have less and less capacity to intervene to keep this damage from producing serious social disruption, including conflict.

These hypotheses should be thoroughly tested using both historical and contemporary data at the regional and societal levels. There is great need for empirical research by students of security affairs.

### *The Recent Salience of Environmental Issues*

While the last decades have seen increasing environmental damage around the globe, for the most part this change has progressed incrementally rather than abruptly. Several factors explain the sudden attention recently given the issue. First, with the waning of the ideological and military confrontation between the superpowers, a space for other issues has opened in public discourse in Western societies. Second, public and media awareness of global environmental change was catalyzed in North America by the particularly hot and dry summer of 1988.<sup>13</sup> These two factors are principally circumstantial. But there is a third factor at work: during the last decade there has been a genuine shift in the scientific community's perception of global environmental problems. The environmental system, in particular the earth's climate, used to be regarded as relatively resilient and stable in the face of human insults. But now it is widely believed to have multiple local equilibria that are not highly stable.<sup>14</sup> In 1987, for example, geochemist Wallace Broecker reflected on recent polar ice-core and ocean-sediment data: "What these

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hardship was unavoidable, because human population grows geometrically when unconstrained, while food production can only grow arithmetically. Thomas Malthus, *An Essay on the Principle of Population* (New York: Penguin, 1970 [1798]), pp. 70–71.

13. See Stephen Schneider in *Global Warming: Are We Entering the Greenhouse Century?* (San Francisco: Sierra Club, 1989), chapter 7.

14. The development of chaos theory has contributed to this understanding. A chaotic system has nonlinear and feedback relationships between its variables that amplify small perturbations, thereby rendering accurate prediction of the system's state increasingly difficult the further one tries to project into the future. In chaos (not to be confused with randomness), deterministic causal processes still operate at the micro-level and, although the system's state may not be precisely predictable for a given point in the future, the boundaries within which its variables must operate are often identifiable. See James Crutchfield, J. Doyne Farmer, and Norman Packard, "Chaos," *Scientific American*, Vol. 255, No. 6 (December 1986), pp. 46–57; James Gleick, *Chaos: Making of a New Science* (New York: Viking, 1987).

records indicate is that Earth's climate does not respond to forcing in a smooth and gradual way. Rather, it responds in sharp jumps which involve large-scale reorganization of Earth's system. . . . We must consider the possibility that the main responses of the system to our provocation of the atmosphere will come in jumps whose timing and magnitude are unpredictable."<sup>15</sup>

A paradigm-shattering example of such nonlinear or "threshold" effects in complex environmental systems was the discovery of the Antarctic ozone hole in the mid-1980s.<sup>16</sup> The hole was startling evidence of the instability of the environmental system in response to human inputs, of the capacity of humankind to significantly affect the ecosystem on a global scale, and of our inability to predict exactly how the system will change.

This altered perception of the nature of the environmental system has percolated out of the scientific community into the policymaking community.<sup>17</sup> It may also be influencing the broader public's view of environmental problems. Scientists, policymakers, and laypeople are beginning to interpret data about environmental change in a new light: progressive, incremental degradation of environmental systems is not as tolerable as it once was, because we now realize that we do not know where and when we might cross a threshold and move to a radically different and perhaps highly undesirable system.

As compared to the first two factors accounting for the renewed salience of environmental issues, this one is not at all circumstantial; it is rooted in a maturing understanding of natural systems and the global damage humans

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15. Wallace Broecker, "Unpleasant Surprises in the Greenhouse?" *Nature*, Vol. 328, No. 6126 (July 9, 1987), pp. 123–126. See also James Gleick, "Instability of Climate Defies Computer Analysis," *New York Times*, March 20, 1988, p. 30. William Clark has made a similar point about interlinked physical, ecological, and social systems: "Typically in such systems, slow variation in one property can continue for long periods without noticeable impact on the rest of the system. Eventually, however, the system reaches a state in which its buffering capacity or resilience has been so reduced that additional small changes in the same property, or otherwise insignificant external shocks, push the system across a threshold and precipitate a rapid transition to a new system state or equilibrium." See William Clark, *On the Practical Implications of the Carbon Dioxide Question* (Laxenburg, Austria: International Institute of Applied Systems Analysis, 1985), p. 41.

16. J.C. Farman, B.G. Gardiner, and J.D. Shanklin, "Large Losses of Total Ozone in Antarctica Reveal Seasonal  $\text{ClO}_x/\text{NO}_x$  Interaction," *Nature*, Vol. 315, No. 6016 (May 16, 1985), pp. 207–210. Significant depletion of stratospheric ozone over Antarctica began in the 1970s, but was not identified until the 1980s because ozone-measuring satellites had been programmed to discard anomalous results. See Schneider, *Global Warming*, p. 226.

17. See, for example, the speeches on the floor of the U.S. Senate by Senators Nunn, Gore and Wirth, June 28, 1990, *Congressional Record—Senate*, pp. S8929–S8937.

are inflicting on these systems. This understanding is likely to endure, as will strong concern about the environment. Over the next fifty years there will be no shortage of increasingly ominous environmental data to interpret through this new paradigm. Even if there are no dramatic, nonlinear shifts in the ecosystem (though their probability may be quite high), environmental problems will remain prominent on our scientific, policy, and public agendas.

### *Recent Research on Environmental Change and Conflict*

Although there is an old and rich body of thought on the social impacts of environmental change,<sup>18</sup> the literature on the specific connections between environmental change and acute conflict is surprisingly thin. Here I briefly review several important studies.

Angus MacKay examines the relationship between climate change and civil violence in the kingdom of Castile (much of modern-day Spain).<sup>19</sup> During the fifteenth century, there were numerous well-documented episodes of popular unrest in Castile, and some seem to have been produced directly by climate-induced food shortages. In March of 1462, for instance, rioters rampaged through Seville after floods forced the price of bread beyond the means of the poor. Usually, however, the causal connections were more complex. An important intervening factor was the fabric of religious and social beliefs held by the people and promoted by preachers, especially those beliefs

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18. Discussions of the relationship between environment and society date back to the classical Greeks. In the early twentieth century, many explanations tended towards a simplistic "environmental determinism" that gave little regard to the role in human-environmental systems of feedback loops, human adaptability, and social institutions. See, for instance, Ellsworth Huntington, *Civilization and Climate* (New Haven: Yale University Press, 1915). This perspective has seen something of a resurgence in recent decades; see, for example, Margaret Biswas and Arit Biswas, eds., *Food, Climate and Man* (New York: Wiley, 1979). A survey of some of the best modern literature is William Clark, "The Human Dimensions of Global Change," in Committee on Global Change (U.S. National Committee for the IGBP), *Toward an Understanding of Global Change: Initial Priorities for U.S. Contributions to the International Geosphere-Biosphere Program (IGBP)* (Washington, D.C.: National Academy Press, 1988), pp. 134–213. On the social impact of climate change, see Robert Kates, Jesse Ausubel, and Mimi Berberian, eds., *Climate Impact Assessment: Studies of the Interaction of Climate and Society*, Scientific Committee on Problems of the Environment (SCOPE) No. 27 (New York: Wiley, 1985).

19. Angus MacKay, "Climate and Popular Unrest in Late Medieval Castile," in T.M. Wigley, M.J. Ingram, and G. Farmer, *Climate and History: Studies in Past Climates and Their Impact on Man* (Cambridge: Cambridge University Press, 1981), pp. 356–376. For other historical case studies of climate-society interaction, see Hubert Lamb, *Weather, Climate and Human Affairs* (London: Routledge, 1988).

attributing weather fluctuations to the sin of someone in the community.<sup>20</sup> MacKay thus argues against a simplistic “stimulus-response” model of environment-conflict linkages and instead for one that allows for “culturally mediated” behavior.

Addressing a modern conflict, William Durham has analyzed the demographic and environmental pressures behind the 1969 “Soccer War” between El Salvador and Honduras.<sup>21</sup> Because of the prominence in this conflict of previous migration from El Salvador to Honduras, and because of the striking evidence of population growth and land stress in the two countries (most notably in El Salvador), a number of analysts have asserted that the Soccer War is a first-class example of an ecologically driven conflict.<sup>22</sup> A simple Malthusian interpretation does seem to have credibility when one looks at the aggregate data.<sup>23</sup> But Durham shows that changes in agricultural practice and land distribution—to the detriment of poor farmers—were more powerful inducements to migration than sheer population growth. Land scarcity developed not because there was too little to go around, but because of “a process of competitive exclusion by which the small farmers [were] increasingly squeezed off the land” by large land owners.<sup>24</sup> Durham thus contends that ecologists cannot directly apply to human societies the simple, density-dependent models of resource competition they commonly use to study asocial animals: a distributional component must be added, because human behavior is powerfully constrained by social structure and the resource access it entails.<sup>25</sup>

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20. Anger over food scarcity was sometimes turned against Jews and *conversos* (Jews who had converted to Christianity after Iberian pogroms in the late fourteenth century), and sometimes against small shopkeepers who were accused of the “sins” of creating shortages and overpricing food.

21. William Durham, *Scarcity and Survival in Central America: The Ecological Origins of the Soccer War* (Stanford, Calif.: Stanford University Press, 1979).

22. For instance, see Paul Ehrlich, Anne Ehrlich, and John Holdren, *Ecoscience: Population, Resources, Environment* (San Francisco: Freeman, 1977), p. 908.

23. El Salvador was the most densely populated country in the Western Hemisphere (190 people per square kilometer in 1976; compare India at 186), with a population growth rate of 3.5 percent per year (representing a doubling time of about twenty years). Most of the country had lost its virgin forest, land erosion and nutrient depletion were severe, and total food production fell behind consumption in the mid-50s. Per capita farmland used for basic food crops fell from 0.15 hectares in 1953 to 0.11 hectares in 1971.

24. Durham, *Scarcity and Survival*, p. 54.

25. The importance of variables intervening between population density and conflict is emphasized in Nazli Choucri, ed., *Multidisciplinary Perspectives on Population and Conflict* (Syracuse, N.Y.: Syracuse University Press, 1984); see also Jack Goldstone, *Revolution and Rebellion in the Early Modern World* (Berkeley, Calif.: University of California Press, 1991).



Others have analyzed environment-conflict linkages in the Philippines.<sup>26</sup> Although the country has suffered from serious internal strife for many decades, its underlying causes may be changing: population displacement, deforestation, and land degradation appear to be increasingly powerful forces driving the current communist-led insurgency.<sup>27</sup> Here, too, the linkages between environmental change and conflict are complex, involving numerous intervening variables, both physical and social. The Filipino population growth rate of 2.5 percent is among the highest in Southeast Asia. To help pay the massive foreign debt, the government has encouraged the expansion of large-scale lowland agriculture. Both factors have swelled the number of landless agricultural laborers. Many have migrated to the Philippines' steep and ecologically vulnerable uplands where they have cleared land or established plots on previously logged land. This has set in motion a cycle of erosion, falling food production, and further clearing of land. Even marginally fertile land is becoming hard to find in many places, and economic conditions are often dire for the peasants.<sup>28</sup> Civil dissent is rampant in these peripheral areas, which are largely beyond the effective control of the central government.

While these studies are commendable, a review of all of the recent work on environmental change and conflict reveals a number of difficulties, some methodological and some conceptual. First, researchers often emphasize human-induced climate change and ozone depletion to the neglect of severe terrestrial and aquatic environmental problems such as deforestation, soil degradation, and fisheries depletion. Second, much of the recent writing on the links between environmental change and conflict is anecdotal. These pieces do not clearly separate the "how" question (how will environmental change lead to conflict?) from the "where" question (where will such conflict occur?). I address the "how" question in the following sections of this article.

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26. See especially Gareth Porter and Delfin Ganapin, Jr., *Resources, Population, and the Philippines' Future: A Case Study*, WRI Paper No. 4 (Washington, D.C.: World Resources Institute [WRI], 1988).

27. Other works on the Philippines used in this article are Gary Hawes, "Theories of Peasant Revolution: A Critique and Contribution from the Philippines," *World Politics*, Vol. 42, No. 1 (January 1990), pp. 261–298; Gregg Jones, *Red Revolution: Inside the Philippine Guerrilla Movement* (Boulder, Colo.: Westview, 1989); World Bank, *Philippines: Environment and Natural Resource Management Study* (Washington, D.C.: World Bank, 1989).

28. Leonard notes that, around the planet, population growth, inequitable land distribution, and agricultural modernization have caused huge numbers of desperately poor people to move to "remote and ecologically fragile rural areas" or to already overcrowded cities. See Jeffrey Leonard, "Overview," *Environment and the Poor: Development Strategies for a Common Agenda* (New Brunswick, N.J.: Transaction, 1989), p. 5.

Third, environmental-social systems are hard to analyze. They are characterized by multiple causes and effects and by a host of intervening variables, often linked by interactive, synergistic, and nonlinear causal relations. Empirical data about these variables and relations are rarely abundant. Although the underlying influence of environmental factors on conflict may be great, the complex and indirect causation in these systems means that the scanty evidence available is always open to many interpretations. Furthermore, understanding environmental-social systems involves specifying links across levels of analysis usually regarded as quite independent.<sup>29</sup>

Fourth, the prevailing "naturalistic" epistemology and ontology of social science may hinder accurate understanding of the links between physical and social variables within environmental-social systems.<sup>30</sup> In particular, it may be a mistake to conjoin, in causal generalizations, types of physical event with types of intentional social action.<sup>31</sup> Fifth, researchers must acquire detailed knowledge of a daunting range of disciplines, from atmospheric science and agricultural hydrology to energy economics and international relations theory.

Sixth and finally, the modern realist perspective that is often used to understand security problems is largely inadequate for identifying and explaining the links between environmental change and conflict. Realism focuses on states as rational maximizers of power in an anarchic system; state behavior is mainly a function of the structure of power relations in the system.<sup>32</sup> But this emphasis on states means that theorists tend to see the world as divided into territorially distinct, mutually exclusive countries, not broader environmental regions or systems. Realism thus encourages scholars to deemphasize transboundary environmental problems, because such prob-

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29. For example, researchers might need to be able to show how countless individual actions affect global climate variables (thus moving "up" through several levels of analysis), and how, in turn, these global variables influence conflict behavior (thereby moving back "down" to group and individual behavior).

30. A naturalistic view of social science holds that there is no qualitative difference between the domains of investigation of the natural and social sciences, suggesting that the procedures used for research and explanation can be basically the same in both domains.

31. For over three decades, issues surrounding intentionality and causal generalization have been the subject of heated debate in philosophy of mind, language, and science. For the purposes of this article, however, I treat as unproblematic causal generalizations that include physical and social variables.

32. My comments here principally refer to the influential "neorealist" school. See in particular Kenneth Waltz, *Theory of International Politics* (Reading, Mass.: Addison-Wesley, 1979); and Robert Gilpin, *War and Change in World Politics* (Cambridge: Cambridge University Press, 1981).

lems often cannot be linked to a particular country, and do not have any easily conceptualized impact on the structure of economic and military power relations between states. Realism induces scholars to squeeze environmental issues into a structure of concepts including "state," "sovereignty," "territory," "national interest," and "balance of power." The fit is bad, which may lead theorists to ignore, distort, and misunderstand important aspects of global environmental problems.

### *Mapping Causes and Effects*

This article proposes a research agenda to guide the study of environmental change and acute conflict. Before we can formulate plausible hypotheses, however, we need a clear analytical framework, such as suggested by Figure 1. This and subsequent figures in this article provide the basis for a detailed causal-path analysis of the links between environmental change and conflict. Such an analysis can help bring some order into the profusion of predictions concerning these issues, and it can also help researchers address several of the impediments to research mentioned above.<sup>33</sup>

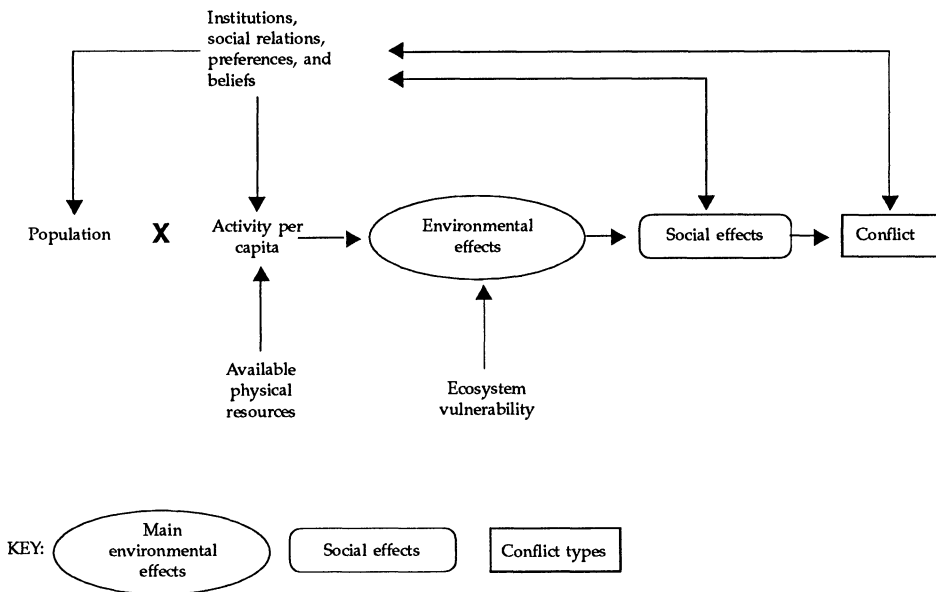
Figure 1 suggests that the total effect of human activity on the environment in a particular ecological region is mainly a function of two variables: first, the product of total population in the region and physical activity per capita, and second, the vulnerability of the ecosystem in that region to those particular activities. Activity per capita, in turn, is a function of available physical resources (which include nonrenewable resources such as minerals, and renewable resources such as water, forests, and agricultural land) and ideational factors, including institutions, social relations, preferences, and beliefs.<sup>34</sup> The figure also shows that environmental effects may cause social effects that in turn could lead to conflict. For example, the degradation of agricultural land might produce large-scale migration, which could create

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33. Most notably, it can help them gauge the causal power of distant environmental forces, identify potentially important interactions of simultaneous environmental problems, specify intervening variables, and identify causal links across levels of analysis.

34. Over short and medium terms, activity per capita is also a function of the economy's current capital stock, which reflects the society's prevailing level and type of technological development. Over the long term, we can assume that a society's technology is a result of two components of Figure 1: certain ideational factors (most importantly, beliefs about the nature of physical reality held by particular knowledge-oriented groups in the society) and available physical resources. I use the adjective "ideational" to emphasize that factors such as institutions, social relations, and beliefs are products of the human mind.

**Figure 1. Environmental Change and Acute Conflict.**



ethnic conflicts as migratory groups clash with indigenous populations. There are important feedback loops from social effects and conflict to the ideational factors and thence back to activity per capita and population. Thus, ethnic clashes arising from migration could alter the operation of a society's markets and thereby its economic activity.<sup>35</sup>

35. Numerous writers, especially those considering the social impact of climate change, have generated similar diagrams. See in particular the excellent survey article by Richard Warrick and William Riebsame entitled "Societal Response to CO<sub>2</sub>-Induced Climate Change: Opportunities for Research," *Climatic Change*, Vol. 3, No. 4 (1981), pp. 387–428. Two points should be noted about Figure 1: First, there are many ways it could be made more accurate, but at the cost of greater complexity. For example, there are feedback loops from social effects and conflict to environmental effects. The diagrams in this article highlight what I believe are the variables and causal linkages most important to our discussion. Second, each variable in Figure 1 aggregates many sub-variables. For instance, "activity per capita" encompasses sub-variables ranging from the extent of cattle ranching to the rate of automobile use. Consequently, an arrow in Figure 1 may represent either a positive or a negative correlation, depending on the specific sub-variables considered. In Figures 2–4, which identify more specific variables, all arrows represent positive correlations.

To clarify the research agenda, we can divide the "how" question (how will environmental change lead to conflict?) into two independent questions. First, what are the important social effects of environmental change? Second, what types of acute conflict, if any, are most likely to result from these social effects? The first question asks about the nature of the arrow in Figure 1 between "environmental effects" and "social effects," while the second asks about the arrow between "social effects" and "conflict."

My focus on these two causal linkages does not deny the importance of the other variables and linkages in the figure. We must be aware of the role of population growth, demographic structure, and patterns of population distribution.<sup>36</sup> And we must understand the effect of the ideational factors at the top of the diagram. This social and psychological context is immensely broad and complex. It includes patterns of land distribution (as in the Soccer War); family and community structure; the economic and legal incentives to consume and produce goods, including the system of property rights and markets; perceptions of the probability of long-run political and economic stability; historically rooted patterns of trade and interaction with other societies (as with debt and export relations between the Philippines and the North); the distribution of coercive power within and among nations; the form and effectiveness of institutions of governance; and metaphysical beliefs about the relationship between humans and nature (as in medieval Castile).

Without a full understanding of these intervening factors we cannot begin to grasp the true nature of the relationships between human activity, environmental change, social disruption, and conflict.<sup>37</sup> These factors largely determine the vulnerability and adaptability of a society when faced with environmental stresses. There is historical evidence that certain societies have technological, institutional, or cultural characteristics that make them very

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36. Experts vigorously dispute the effects of population growth on the environment, economic well-being, and social organization. Julian Simon is optimistic in *The Ultimate Resource* (Princeton: Princeton University Press, 1981); Paul and Anne Ehrlich reiterate their well-known pessimism in *The Population Explosion* (London: Hutchinson, 1990). The question is surveyed by Geoffrey McNicoll in "Consequences of Rapid Population Growth: An Overview and Assessment," *Population and Development Review*, Vol. 10, No. 2 (June 1984), pp. 177–240.

37. Recognition of the role of these factors distinguishes simplistic environmental determinism from sophisticated accounts of the nature of the environmental threat posed to humankind. Perhaps the most extreme example of the former in the environmental-security literature is Brown, "Climate, Ecology and International Security," pp. 523–524. Brown implies that climate change was an important and relatively proximate cause of social upheaval in Europe in the 1840s, imperial expansion between 1850 and 1940, the Cold War, and the 1974 Ethiopian coup.

resilient to such pressures.<sup>38</sup> Not only do we need to identify the thresholds beyond which given societies cannot effectively respond, we need to determine why some societies respond better than others.

Figure 1 clarifies these aspects of our research agenda. If we wish to understand a society's capacity to prevent severe social disruption (where the preventive action could be either mitigation of, or adaptation to, the environmental stress), we need to understand the arrows between the ideational factors at the top of the figure and "population," "activity per capita," and "social effects" along the main spine of the figure. If we wish to understand a society's propensity toward conflict (given certain social effects due to the environmental stress), we need to understand the arrow between the ideational factors and "conflict." When sufficiently advanced, this research should help identify key intervention points where policymakers might be able to alter the causal processes linking human activity, environmental degradation, and conflict. These interventions will fall into two general categories: those that seek to prevent negative social effects and those that seek to prevent the conflict that could result from these social effects. In the following pages I refer to these as "first-stage" and "second-stage" interventions.

#### THE RANGE OF ENVIRONMENTAL PROBLEMS

Developing countries are likely to be affected sooner and more severely by environmental change than rich countries. By definition, they do not have the financial, material, or intellectual resources of the developed world; furthermore, their social and political institutions tend to be fragile and riven with discord. It is probable, therefore, that developing societies will be less able to apprehend or respond to environmental disruption.<sup>39</sup>

Seven major environmental problems (the "environmental effects" in Figure 1) might plausibly contribute to conflict within and among developing countries: greenhouse warming, stratospheric ozone depletion, acid deposition, deforestation, degradation of agricultural land, overuse and pollution

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38. Social vulnerability and adaptability have been the focus of much research and thought. See Warrick and Riebsame, "Societal Response." On the conditions and variables that determine vulnerability, see Diana Liverman, "Vulnerability to Global Environmental Change," in Roger Kasperson, et al., eds., *Understanding Global Environmental Change: The Contributions of Risk Analysis and Management*, report of an international workshop at Clark University, October 11–13, 1989 (Worcester, Mass.: Clark University, 1989), pp. 32–33.

39. Gurr, "Political Consequences of Scarcity," pp. 70–71.

of water supplies, and depletion of fish stocks.<sup>40</sup> These problems can all be crudely characterized as large-scale human-induced problems, with long-term and often irreversible consequences, which is why they are often grouped together under the rubric "global change."<sup>41</sup> However, they vary greatly in spatial scale: the first two involve genuinely global physical processes, while the last five involve regional physical processes, although they may appear in locales all over the planet. These seven problems also vary in time scale: for example, while a region can be deforested in only a few years, and severe ecological and social effects may be noticeable almost immediately, human-induced greenhouse warming will probably develop over many decades<sup>42</sup> and may not have truly serious implications for humankind for half a century or more after the signal is first detected. In addition, some of these problems (for instance, deforestation and degradation of water supplies) are much more advanced than others (such as greenhouse warming and ozone depletion) and are already producing serious social disruption. This variance in tangible evidence for these problems contributes to great differences in our certainty about their ultimate severity. The uncertainties surrounding greenhouse warming, for example, are thus far greater than those concerning deforestation.<sup>43</sup>

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40. I have left off this list a number of environmental problems. Declining biodiversity, for example, might contribute to acute conflict (by weakening agricultural productivity over the long term), but even more indirectly than the seven environmental stresses discussed here. Increased dumping of toxic wastes in the South, and accidents in the South involving subsidiaries of Northern companies (such as the Bhopal tragedy), will probably do no more than strain economic and diplomatic relations, although such incidents could lead to sporadic, localized violence. Perceptions of environmental damage or potential damage (whether or not the perceptions are justified) might also induce tensions; for instance, the siting of a nuclear plant close to an international border could lead to protests in neighboring countries. However, it seems unlikely that such perceptions by themselves could cause widespread conflict.

41. Readers interested in technical background on these problems should consult *World Resources 1990–91* (New York: Oxford University Press, 1990) and *World Resources 1988–89* (New York: Basic Books, 1988). This publication, produced biennially by the World Resources Institute (WRI) in collaboration with the United Nations Environment Programme and other organizations, is widely regarded as the most accessible, accurate, and comprehensive source for information on global change issues. The more popular *State of the World* report published annually by the Worldwatch Institute is useful but sometimes selective and tendentious.

42. However, as Broecker has pointed out, nonlinear or threshold effects in the atmospheric system could produce a sudden shift of the *climate* to a new equilibrium by altering, for example, the direction of major ocean currents such as the Gulf Stream. Broecker, "Unpleasant Surprises in the Greenhouse?" p. 124.

43. However, the uncertainties remain substantial for deforestation. See Vaclav Smil, *Energy, Food, Environment: Realities, Myths, Options* (Oxford, U.K.: Oxford University Press, 1987), pp. 231–237.

Many of these problems are causally interrelated. For instance, acid deposition damages agricultural land, fisheries, and forests. Greenhouse warming may contribute to deforestation by moving northward the optimal temperature and precipitation zones for many tree species, by increasing the severity of windstorms and wildfires, and by expanding the range of pests and diseases.<sup>44</sup> The release of carbon from these dying forests would reinforce the greenhouse effect. The increased incidence of ultraviolet radiation due to the depletion of the ozone layer will probably damage trees and crops, and it may also damage the phytoplankton at the bottom of the ocean food chain.<sup>45</sup>

Finally, when we consider the social effects of environmental change, especially of climate change, we should be especially aware of changes in the incidence of "extreme" environmental events. Social impacts result "not so much from slow fluctuations in the mean, but from the tails of the distribution, from extreme events." While a two-to-three degree celsius mean global warming might not seem too significant for agricultural production, it may produce a large increase in crop-devastating droughts, floods, heat waves, and storms.<sup>46</sup>

#### FOUR PRINCIPAL SOCIAL EFFECTS

Environmental degradation may cause countless often subtle changes in developing societies. These range from increased communal cooking as fuelwood becomes scarce around African villages, to worsened poverty of Filipino coastal fishermen whose once-abundant grounds have been destroyed by trawlers and industrial pollution. Which of the many types of social effect might be crucial links between environmental change and acute conflict? This is the first part of the "how" question. To address it, we must use both the best knowledge about the social effects of environmental change and the best knowledge about the nature and causes of social conflict.

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44. WRI, et al., *World Resources 1990-91*, p. 111.

45. Robert Worrest, Hermann Gucinski, and John Hardy, "Potential Impact of Stratospheric Ozone Depletion on Marine Ecosystems," in John Topping, Jr., ed., *Coping with Climate Change: Proceedings of the Second North American Conference on Preparing for Climate Change* (Washington, D.C.: The Climate Institute, 1989), pp. 256-262.

46. T.M.L. Wigley, "Impact of Extreme Events," *Nature*, Vol. 316, No. 6024 (July 11, 1985), pp. 106-107. Since the probability distributions for most climate variables describe a bell curve, Wigley calculates that a shift in the mean by one standard deviation would change a 1-in-20-year extreme to one that occurs on average 1 year in 4, while the 1-in-100-year extreme would become a 1-in-11-year event.



In thus working from both ends towards the middle of the causal chain, I hypothesize that four principal social effects may, either singly or in combination, substantially increase the probability of acute conflict in developing countries: decreased agricultural production, economic decline, population displacement, and disruption of legitimized and authoritative institutions and social relations. These effects will often be causally interlinked, sometimes with reinforcing relationships. For example, the population displacement resulting from a decrease in agricultural production may further disrupt agricultural production. Or economic decline may lead to the flight of people with wealth and education, which in turn could eviscerate universities, courts, and institutions of economic management, all of which are crucial to a healthy economy.

AGRICULTURAL PRODUCTION. Decreased agricultural production is often mentioned as potentially the most worrisome consequence of environmental change,<sup>47</sup> and Figure 2 presents some of the causal scenarios frequently proposed by researchers. This illustration is not intended to be exhaustive: the systemic interaction of environmental and agricultural variables is far more complex than the figure suggests.<sup>48</sup> Moreover, no one region or country will exhibit all the indicated processes: while some are already clearly evident in certain areas, others are not yet visible anywhere.

The Philippines provides a good illustration of deforestation's impact, which can be traced out in the figure. Since the Second World War, logging and the encroachment of farms have reduced the virgin and second-growth forest from about sixteen million hectares to 6.8–7.6 million hectares.<sup>49</sup> Across the archipelago, logging and land-clearing have accelerated erosion, changed regional hydrological cycles and precipitation patterns, and decreased the land's ability to retain water during rainy periods. The resulting flash floods have damaged irrigation works while plugging reservoirs and irrigation channels with silt. These factors may seriously affect crop production. For ex-

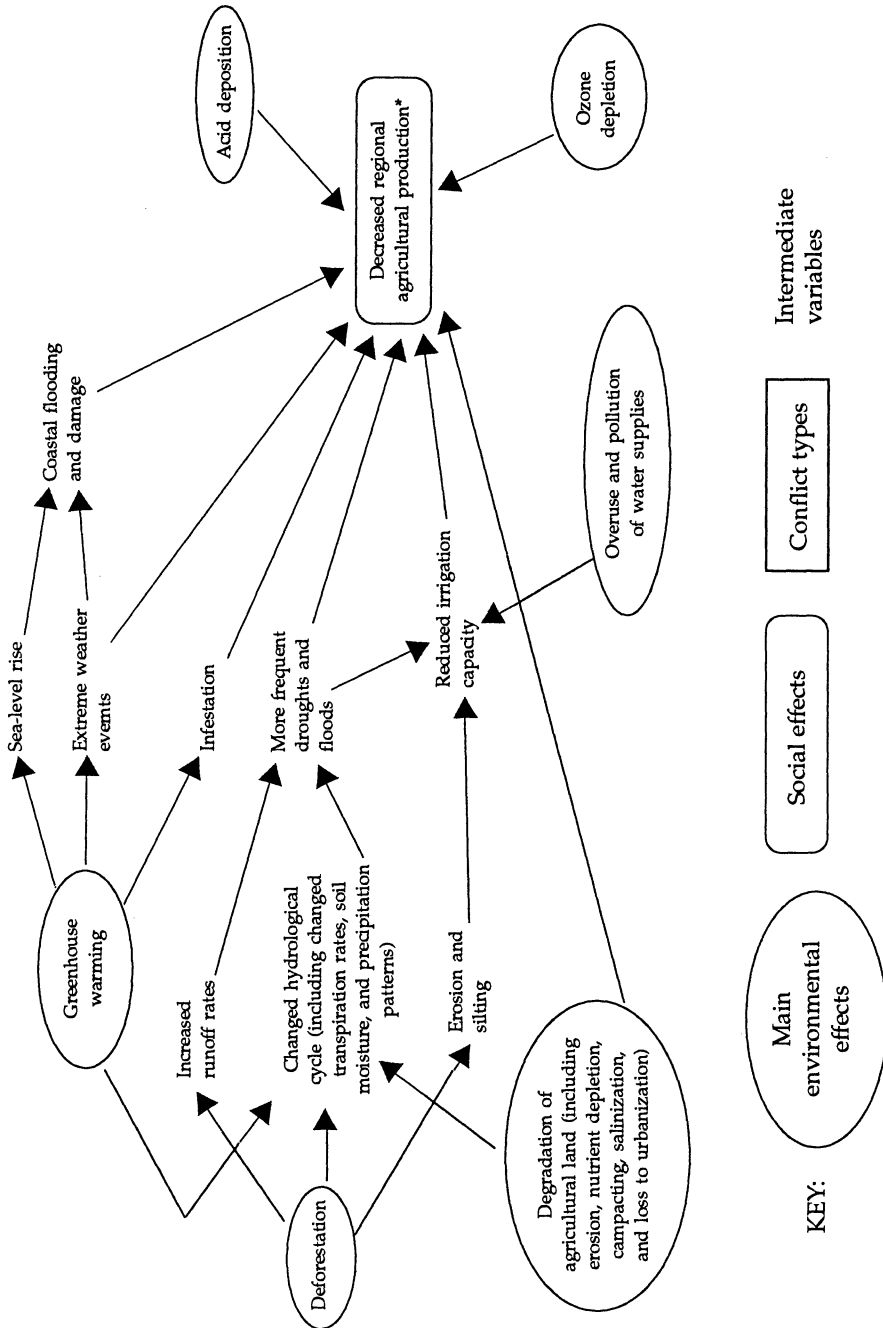
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47. See, for example, Lester Brown, "Reexamining the World Food Prospect," in Worldwatch Institute, *State of the World 1989* (New York: Norton, 1989), pp. 41–58.

48. Useful discussions of these systems include World Commission on Environment and Development (commonly known as the Brundtland Commission), "Food Security: Sustaining the Potential," in *Our Common Future* (Oxford: Oxford University Press, 1987), chapter 5, pp. 118–146; WRI, et al., *World Resources 1988–89*, pp. 18–21, 51–68, and especially 215–234, 271–284; WRI, et al., *World Resources 1990–91*, pp. 5–6, 83–100; United Nations Food and Agriculture Organization (FAO), *The State of Food and Agriculture 1989* (Rome: FAO, 1989), pp. 65–74.

49. Porter and Ganapin, *Resources, Population, and the Philippines' Future*, p. 24. These authors call this "perhaps the most rapid destruction of forest reserves in the world." The figures cited refer to adequately stocked forested land, and are approximate.

**Figure 2. Possible Effects of Environmental Change on Agricultural Production.**



\*See Figures 3 and 4.

ample, when the government of the Philippines and the European Economic Community commissioned an Integrated Environmental Plan for the still relatively unspoiled island of Palawan, the authors of the study found that only about half of the 36,000 hectares of irrigated farmland projected within the Plan for 2007 will actually be irrigable because of the hydrological effects of decreases in forest cover.<sup>50</sup>

Figure 2 also highlights the importance of the degradation and decreasing availability of good agricultural land, problems that deserve much closer attention than they usually receive. Currently, total global cropland amounts to about 1.5 billion hectares. Optimistic estimates of total arable land on the planet, which includes both current and potential cropland, range from 3.2 to 3.4 billion hectares, but nearly all the best land has already been exploited. What is left is either less fertile, not sufficiently rainfed or easily irrigable, infested with pests, or harder to clear and work.<sup>51</sup>

For developing countries during the 1980s, cropland grew at just 0.26 percent a year, less than half the rate of the 1970s. More importantly, in these countries arable land per capita dropped by 1.9 percent a year.<sup>52</sup> In the absence of a major increase in arable land in developing countries, experts expect that the world average of 0.28 hectares of cropland per capita will decline to 0.17 hectares by the year 2025, given the current rate of world population growth.<sup>53</sup> Large tracts are being lost each year to urban encroachment, erosion, nutrient depletion, salinization, waterlogging, acidification, and compacting. The geographer Vaclav Smil, who is generally very conservative in his assessments of environmental damage, estimates that two to three million hectares of cropland are lost annually to erosion; perhaps twice as much land goes to urbanization, and at least one million hectares are abandoned because of excessive salinity. In addition, about one-fifth of the

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50. Christopher Finney and Stanley Western, "An Economic Analysis of Environmental Protection and Management: An Example from the Philippines," *The Environmentalist*, Vol. 6, No. 1 (1986), p. 56.

51. Experts generally describe a country as "land scarce" when 70 percent or more of the arable land is under production. In Asia about 82 percent of all arable land is cultivated. See WRI, et al., *World Resources 1990-91*, p. 5.

52. Nafis Sadik, *The State of the World Population 1990* (New York: United Nations Population Fund, 1990), p. 8.

53. WRI, et al., *World Resources 1990-91*, p. 87. Nearly 73 percent of all rural households in developing countries are either landless or nearly landless. Using this figure, Leonard estimates that "935 million rural people live in households that have too little land to meet the minimum subsistence requirements for food and fuel. These data exclude China, which could add as many as 100-200 million more people to the category." See Leonard, "Overview," p. 13.

world's cropland is suffering from some degree of desertification.<sup>54</sup> Taken together, he concludes, the planet will lose about 100 million hectares of arable land between 1985 and 2000.<sup>55</sup>

Figure 2 also depicts some of the effects that greenhouse warming and climate change may have on agricultural production.<sup>56</sup> Coastal cropland in countries such as Bangladesh and Egypt is extremely vulnerable to storm surges. Such events could become more common and devastating, because global warming will cause sea levels to rise and might intensify storms. The greenhouse effect will also change precipitation patterns and soil moisture; while this may benefit some agricultural regions, others will suffer. Many plants grow faster and larger in a warm environment rich in carbon dioxide, and they often use water more efficiently.<sup>57</sup> But optimistic estimates of greatly increased crop yields have usually been based on laboratory experiments under ideal growing conditions. In addition, these estimates have ignored the influence on yields of more frequent extreme climate events (especially droughts and heat waves), increased pest infestation, and the decreased nutritional quality of crops grown in a carbon dioxide-enriched atmosphere.

**ECONOMIC DECLINE.** If we are interested in environment-conflict linkages, perhaps the most important potential social effect of environmental degra-

54. Experts give "desertification" a variety of meanings. In general, it implies a complex syndrome of very low soil productivity, poor rain-use efficiency by vegetation, and consequent adverse changes in the hydrological cycle. It can therefore encompass several of the variables identified in Figure 2. See Michel Verstraete, "Defining Desertification: A Review," *Climatic Change*, Vol. 9, No. 1/2 (August/October 1986), pp. 5-18.

55. Smil gives a startling account of the situation in China. From 1957 to 1977 the country lost 33.33 million hectares of farmland (30 percent of its 1957 total), while it added 21.2 million hectares of largely marginal land. He notes that "the net loss of 12 million hectares during a single generation when the country's population grew by about 300 million people means that per capita availability of arable land dropped by 40 per cent and that China's farmland is now no more abundant than Bangladesh's—a mere one-tenth of a hectare per capita!" See Smil, *Energy, Food, Environment*, pp. 223 and 230.

56. There is scientific debate about the likely magnitude, rate, and timing of greenhouse warming and about its climatic, ecological, and social impacts. The current consensus is summarized in the reports prepared by Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC) under the auspices of the World Meteorological Organization and the United Nations Environment Programme. The complete report of Working Group I has been published as J.T. Houghton, G.J. Jenkins, and J.J. Ephraums, eds., *Climate Change: The IPCC Scientific Assessment* (Cambridge: Cambridge University Press, 1990). For a thorough assessment of climate change and agriculture, see M.L. Parry, T.R. Carter, and N.T. Konijn, eds., *The Impact of Climatic Variations on Agriculture*, Volume 1: *Assessments in Cool Temperate and Cold Regions*; Volume 2: *Assessments in Semi-arid Regions* (Dordrecht, Netherlands: Kluwer, 1989).

57. See R.A. Warrick, R.M. Gifford, and M.L. Parry, "CO<sub>2</sub>, Climatic Change and Agriculture: Assessing the Response of Food Crops to the Direct Effects of Increased CO<sub>2</sub> and Climatic Change," in Bert Bolin, et al., eds. *The Greenhouse Effect, Climatic Change, and Ecosystems*, SCOPE No. 29 (New York: Wiley, 1986), pp. 393-474.

dation is the further impoverishment it may produce in developing societies. In Figure 3, I suggest some key causal processes. The figure shows that economic productivity may be influenced directly by environmental disruption, or indirectly via other social effects such as decreased agricultural production. While few developing countries will exhibit all causal links indicated in Figure 3, most will exhibit some.

A great diversity of factors might affect wealth production. For example, increased ultraviolet radiation caused by ozone depletion is likely to raise the rate of disease in humans and livestock,<sup>58</sup> which could have serious economic results. Logging for export markets may produce short-term economic gain for the country's elite, but increased runoff can damage roads, bridges, and other valuable infrastructure, while the extra siltation reduces the transport and hydroelectric capacity of rivers. As forests are destroyed, wood becomes scarcer and more expensive, and it absorbs an increasing share of the household budget for the poor families that use it for fuel.<sup>59</sup>

Agriculture is the source of much of the wealth generated in developing societies. Food production soared in many regions over the last decades because the green revolution more than compensated for inadequate or declining soil productivity;<sup>60</sup> but some experts believe this economic relief will be short-lived. Jeffrey Leonard writes: "Millions of previously very poor families that have experienced less than one generation of increasing wealth due to rising agricultural productivity could see that trend reversed if environmental degradation is not checked."<sup>61</sup> Damage to the soil is already producing a harsh economic impact in some areas.<sup>62</sup>

Gauging the actual economic cost of land degradation is not easy. Current national income accounts do not incorporate measures of resource depletion: "A nation could exhaust its mineral reserves, cut down its forests, erode its soils, pollute its aquifers, and hunt its wildlife to extinction—all without

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58. Janice Longstreth, "Overview of the Potential Health Effects Associated with Ozone Depletion," in Topping, *Coping with Climate Change*, pp. 163–167.

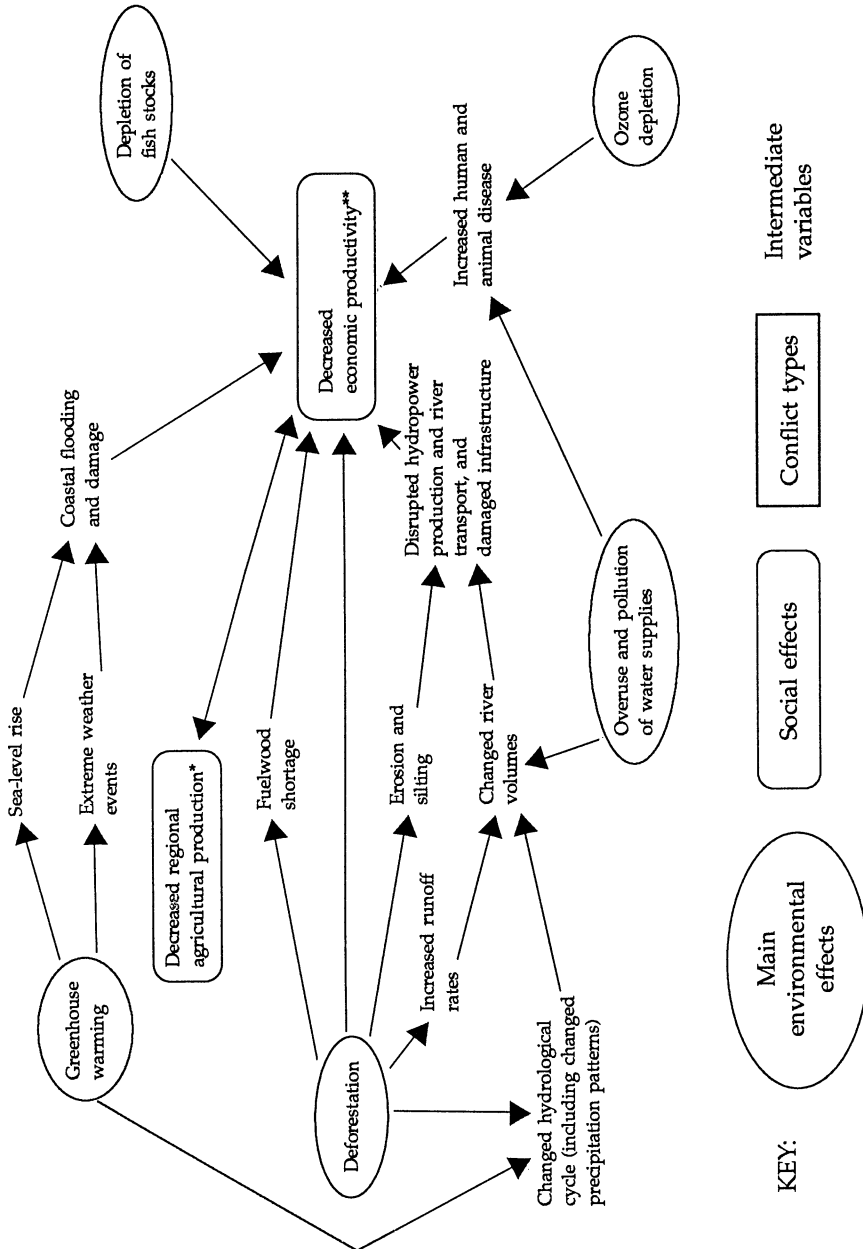
59. The FAO estimates that up to 2.5 billion people in the developing world will face acute fuelwood shortages by the year 2000. FAO, *Fuelwood Supplies in the Developing Countries*, FAO Forestry Paper No. 42 (Rome: FAO, 1983).

60. The term "green revolution" refers to the dramatic gains in crop output in the developing countries from the 1960s into the 1980s due to higher-yielding grains and the intensive use of irrigation, chemical fertilizers, and pesticides.

61. Leonard, *Environment and the Poor*, p. 27.

62. For a case study of Indonesia, see Robert Repetto, "Balance-Sheet Erosion—How to Account for the Loss of Natural Resources," *International Environmental Affairs*, Vol. 1, No. 2 (Spring 1989), pp. 103–137.

**Figure 3. Possible Effects of Environmental Change on Economic Productivity in Developing Countries.**



\*See Figures 2 and 4.

\*\*See Figure 4.

affecting measured income."<sup>63</sup> The inadequacy of measures of economic productivity reinforces the perception that there is a policy trade-off between economic growth and environmental protection; this perception, in turn, encourages societies to generate present income at the expense of their potential for future income.<sup>64</sup>

POPULATION DISPLACEMENT. Some commentators have suggested that environmental degradation may produce vast numbers of "environmental refugees."<sup>65</sup> Sea-level rise may drive people back from coastal and delta areas in Egypt; spreading desert may empty Sahelian countries as their populations move south; Filipino fishermen may leave their depleted fishing grounds for the cities. The term "environmental refugee" is somewhat misleading, however, because it implies that environmental disruption could be a clear, proximate cause of refugee flows. Usually, though, environmental disruption will be only one of many interacting physical and social variables, including agricultural and economic decline, that ultimately force people from their homelands. For example, over the last three decades, millions of people have migrated from Bangladesh to neighboring West Bengal and Assam in India. While detailed data are scarce (in part because the Bangladeshi government is reluctant to admit there is significant out-migration), many specialists believe this movement is a result, at least in part, of shortages of adequately fertile land due to a rapidly growing population. Flooding, caused by deforestation in watersheds upstream on the Ganges and Brahmaputra rivers, might also be driving people from the area.<sup>66</sup> In the future, this migration could be aggravated by rising sea-levels coupled with extreme weather events (both perhaps resulting from climate change).

DISRUPTED INSTITUTIONS AND SOCIAL RELATIONS. The fourth social effect especially relevant to the connection between environment change and acute conflict is the disruption of institutions and of legitimized, accepted, and

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63. Robert Repetto, "Wasting Assets: The Need for National Resource Accounting," *Technology Review*, January 1990, p. 40.

64. Repetto carefully analyzes soil types, cropping practices, logging, and erosion rates in upland areas of Java. Applying a 10 percent discount rate to the future stream of lost income, Repetto calculates the total economic cost of one year of erosion to be \$481 million; this is about 40 percent of the annual value of upland cropland production. He writes: "Nearly 40 cents in future income is sacrificed to obtain each dollar for current consumption." He also estimates that off-site costs, including the higher expense of clearing waterways and irrigation channels of silt, come to \$30–\$100 million a year. Repetto, "Balance-Sheet Erosion," pp. 129–132.

65. E.g., Jacobson, *Environmental Refugees*.

66. Lester Brown and John Young, "Feeding the World in the Nineties," in Worldwatch Institute, *State of the World: 1990* (New York: Norton, 1990), p. 61.

authoritative social relations. In many developing societies, the three social effects described above are likely to tear this fabric of custom and habitual behavior. A drop in agricultural output may weaken rural communities by causing malnutrition and disease, and by encouraging people to leave; economic decline may corrode confidence in the national purpose, weaken the tax base, and undermine financial, legal, and political institutions; and mass migrations of people into a region may disrupt labor markets, shift class relations, and upset the traditional balance of economic and political authority between ethnic groups.

### *The Capacity of Developing Countries to Respond: First-Stage Interventions*

Can developing countries respond to environmental problems effectively enough to avert these negative social effects? The aggregate data on world food production might give us reason for optimism. Between 1965 and 1986, many developing regions suffered serious environmental problems, including erosion, salinization, and loss of land to urbanization. Yet global cereal production increased at 3 percent a year, meat and milk output increased 2 percent annually, while the rate for oil crops, vegetables, and pulses was 2.5 percent.<sup>67</sup> At the regional level, increased food production kept ahead of population growth, except in Africa, and local shortfalls were alleviated by exports from developed countries with huge surpluses. We might therefore conclude that developing countries have sufficient capacity, with intermittent assistance from Northern grain exporters, to respond to environmental problems.

But aggregate figures hide significant disparities in food availability among and within developing countries.<sup>68</sup> Moreover, these figures are becoming less promising than they once were: many developing countries have already reaped most of the green revolution's potential benefit, and the rate of increase in global cereal production has declined by over 40 percent since the 1960s.<sup>69</sup> For three successive years—from 1987 through 1989—estimated

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67. WRI, et al., *World Resources 1988–89*, p. 52.

68. In 1985, for example, average caloric intake was insufficient for health, growth, and productive work in eight countries in Asia, and six in Latin America and the Caribbean. *Ibid.*, p. 53.

69. From 1962–72, global cereal production increased at an annual rate of 3.7 percent; from 1972–82, at 2.5 percent; and from 1982–86, at 2.1 percent. See Pierre Crosson and Norman Rosenberg, "Strategies for Agriculture," *Scientific American*, Vol. 261, No. 3 (September 1989), p. 130.



global cereal consumption exceeded production.<sup>70</sup> Bumper grain crops were again harvested in 1990, but carry-over stocks can be depleted rapidly, and we remain within one or two years of a global food crisis.

Over the long term, the capacity of developing countries to respond effectively to the consequences of environmental change on agriculture will depend on the complex interactions within each society of the factors indicated in Figure 1. Of particular importance are the society's prevailing land-use practices, land distribution, and market mechanisms within the agricultural sector.<sup>71</sup> Market factors are especially relevant today as numerous developing countries are relinquishing state control over the marketplace, reducing government spending, and removing impediments to foreign investment. Economists often contend that—in a market economy with an efficient price mechanism—environmentally induced scarcity will encourage conservation, technological innovation, and resource substitution. Julian Simon, in particular, displays an unwavering faith in the capacity of human ingenuity to overcome scarcity when spurred by self-interest.<sup>72</sup> Many economists point to the success of the green revolution, which was often driven by market forces; it involved both new technologies and the substitution of petroleum resources (in the form of fertilizer) for inadequate or degraded nutrients in the soil. This argument supports the policies for market liberalization and “structural adjustment” currently promoted by international financial and lending institutions, such as the International Monetary Fund and World Bank. Below, however, I suggest why these policies will not be an effective response to environmental scarcity in the future.

#### CORNUCOPIANS AND NEO-MALTHUSIANS

Experts in environmental studies now commonly use the labels “cornucopian” for optimists like Simon and “neo-Malthusian” for pessimists like Paul and Anne Ehrlich.<sup>73</sup> Cornucopians do not worry much about protecting the stock of any single resource, because of their faith that market-driven human ingenuity can always be tapped to allow the substitution of more abundant

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70. FAO, *The State of Food and Agriculture* 1989, p. 13.

71. For a thorough review, see Piers Blaikie and Harold Brookfield, *Land Degradation and Society* (London: Methuen, 1987).

72. Simon, *The Ultimate Resource*. Population growth, by Simon's analysis, is not necessarily a bad thing; in fact, it may be helpful because it increases the labor force and the pool of potential human ingenuity. See also Ester Boserup, *The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure* (Chicago: Aldine, 1965).

73. Ehrlich, Ehrlich, and Holdren, *Ecoscience*; Ehrlich and Ehrlich, *The Population Explosion*.

resources to produce the same end-use service. Simon, for example, writes: "There is no physical or economic reason why human resourcefulness and enterprise cannot forever continue to respond to impending shortages and existing problems with new expedients that, after an adjustment period, leave us better off than before the problem arose."<sup>74</sup> Neo-Malthusians are much more cautious. For renewable resources, they often distinguish between resource "capital" and its "income": the capital is the resource stock that generates a flow (the income) that can be tapped for human consumption and well-being. A "sustainable" economy, using this terminology, is one that leaves the capital intact and undamaged so that future generations can enjoy an undiminished income stream.<sup>75</sup>

Historically, cornucopians have been right to criticize the idea that resource scarcity places fixed limits on human activity. Time and time again, human beings have circumvented scarcities, and neo-Malthusians have often been justly accused of "crying wolf." But in assuming that this experience pertains to the future, cornucopians overlook seven factors.

First, whereas serious scarcities of critical resources in the past usually appeared singly, now we face multiple scarcities that exhibit powerful interactive, feedback, and threshold effects. An agricultural region may, for example, be simultaneously affected by degraded water and soil, greenhouse-induced precipitation changes, and increased ultraviolet radiation. This makes the future highly uncertain for policymakers and economic actors; tomorrow will be full of extreme events and surprises. Furthermore, as numerous resources become scarce simultaneously, it will be harder to identify substitution possibilities that produce the same end-use services at costs that prevailed when scarcity was less severe. Second, in the past the scarcity of a given resource usually increased slowly, allowing time for social, economic, and technological adjustment. But human populations are much larger and activities of individuals are, on a global average, much more resource-intensive than before. This means that debilitating scarcities often develop much more quickly: whole countries may be deforested in a few

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74. Simon, *The Ultimate Resource*, p. 345.

75. For example, if average topsoil creation on farmed land is about 0.25 millimeters per year (or about 3.25 tons/hectare), then to be sustainable, agriculture should not, on average, produce soil loss greater than this amount. According to neo-Malthusians, such a limit on human activity should rarely be breached: topsoil is a resource essential to human well-being; human beings cannot create it themselves; and petroleum-based substitutes such as fertilizers and pesticides are only short-term remedies.

decades; most of a region's topsoil can disappear in a generation; and critical ozone depletion may occur in as little as twenty years. Third, today's consumption has far greater momentum than in the past, because of the size of the consuming population, the sheer quantity of material consumed by this population, and the density of its interwoven fabric of consumption activities. The countless individual and corporate economic actors making up human society are heavily committed to certain patterns of resource use; and the ability of our markets to adapt may be sharply constrained by these entrenched interests.

These first three factors may soon combine to produce a daunting syndrome of environmentally induced scarcity: humankind will face multiple resource shortages that are interacting and unpredictable, that grow to crisis proportions rapidly, and that will be hard to address because of powerful commitments to certain consumption patterns.

The fourth reason that cornucopian arguments may not apply in the future is that the free-market price mechanism is a bad gauge of scarcity, especially for resources held in common, such as a benign climate and productive seas. In the past, many such resources seemed endlessly abundant; now they are being degraded and depleted, and we are learning that their increased scarcity often has tremendous bearing on a society's well-being. Yet this scarcity is at best reflected only indirectly in market prices. In addition, people often cannot participate in market transactions in which they have an interest, either because they lack the resources or because they are distant from the transaction process in time or space; in these cases the true scarcity of the resource is not reflected by its price.

The fifth reason is an extension of a point made earlier: market-driven adaptation to resource scarcity is most likely to succeed in wealthy societies, where abundant reserves of capital, knowledge, and talent help economic actors invent new technologies, identify conservation possibilities, and make the transition to new production and consumption patterns. Yet many of the societies facing the most serious environmental problems in the coming decades will be poor; even if they have efficient markets, lack of capital and know-how will hinder their response to these problems.

Sixth, cornucopians have an anachronistic faith in humankind's ability to unravel and manage the myriad processes of nature. There is no *a priori* reason to expect that human scientific and technical ingenuity can always surmount all types of scarcity. Human beings may not have the mental capacity to understand adequately the complexities of environmental-social

systems. Or it may simply be impossible, given the physical, biological, and social laws governing these systems, to reduce all scarcity or repair all environmental damage. Moreover, the chaotic nature of these systems may keep us from fully anticipating the consequences of various adaptation and intervention strategies.<sup>76</sup> Perhaps most important, scientific and technical knowledge must be built incrementally—layer upon layer—and its diffusion to the broader society often takes decades. Any technical solutions to environmental scarcity may arrive too late to prevent catastrophe.

Seventh and finally, future environmental problems, rather than inspiring the wave of ingenuity predicted by cornucopians, may instead reduce the supply of ingenuity available in a society. The success of market mechanisms depends on an intricate and stable system of institutions, social relations, and shared understandings (the ideational factors in Figure 1). Cornucopians often overlook the role of *social* ingenuity in producing the complex legal and economic climate in which *technical* ingenuity can flourish. Policymakers must be clever “social engineers” to design and implement effective market mechanisms.<sup>77</sup> Unfortunately, however, the syndrome of multiple, interacting, unpredictable, and rapidly changing environmental problems will increase the complexity and pressure of the policymaking setting. It will also generate increased “social friction” as elites and interest groups struggle to protect their prerogatives. The ability of policymakers to be good social engineers is likely to go *down*, not up, as these stresses increase.

Population size and growth are key variables producing the syndrome of environmental scarcity I have described. While sometimes population growth does not damage the environment, often this growth—in combination with prevailing social structures, technologies, and consumption patterns—makes environmental degradation worse. During the 1970s and early 1980s, family size dropped dramatically in many countries from six or seven children to three or four. But family planners have discovered that it is much more

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76. On chaotic processes, see footnote 14. Our technological interventions might increase the probability of dramatic threshold effects in environmental-social systems. For example, the cultural ecologist Roy Rappaport notes that our quest for higher crop yields has produced “some of the most delicate and unstable ecosystems ever to have appeared on the face of the earth.” Roy Rappaport, “The Flow of Energy in an Agricultural Society,” *Scientific American*, Vol. 225, No. 3 (September 1971), p. 126.

77. Development experts dispute the extent to which such social engineering is possible. On the determinants of the “social capability” to seize opportunities for economic growth, see James Bradford De Long, “The ‘Protestant Ethic’ Revisited: A Twentieth Century Look,” *The Fletcher Forum of World Affairs*, Vol. 13, No. 2 (Summer 1989), pp. 229–241.

difficult to convince parents to forgo a further one or two children to bring family size down to replacement rate. As a result, the growth rates of some of the world's most populous countries—including India and China—are hardly declining at all.<sup>78</sup> India's rate has leveled off at around 2.1 percent (17.9 million people) per year, China's at around 1.3 percent (14.8 million) per year. These developments have recently led the United Nations to increase its mid-range estimate of the globe's population when it stabilizes (predicted to occur towards the end of the twenty-first century) from 10.2 to 11 billion, which is over twice the size of the planet's current population.<sup>79</sup>

Consequently, many countries will have to keep boosting their agricultural production by 2 to 4 percent per year well into the next century to avoid huge food imports.<sup>80</sup> But, for the seven reasons discussed above, the social and technical engineers in these countries might not be able to supply the ever-increasing ingenuity required over this extended period. In particular, in many developing countries the effects of land scarcity and degradation are likely to become much more evident as the potential gains from green revolution technologies are fully realized. Unfortunately, there is no new generation of agricultural technologies waiting in the wings to keep productivity rising. Genetic engineering may eventually help scientists develop nitrogen-fixing, salinity-resistant, and drought-resistant grains, but their widespread use in the developing world is undoubtedly decades in the future.

Although we must be careful not to slip into environmental determinism, when it comes to the poorest countries on this planet we should not invest too much faith in the potential of human ingenuity to respond to multiple,

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78. Sadik, *The State of World Population 1990*; Griffith Feeney, et al., "Recent Fertility Dynamics in China: Results from the 1987 One Percent Population Survey," *Population and Development Review*, Vol. 15, No. 2 (June 1989), pp. 297–321.

79. Demographers have long assumed that developing countries would pass through a "demographic transition" similar to that exhibited by currently developed countries in the nineteenth and twentieth centuries, during which a decline in death rate was eventually followed by a compensating decline in birth rate. This transition is thought to have resulted from increased material prosperity and certain social changes, such as higher literacy rates and the emancipation of women. However, if some developing countries cannot maintain a steady growth in social and economic prosperity, their demographic transition may be in doubt.

80. Assuming that the necessary foreign exchange or financial aid is available, such imports might seem a reasonable way to compensate for Southern shortfalls, even over an extended period. However, a dependence on agricultural areas in the North will make importers vulnerable to vagaries of climate, economics, and politics in the exporting countries. As the redundancy of food-growing regions is reduced, the likelihood of a sudden and severe global shortfall increases.

interacting, and rapidly changing environmental problems once they have become severe. The most important of the seven factors above is the last: growing population, consumption, and environmental stresses will increase social friction. This will reduce the capacity of policymakers in developing countries to intervene as good social engineers in order to chart a sustainable development path and prevent further social disruption. Neo-Malthusians may underestimate human adaptability in *today's* environmental-social system, but as time passes their analysis may become ever more compelling.<sup>81</sup>

### *Types of Conflict*

It seems likely that first-stage policy interventions will not be fully successful in preventing the four principal social effects posited above. We therefore turn to the second part of the "how" question: if agricultural production drops, if developing societies slide further into poverty, if large numbers of people are forced from their homelands, and if institutions and social relations are disrupted, what kinds of conflict are likely to develop? At present, we can bring only limited empirical evidence to bear on this question. This may be partly because environmental and population pressures have not yet passed a critical threshold of severity in many developing countries; also, there has been little case-study research on environment-conflict linkages. In what follows, therefore, I propose some further hypotheses for testing.

#### THREE THEORETICAL PERSPECTIVES ON CONFLICT

Three types of theory on the nature and etiology of social conflict—one each at the individual, group, and systemic levels of analysis—are particularly important in light of the four general social effects identified.

Frustration-aggression theories use individual psychology to explain civil strife, including strikes, riots, coups, revolutions, and guerrilla wars. They

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81. While I contend that cornucopian policies are unlikely to prove successful in the long run, their failure will occur in different ways and at different rates in different societies. Notably, some rapidly industrializing societies—such as Thailand, South Korea, and Indonesia—seem to have successfully shaped their social, economic, and political structures to promote the production of material wealth. As this development is often at stunning cost to the environment, it represents in part a massive conversion of current and future ecological wealth to current economic wealth, in the form of physical and intellectual capital and materials for consumption. This wealth may give these countries greater ability to respond and adapt to environmental change, thus weakening the force of the fifth factor above. But the other six factors will still have force, which suggests that these societies are only postponing the crisis, not escaping it.

suggest that individuals become aggressive when they feel frustrated by something or someone they believe is blocking them from fulfilling a strong desire. An important subset of these theories suggests that this frustration and aggression can be caused by relative deprivation, when people perceive a widening gap between the level of satisfaction they have achieved (often defined in economic terms) and the level they believe they deserve.<sup>82</sup>

Group-identity theories use social psychology to help explain conflicts involving nationalism, ethnicity, and religion. The focus is on the way groups reinforce their identities and the “we-they” cleavages that often result. Individuals may have a need for a sense of camaraderie or “we-ness” that can be satisfied in a group when it discriminates against or attacks another group; similarly, a person’s sense of self-worth may be strengthened when his or her group’s status is enhanced relative to that of other groups. By attacking outside groups, leaders may try to exploit these needs in order to increase their political power within their own groups, but this behavior makes divisions between groups deeper and more acrimonious.<sup>83</sup>

Structural theories, which are often grounded in the assumptions of microeconomics and game theory, explain conflicts that arise from the rational calculations of actors in the face of perceived external constraints. The structure of an actor’s social situation is the perceived set of possible interactions with other actors and the perceived likely outcomes of these interactions. This structure is determined by physical factors such as number of actors, resource limits, and barriers to movement or communication; by social factors such as shared beliefs and understandings, rules of social interaction, and the set of power relations between actors; and by psychological factors such as the beliefs and preferences of other actors.<sup>84</sup>

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82. John Dollard, et al., *Frustration and Aggression* (New Haven: Yale University Press, 1939); Leonard Berkowitz, *Aggression: A Social Psychological Analysis* (New York: McGraw-Hill, 1962). On relative deprivation, see James Davies, “Toward a Theory of Revolution,” *American Sociological Review*, Vol. 6, No. 1 (February 1962), pp. 5–19; Ted Gurr, *Why Men Rebel* (Princeton, N.J.: Princeton University Press, 1970); and Ted Gurr and Raymond Duvall, “Civil Conflict in the 1960s: A Reciprocal Theoretical System with Parameter Estimates,” *Comparative Political Studies*, Vol. 6, No. 2 (July 1973), pp. 135–169.

83. See M. Sherif, *Group Conflict and Cooperation: Their Social Psychology* (London: Routledge and Kegan Paul, 1966); Henri Tajfel, ed., *Differentiation between Social Groups* (London: Academic Press, 1978); Henri Tajfel, *Human Groups and Social Categories: Studies in Social Psychology* (Cambridge: Cambridge University Press, 1981); Edward Azar and John Burton, *International Conflict Resolution: Theory and Practice* (Sussex, U.K.: Wheatsheaf, 1986); Lewis Coser, *The Functions of Social Conflict* (London: Free Press, 1956); Donald Horowitz, *Ethnic Groups in Conflict* (Berkeley: University of California Press, 1985).

84. As Alexander Wendt notes, the view of structure as constraint is only one of three possible

General structural theories suggest that external constraints can encourage or even compel actors to engage in conflict.<sup>85</sup> Domestic structural theories hold that civil strife will be more likely if there are well-organized groups within a society that can quickly articulate, channel, and coordinate discontent. These theories suggest that insurgency is a function of the "opportunity structure" that confronts groups challenging the authority of elites. This opportunity structure depends on the relative power and resources of challenger and elite groups, on the power of groups that might ally themselves with challenger or elite groups, and on the costs and benefits that groups believe they will accrue through different kinds of collective action in support of or in opposition to elite groups.<sup>86</sup>

Drawing on these theories, I hypothesize that severe environmental degradation will produce three principal types of conflict. These should be considered ideal types: they will rarely, if ever, be found in pure form in the real world.

**SIMPLE SCARCITY CONFLICTS.** Simple scarcity conflicts are explained and predicted by general structural theories. They are the conflicts we would expect when state actors rationally calculate their interests in a zero-sum or negative-sum situation such as might arise from resource scarcity.<sup>87</sup> We have seen such conflicts often in the past; they are easily understood within the realist paradigm of international relations theory, and they therefore are likely to receive undue attention from current security scholars. In Figure 4, I propose that simple scarcity conflicts may arise over three types of resource

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positions on the issue. Structure can also be thought of as generating the actors rather than constraining them, or structure and actor can be seen as dialectically related—that is, as Anthony Giddens suggests, generating but not reducible to each other. Alexander Wendt, "The Agent-Structure Problem," *International Organization*, Vol. 41, No. 3. (Summer 1987), pp. 335–370; Anthony Giddens, *The Constitution of Society: Outline of the Theory of Structuration* (Cambridge, U.K.: Polity Press, 1984).

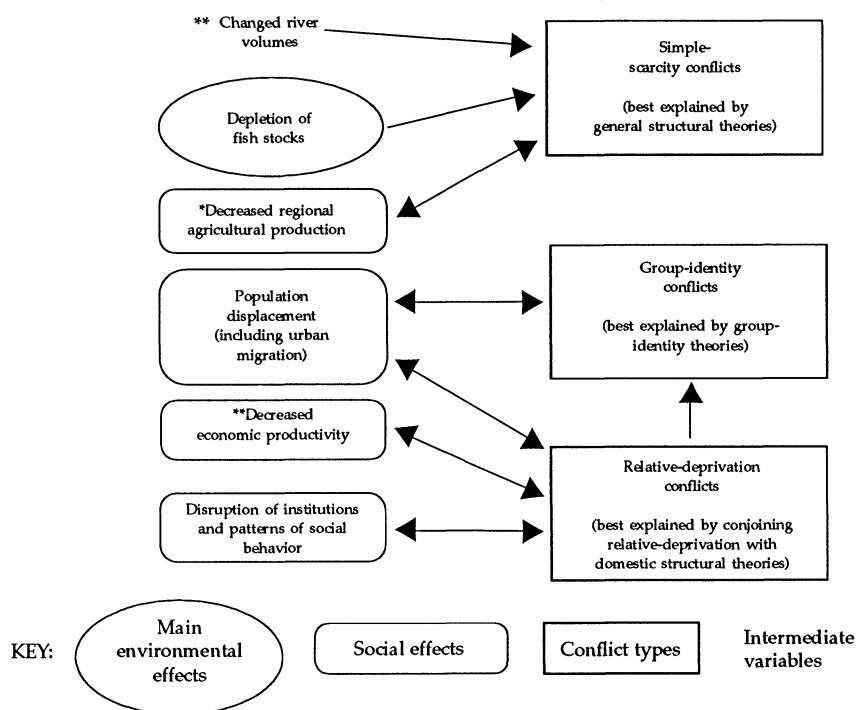
85. Those scholars who emphasize such constraints usually also acknowledge the causal importance of internal factors, such as the actor's particular interests and beliefs. By stressing power relations almost exclusively, perhaps Waltz comes closest to presenting a purely structural theory of international behavior and war. De Mesquita contends that the geographic proximity of actors is an important structural determinant of international conflict, while Choucri and North emphasize differences in states' resource endowments. See Waltz, *Theory of International Politics*; Bruce Bueno de Mesquita, *The War Trap* (New Haven: Yale University Press, 1981); and Nazli Choucri and Robert North, *Nations in Conflict* (San Francisco: Freeman, 1975).

86. See in particular Doug McAdam, *Political Process and the Development of Black Insurgency, 1930–1970* (Chicago: University of Chicago Press, 1982); and Charles Tilly, *From Mobilization to Revolution* (Reading, Mass.: Addison-Wesley, 1978).

87. The adjective "simple" does not mean "unimportant." Rather, it distinguishes this type of conflict from others that involve psychological and social processes more complex than those posited by rational-choice theorists.



**Figure 4. Types of Conflict likely to Arise from Environmental Change in the Developing World.**



\*See Figures 2 and 3.

\*\*See Figure 3.

in particular: river water, fish, and agriculturally productive land. These renewable resources seem particularly likely to spark conflict because their scarcity is increasing rapidly in some regions, they are often essential for human survival, and they can be physically seized or controlled. There may be a positive feedback relationship between conflict and reduced agricultural production: for example, lower food supplies caused by environmental change may lead countries to fight over irrigable land, and this fighting could further reduce food supplies.

The current controversy over the Great Anatolia Project on the Euphrates River illustrates how simple scarcity conflicts can arise. By early in the next

century, Turkey plans to build a huge complex of twenty dams and irrigation systems along the upper reaches of the Euphrates.<sup>88</sup> This \$21 billion project, if fully funded and built, would reduce the average annual flow of the Euphrates within Syria from 32 billion cubic meters to 20 billion.<sup>89</sup> The water that passes through Turkey's irrigation systems and on to Syria will be laden with fertilizers, pesticides, and salts. Syria is already desperately short of water, with an annual water availability of only about 600 cubic meters per capita.<sup>90</sup> Much of the water for its towns, industries, and farms comes from the Euphrates, and the country has been chronically vulnerable to drought. Furthermore, Syria's population growth rate, at 3.7 percent per year, is one of the highest in the world, and this adds further to the country's demand for water.

Turkey and Syria have exchanged angry threats over this situation. Syria gives sanctuary to guerrillas of the Kurdish Workers Party (the PKK), which has long been waging an insurgency against the Turkish government in eastern Anatolia. Turkey suspects that Syria might be using these separatists to gain leverage in bargaining over Euphrates River water. Thus in October, 1989, then Prime Minister Turgut Ozal suggested that Turkey might impound the river's water if Syria did not restrain the PKK. Although he later retracted the threat, the tensions have not been resolved, and there are currently no high-level talks on water sharing.<sup>91</sup>

**GROUP-IDENTITY CONFLICTS.** Group-identity conflicts are explained and predicted by group-identity theories. Such conflicts are likely to arise from the large-scale movements of populations brought about by environmental change. As different ethnic and cultural groups are propelled together under circumstances of deprivation and stress, we should expect intergroup hostility, in which a group would emphasize its own identity while denigrating, discriminating against, and attacking outsiders. The situation in the Bangladesh-Assam region may be a good example of this process; Assam's ethnic

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88. Alan Cowell, "Water Rights: Plenty of Mud to Sling," *New York Times*, February 7, 1990, p. A4; "Send for the Dowry," *The Economist*, December 16, 1989, p. 42.

89. On January 13, 1990, Turkey began filling the giant reservoir behind the Ataturk Dam, the first in this complex. For one month Turkey held back the main flow of the Euphrates River, which cut the downstream flow in Syria to about a quarter of its normal rate.

90. Peter Gleick, "Climate Change and International Politics," pp. 333-339.

91. The issue of Euphrates water is entwined with concerns about territorial integrity and relations with ethnic minorities. Consequently, although water scarcity is a source of serious tensions between Syria and Turkey, and may trigger interstate violence in the future, this dispute is not a pure example of a simple-scarcity conflict. As suggested above, pure examples may be impossible to find.

strife over the last decade has apparently been provoked by migration from Bangladesh.<sup>92</sup>

As population and environmental stresses grow in developing countries, migration to the developed world is likely to surge. "The image of islands of affluence amidst a sea of poverty is not inaccurate."<sup>93</sup> People will seek to move from Latin America to the United States and Canada, from North Africa and the Middle East to Europe, and from South and Southeast Asia to Australia. This migration has already shifted the ethnic balance in many cities and regions of developed countries, and governments are struggling to contain a xenophobic backlash. Such racial strife will undoubtedly become much worse.

RELATIVE-DEPRIVATION CONFLICTS. Relative-deprivation theories indicate that as developing societies produce less wealth because of environmental problems, their citizens will probably become increasingly discontented by the widening gap between their actual level of economic achievement and the level they feel they deserve. The rate of change is key: the faster the economic deterioration, it is hypothesized, the greater the discontent. Lower-status groups will be more frustrated than others because elites will use their power to maintain, as best they can, access to a constant standard of living despite a shrinking economic pie. At some point, the discontent and frustration of some groups may cross a critical threshold, and they will act violently against other groups perceived to be the agents of their economic misery or thought to be benefiting from a grossly unfair distribution of economic goods in the society.

Relative-deprivation theories are often contrasted with domestic structural theories of civil strife, but, as suggested by Figure 4, these points of view can be usefully combined. The emphasis of domestic structural theories on the "opportunity structure" that confronts potential challenger groups is important, because a principal social effect of environmental change in developing countries is likely to be the disruption of institutions and of regular and legitimized social relations. Thus, environmental problems may not only increase the frustration and anger within developing societies (by increasing relative deprivation), but by disrupting institutions and social relations, they may also open up structural opportunities for challenger groups to act on

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92. Myron Weiner, "The Political Demography of Assam's Anti-Immigrant Movement," *Population and Development Review*, Vol. 9, No. 2 (June 1983), pp. 279–292.

93. Ullman, "Redefining Security," p. 143.

their grievances and overthrow existing authority. Doug McAdam contends that “*any* event or broad social process that serves to undermine the calculations and assumptions on which the political establishment is structured occasions a shift in political opportunities.”<sup>94</sup>

The relative-deprivation and domestic-structural perspectives together tell us that severe civil strife is likely when: 1) there are clearly defined and organized groups in a society; 2) some of these groups regard their level of economic achievement, and in turn the broader political and economic system, as wholly unfair; and 3) these same groups believe that all peaceful opportunities to effect change are blocked, yet regard the balance of power within the society as unstable; that is, they believe there are structural opportunities for overthrowing authority in the society.<sup>95</sup>

Figure 4 reflects these two theoretical perspectives: I hypothesize that decreased economic productivity and disrupted institutions will jointly contribute to relative-deprivation conflicts. I again suggest that positive feedbacks may operate: relative-deprivation conflicts may cause further economic decline and institutional dislocation. In addition, the figure reflects the idea that the arrival of refugees in an area, even if the event does not reduce total economic productivity, will probably result in a dilution of existing resources and aggravate a sense of deprivation in the indigenous population. This stress may also manifest itself as inter-ethnic tension. Thus causal arrows point from population displacement to relative-deprivation conflicts and from these conflicts to group-identity conflicts.<sup>96</sup>

The probability of civil strife is also strongly influenced by whether challenger groups have the organizational and leadership capacity to provide themselves with adequate information and coordination. Leaders are impor-

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94. McAdam, *Political Process*, p. 41.

95. A wealth of literature exists on the theoretical and empirical relationships between economic deprivation and civil strife. Mark Lichbach provides a survey in “An Evaluation of ‘Does Economic Inequality Breed Political Conflict?’ Studies,” *World Politics*, Vol. 41, No. 4 (July 1989), pp. 431–470.

96. Population displacement into urban areas may be of particular importance. Many cities in developing countries are already surrounded by sprawling squatters’ settlements rife with disease, crime, and violence. Whether these poor millions will be a source of civil strife remains to be seen. Ullman suggests that modern revolutions have rarely started in cities, because recent arrivals in urban areas are usually too preoccupied with retaining and expanding their economic niches to join revolutionary organizations. See Ullman, “Redefining Security,” p. 142. But urban masses may not remain so quiescent in the future. Heavy urban subsidization in many developing countries of food, transport, and other amenities indicates that governments believe there is a real threat of unrest in the cities.

tant in causing the members of a challenger group to believe that the group's situation should and can be changed. McAdam calls this a group's "cognitive liberation." Leaders define the categories through which challenger groups see their situations and themselves. By developing and exploiting a particular view of the "social good," leaders can shift the preferences of the members of a challenger group so they come to view their situation as illegitimate and intolerable, thus increasing their sense of relative deprivation. In addition, by altering group members' self-perceptions, their understandings of the nature of power, and their assumptions about the possible means to achieve change, leaders can change the perceived opportunity structure.

This theoretical perspective on civil strife can be applied to the Filipino situation. The insurgency is motivated by the relative deprivation of the landless agricultural laborers and poor farmers displaced to the uplands where they try to eke out a living from the failing land; it exploits the structural opportunities provided by the crumbling of the central government's authority in the country's hinterland; and it is facilitated by the creative leadership of the cadres of the New People's Army (NPA) and the National Democratic Front (NDF). These revolutionary groups shape the peasants' understandings of their situation, focus their discontent, and assist them in extracting concessions from landlords. Gary Hawes points out that the rationality of Filipino peasants must be understood within their own world of meaning, which includes a strong commitment to family and community. The NDF has sought to build on this world of meaning to create "a national community linked not by kinship, but by something analogous, a commitment to a vision of a better future for all those who are exploited."<sup>97</sup>

Assessing the prospect for civil strife arising from environmental degradation in a particular society requires a thorough understanding of the society's social relations and institutions; its class, ethnic, religious, and linguistic structure; the culture of leadership in these groups and in the society as a whole; and the beliefs about the social good that motivate challenger and elite groups.<sup>98</sup> Since analysis must be so specific to each case, we cannot hope for more than rough, probabilistic generalizations about the relationship between environmental degradation, economic decline, and civil strife.

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97. Hawes, "Theories of Peasant Revolution," pp. 297–298.

98. In technical terms, we need to use the techniques of anthropology, ethno-methodology, and interpretivism to develop a detailed "internal" understanding of these societies. See Clifford Geertz, *The Interpretation of Cultures* (New York: Basic Books, 1973).

## CONFLICT OBJECTIVES AND SCOPE

Table 1 compares some attributes of the principal types of acute conflict that I hypothesize may result from environmental change. The table lists the objectives sought by actors involved in these conflicts (which are, once again, ideal types). There is strong normative content to the motives of challenger groups involved in relative-deprivation conflicts: these groups believe the distribution of rewards is unfair. But such an "ought" does not necessarily drive simple-scarcity conflicts: one state may decide that it needs something another state has, and then try to seize it, without being motivated by a strong sense of unfairness or injustice.

Table 1 also shows that the scope of conflict can be expected to differ. Although relative-deprivation conflicts will tend to be domestic, we should not underestimate their potentially severe international repercussions. The correlation between civil strife and external conflict behavior is a function of the nature of the regime and of the kind of internal conflict it faces. For example, highly centralized dictatorships threatened by revolutionary actions, purges, and strikes are especially prone to engage in external war and belligerence. In comparison, less centralized dictatorships are prone to such behavior when threatened by guerrilla action and assassinations.<sup>99</sup> External aggression may also result after a new regime comes to power through civil strife: regimes borne of revolution, for example, are particularly good at mobilizing their citizens and resources for military preparation and war.<sup>100</sup>

While environmental stresses and the conflicts they induce may encourage the rise of revolutionary regimes, other results are also plausible: these pres-

**Table 1. Comparison of Conflict Types.**

Conflict Type	Objective Sought	Conflict Scope
Simple scarcity	Relief from scarcity	International
Group identity	Protection and reinforcement of group identity	International or domestic
Relative deprivation	Distributive justice	Domestic (with international repercussions)

99. Jonathan Wilkenfeld, "Domestic and Foreign Conflict Behavior of Nations," *Journal of Peace Research*, Vol. 5 (1968), pp. 56–69.

100. See Theda Skocpol, "Social Revolutions and Mass Military Mobilization," *World Politics*, Vol. 40, No. 2 (January 1988), pp. 147–168.

tures might overwhelm the management capacity of institutions in developing countries, inducing praetorianism<sup>101</sup> or widespread social disintegration. They may also weaken the control of governments over their territories, especially over the hinterland (as in the Philippines). The regimes that do gain power in the face of such disruption are likely to be extremist, authoritarian, and abusive of human rights.<sup>102</sup> Moreover, the already short time horizons of policymakers in developing countries will be further shortened. These political factors could seriously undermine efforts to mitigate and adapt to environmental change. Soon to be the biggest contributors to global environmental problems, developing countries could become more belligerent, less willing to compromise with other states, and less capable of controlling their territories in order to implement measures to reduce environmental damage.

If many developing countries evolve in the direction of extremism, the interests of the North may be directly threatened. Of special concern here is the growing disparity between rich and poor nations that may be induced by environmental change. Robert Heilbroner notes that revolutionary regimes "are not likely to view the vast difference between first class and cattle class with the forgiving eyes of their predecessors." Furthermore, these nations may be heavily armed, as the proliferation of nuclear and chemical weapons and ballistic missiles continues. Such regimes, he asserts, could be tempted to use nuclear blackmail as a "means of inducing the developed world to transfer its wealth on an unprecedented scale to the underdeveloped world."<sup>103</sup> Richard Ullman, however, argues that this concern is overstated. Third world nations are unlikely to confront the North violently in the face of the "superior destructive capabilities of the rich."<sup>104</sup> In light of the discussion in this article, we might conclude that environmental stress and its attendant social disruption will so debilitate the economies of developing countries that they will be unable to amass sizeable armed forces, conven-

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101. "Praetorian" is a label used by Samuel Huntington for societies in which the level of political participation exceeds the capacity of political institutions to channel, moderate, and reconcile competing claims to economic and political resources. "In a praetorian system, social forces confront each other nakedly; no political institutions, no corps of professional political leaders are recognized or accepted as the legitimate intermediaries to moderate group conflict." Samuel Huntington, *Political Order in Changing Societies* (New Haven: Yale University Press, 1968), p. 196.

102. Ophuls notes that ecological scarcity "seems to engender overwhelming pressures toward political systems that are frankly authoritarian by current standards." Ophuls, *Ecology*, p. 163.

103. Heilbroner, *Inquiry*, pp. 39 and 95. These North-South disputes would be the international analogues of domestic relative-deprivation conflicts.

104. Ullman, "Redefining Security," p. 143.

tional or otherwise. But the North would surely be unwise to rely on impoverishment and disorder in the South for its security.

#### SECOND-STAGE INTERVENTIONS

Many factors could break the causal links between the four main social effects of environmental change and the three types of conflict hypothesized above. Some of these factors could be open to intentional manipulation by policymakers. Focusing first on domestic conflict, it appears that regime repressiveness is a critical variable. For instance "semi-repressive" regimes may be more vulnerable to insurgency induced by income inequality than are either highly repressive or democratic regimes. In semi-repressive societies, dissident groups can develop relatively strong organizations, but opportunities to engage in effective and nonviolent forms of political action are blocked.<sup>105</sup>

Another key variable is the perceived legitimacy of the regime, that is, its perceived fairness, appropriateness, and reasonableness. Seymour Martin Lipset shows that this variable mediates the relationship between economic crisis and political instability: economic crisis must first lead to a crisis of legitimacy before widespread civil strife can occur.<sup>106</sup> A perception that the political and economic system is legitimate will moderate a citizen's sense of relative deprivation and will hinder the mass mobilization of discontent. Through various techniques of persuasion and distraction, policymakers may be able to sustain a perception of legitimacy even in the face of environmentally induced economic decline.

Finally, we must not forget the role of *politics* in shaping a society's response to social stress. For example, analyzing variance in the effects of the depression on European societies in the 1930s, Ekkart Zimmermann and Thomas Saalfeld emphasize the explanatory power of coalitions between politically powerful groups such as agrarian classes, labor, the bourgeoisie/business class, and the state. Whether stabilizing coalitions form, in spite of economic stress, is influenced by a host of factors, including political culture, the nature and extent of socioeconomic cleavage, the "channels and proce-

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105. Edward Muller and Mitchell Seligson, "Inequality and Insurgency," *American Political Science Review*, Vol. 81, No. 2 (June 1987), pp. 425–452.

106. See Seymour Martin Lipset, *Political Man: The Social Bases of Politics* (Garden City, N.Y.: Doubleday, 1959), pp. 77–83; and Mitchell Seligson and Edward Muller, "Democratic Stability and Economic Crisis: Costa Rica, 1978–83," *International Studies Quarterly*, Vol. 31, No. 3 (September 1987), pp. 301–326.



dures" for political bargaining and, as emphasized above, political leadership.<sup>107</sup>

Several variables might offer opportunities for second-stage policy intervention to prevent war. The spread of liberal democracy in the developing world might reduce the chance that environmental stress (and its social effects) will cause interstate conflict.<sup>108</sup> Similarly, increased trade between states could increase their economic interdependence and thereby strengthen disincentives to engage in conflict.<sup>109</sup> Also important are the nature and rate of change of power relations among states; these relations may be affected by environmental degradation, yet they may also be open to independent manipulation by political leaders. Numerous scholars of international affairs, especially those of the realist school, have claimed that shifting power relations can prompt war. Robert Gilpin and others suggest that war may be started by a dominant state suffering declining power, while A.F.K. Organski and Jacek Kugler contend the initiator will usually be a weaker state gaining in power and challenging the hegemon.<sup>110</sup> Whichever view is more accurate, these theories suggest that statesmen might hold in check the risk of interstate conflict despite the effects of environmental change, if they can keep power relations among states relatively stable.

## *Conclusions*

This article sets out a research agenda for studying the links between environmental change and acute conflict. Given current theories and data, we probably cannot go much further than the preliminary analysis offered here. Case studies of specific societies focused on the "where" question—where are the different kinds of environmentally derived conflict most likely to

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107. Ekkart Zimmermann and Thomas Saalfeld, "Economic and Political Reactions to the World Economic Crisis of the 1930s in Six European Countries," *International Studies Quarterly*, Vol. 32, No. 3 (September 1988), p. 326.

108. The argument that democracies are less inclined to war is often traced to Kant. For a thorough discussion, see Michael Doyle, "Liberalism and World Politics," *American Political Science Review*, Vol. 80, No. 4 (December 1986), pp. 1151–1170. This kind of second-stage intervention may be particularly difficult because environmental change may reduce the prospects for success of democratic regimes.

109. See Richard Rosecrance, *The Rise of the Trading State* (New York: Basic Books, 1986).

110. Gilpin, *War and Change in World Politics*, pp. 94 and 191; A.F.K. Organski and Jacek Kugler, *The War Ledger* (Chicago: University of Chicago Press, 1980); and Jack Levy, "Research Note: Declining Power and the Preventive Motivation for War," *World Politics*, Vol. 40, No. 1 (October 1987), pp. 82–107.

occur?—will help us test our hypotheses about *how* environmental change might contribute to conflict.

Such research will also reveal important things about real societies in the real world. We must in particular look for intervening variables—including institutions, technologies, and market mechanisms—that humankind might influence in order to change the course of environmental-social systems. We may learn that there are real opportunities for intervention; hardship and strife are not preordained. But it seems likely that, as environmental degradation proceeds, the size of the potential social disruption will increase, while our capacity to intervene to prevent this disruption decreases. It is therefore not a reasonable policy response to assume we can intervene at a late stage, when the crisis is upon us. Developing countries, in concert with the North, should act now to address the forces behind environmental degradation.