POLITICS OF GLOBAL ENVIRONMENTAL CHANGE:

A CONCEPTUAL FRAMEWORK

by

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Abstract

The emergence of climate change in the international political agenda is of recent origin. The possibility of environmental changes induced by human action is a relatively new factor in both the conduct and the study of international relations. It is now recognized that technological development, interacting with population trends and patterns of resource uses worldwide, has created problems of a global nature and globalized problems that had earlier been more local or regional in character. Not only do we live in an interdependent world but in an increasingly global one. This paper presents key conceptual and theoretical issues central to prospects for coordinated international responses and presents some empirical evidence. A major concern is depicting the characteristic requisites, conditions, and processes for managing the global environment as well as the principles for environmental management.

TABLE OF CONTENTS

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I. INTRODUCTION

The growing scientific consensus that human beings are altering the global environment in potentially significant ways poses important challenges for scholars of international relations. Despite scientific controversy and continued uncertainty, there is an increasing recognition that the composition of the Earth's atmosphere is changing. This recognition is predicated on both observed trends and projected increases of trace gases generated by human activities which are altering atmospheric balances, potentially affecting the global climate (Schneider 1989a). In these terms the global system must be viewed on a planetary scale, shaped by the interactions between two large, complex systems: (a) *social* processes (characterized by human activities and organizations, institutions, and behavior) and (b) *environmental* processes (characterized by ecosystems and geochemical, geophysical, and biogenic processes).

Much of the focus on global change to date has centered on the natural (physical) processes and on the scientific controversies surrounding analyses and understanding of these processes. The social (human) side of global change -- sources and consequences -- is at an early stage of understanding and the literature at its most nascent stage of development.[1]

The emergence of climate change in the international political agenda is of recent origin. The possibility of global changes induced by human action is a relatively new factor in both the conduct and the study of international relations. It is now recognized that technological development, interacting with population trends and patterns of resource uses worldwide, has created problems of a global nature and globalized problems that had earlier been more local or regional in character. These patterns point to an incontrovertible direction: not only do we live in an interdependent world but in an increasingly global one.

Conceiving of a "global" as distinct from an "international" system poses a serious challenge for scholars of international relations.[2] To state the obvious: analysis of the global system is particularly difficult. The interaction of *social* and *natural* forces provides strains on the global system, calling into question global capacities to adjust, accommodate, or absorb dislocations thrust upon it, and lies beyond the bounds of the field as conventionally conceived. To date the politics among nations and the study of international relations have focused almost exclusively on social interactions across national jurisdictions.[3] The fact that human activities

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[1] See White (1990) and Rosenberg et al (1989) for general patterns of human activities; see Choucri and North (1990) for state-specific patterns.

[2] North (1990) provides a detailed argument for separating "global" from "international," defining "global" as the Fourth Image, and thus extending the original Waltz formulation (Waltz 1959). See Choucri and North (1990) for an explicit articulation of the environmental linkages at each level/"image."

[3] A nascent literature on the global dimension of world politics is emerging. See Pirages (1989) and North (1990). The intellectual debt to Aron (1973), Renouvin and Duroselle (1967) and Sprout and Sprout (1962) must be acknowledged.

within one jurisdiction could alter environmental conditions in another -- and possibly for the planet as a whole -- suggests both that there is a new form of politics and that the theoretical foundation for the study of politics among nations to address a range of inter-state and transnational interactions bearing on the management of environmental transformations generated by social activities.

This paper identifies key conceptual, empirical, and theoretical issues central to prospects for coordinated international responses. It is intended to provide conceptual foundations for systematic study of global environmental change, addressing nature/society interactions in the analyses of international relations as well as coordinated management of human influences. In this context coordination refers to the extent, specificity, and coverage of agreement on environmental management.

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Global Problems

Over the past two decades a large literature has developed attempting to come to grips -- theoretically and empirically -- with effects of human action on local, national, and global environments. The global modeling efforts of the 1970s have attempted to specify relationships systematically.[4] And at the same time a tradition of consciousness-raising has been developed at local, national, and international levels, as recently exemplified by the Brundtland Report (1987). They all point to the problem of individual action vs. collective outcomes. These efforts have provided important information and insights relevant to the problem. But in the parlance of the tragedy of the Commons, for the most part the *states* and their linkages with the world's "villagers" in the *international system*, on the one hand, and the *global* environmental system, on the other, have not been described empirically, or integrated in a theoretically persuasive manner.

Climate change, the most pervasive of the global changes, is now recognized to be influenced by alterations in trace gas emissions due to human actions -- shaped by interactions among population (size and rates of change), resource utilization (types and rates), and technological capabilities. Because states differ in level and composition of economic activity and activity per capita, the generation of local and attendant cross-border effluents and emissions will differ, as will their impacts globally.

A fundamental conceptual challenge -- underlying all other issues -- is to identify important interlinkages between human and natural processes, given that two of nature's basic rules are the first and the second laws of thermodynamics -- that basic energy cannot be "consumed" or "destroyed," nor can resources be used nor work performed (action taken) without some measure of energy degradation from more to less usable forms. Effluents and emissions accompany "work" and energy use. This basic fact lies at the core of the problem of global change.

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[4] See the comprehensive bibliography in Brecke (1989).

Conceptual Issues

Of the many conceptual issues posed by global environmental change, three are particularly central to this paper:

First is the *linkage issue*: relating environmental variables and processes to social activities, national characteristics, and international relations. This issue bears directly on the intellectual core of the social sciences developed over the better part of two centuries as the disciplines designed to improve knowledge of social interactions. The social sciences have been explicitly predicated on understanding social relationships and the philosophical, political, economic, anthropological, and sociological manifestation of these relationships.[5] (Even the behavioral sciences, a recent addition to the social sciences, seek to identify and quantify regularities in human behavior as the basis for formulating the underlying "laws" of human action, rather than the humanity/nature interactions.) It is this practice of focusing exclusively on social interactions -- abstracting humanity from nature and reinforcing this separation by focusing largely on social relations[6]--that impedes our understanding of both the impacts of social action on the natural environment as well as the influence of ecological disturbances on social interactions and social relations.

None of the social sciences are currently directed to address *human* interventions in *nature* nor the responses to intended and unintended consequences on nature due to human action. Indeed, the whole issue of global change lies at the frontier of the social sciences as conventionally viewed.[7] Understanding the sources and consequences of anthropogenic influence will, by necessity, also constitute a major challenge to the social sciences.[8] Since the necessity for policy response worldwide is becoming increasingly salient, the conventional modes of policy deliberation may also be put to the test. Already the possibility of global change has injected scientific evidence and uncertainties into the policy domain -- national and international.[9]

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[5] Exceptions to this generalization reflect the increased recognition of the importance of environmental issues and their integration in disciplinary frameworks. See, for example, the development of economic analysis to address environmental issues, as a distinct subfield of economics. For an analytic perspective, see Arrow and Fisher (1974).

[6] Among the most relevant analyses of this issue are Young (1989). See Krasner (1983) for alternative approaches to the problem of converging expectations and norm development.

[7] For valuation of environment and for analysis of pollution, for example, see Dorfman and Dorfman (1972).

[8] On the role of knowledge and issue linkage in international politics, see, for example, E. Haas (1980).

[9] See Skolnikoff (1990) for a discussion of political obstacles to domestic response to global environmental issues.

Second is the *behavior problem* in concepts of and approaches to the global environment, recognizing that the ecological balance of the globe is inadvertently affected by *how* individuals, institutions, groups, and, most importantly, countries manage their environments and the cross-border environmental effects that could threaten both man-made and natural environments.

Effluents and emissions notwithstanding, however, only with the recognition of these patterns and the availability of plausible scientific evidence does the environmental issue become the target for public policy. The international nature of emissions and effluents all but assures the need for alteration in the behavior of individuals, collectivities, corporations, nations, *and*, in all likelihood, coordinated international response. In these terms bargaining and negotiation become central to the formulation of global environmental policy.

Third is the *institutional challenge*: identifying the appropriate framework for international cooperation at the global environmental level. At issue is whether the global environmental issues can be reduced to issues of scale (requiring therefore only existing modes of international coordination to environmental processes of planetary proportions); or whether there is something generically different about matters pertaining to the global environment (necessitating, therefore, adjustments in prevailing international approaches and institutional responses).

The basic differences and unevenness among states on either side of the ledger -- either contributing to the greenhouse gases or contributing to solutions -- help shape the contours of responses to global responses to environmental change. Already the industrial societies are expressing concern over the developing countries' reluctance to engage in environmental deliberations.[10] And developing states are countering with the charge that since it is the industrial societies that have polluted the environment, they must bear the costs of management. These concerns begin to frame the characteristics of global bargaining over environment.

The nature of political deliberations will continue to be affected by scientific assessments and by interpretation of the evidence, often of a very conflicting nature. But it is the political processes -- national and international -- that will marshall concerted strategies for the management of global issues and will ultimately legitimize the responses to evolving scientific evidence and concerns and corresponding policy options. Against this background, this paper addresses four prelude issues: (1) the conceptual challenges; (2) the empirical record; (3) the contending perspectives in terms of intellectual orientation and public policy; and (4) the international demand of institutional response.

II. CONCEPTUAL CHALLENGE

The global change problem is that human activities are generating serious ecological imbalances, setting in place fundamentally unalterable environmental interventions. In what way and to what extent are such alterations created matters

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[10] With the exception of the United States, the OECD countries appear willing to engage in the search for interventions and policies to induce alterations in human activities and reduce greenhouse gas emissions.

of great controversy. While on scientific grounds there is little danger of imminent collapse of the globe from whatever source of pressure envisaged,[11] the contending hypothesis is for a gradual, imperceptible erosion of environmental viability, straining life-supporting properties. Nature provides the overarching conditions for life; human beings are part of, and dependent upon, nature; social processes increasingly impinge on natural processes. It seems increasingly probably that social impacts on environmental processes may be stressing the resiliency of ecosystems at various levels of complexity.[12] What *is* predictable about the future is that there will be many surprises.[13]

For purposes of framing global environmental policy, it is necessary to distinguish among global processes and outcomes in terms of (1) those which for all practical purposes are, and are likely to remain, *outside* human control (such as cloud formation and solar radiation); (2) those over which human control is *partial* (carbon dioxide levels through fuel uses); and (3) those which are *entirely* under human control, therefore which human beings are primarily, even wholly, responsible as "producers" and which in principle they distribute globally (chlorofluorocarbons affecting the ozone layer -- decomposition of CFCs in the stratosphere releases chlorine, which in turn consumes ozone).

Global Change Dilemma

The influence of humanity and social action on the global environmental is traced to three interdependent processes: *population* growth and attendant social activities and institutions; *technological* development and industrialization; and energy and *resource* use including the legalization of wasteful use of land, water, and resource endowments.[14] It is the *interactions* among population, resources, and technology (knowledge and skills, organizational and mechanical) that shape patterns of trace gas emissions and balances of the greenhouse gases and the attendant implications for the global climate.[15] In this sense perhaps most important is the

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[11] For a review, see Hileman (1989).

[12] For an early statement, see Caldwell (1972); see, for example, Ehrlich, Ehrlich and Holdren (1977); Schneider and Rosenberg (1989); see also Odum (1971).

[13] I am grateful to Thomas Homer-Dixon for a recurrent reminder of this fact. See Brooks (1986) for an effort to develop a "typology" of surprises.

[14] For a review of these processes as related to global environmental change, see the essays in Scientific American 261, September 1989. For a theoretical statement of population/resources/technology interactions as the foundation of state attributes and determinants of behavior internationally, see Choucri and North (1989); Choucri and North (1975); North (1990); Pirages (1989); Ashley (1980).

[15] Other processes are obviously important -- such as potential ecosystem vulnerability or institutional characteristics and capability -- but we consider these consequent rather than core or master variables.

fact that the anthropogenic sources of global change -- and emission of greenhouse gases -- are traced back to actions and investments that are normal and legitimate and entirely in keeping with the most routinized social processes worldwide. (There are also sources that are not normal, and which we would all consider as pathological, not always legitimate, such as nuclear warfare, with potentially potent impacts on the global environment).

From an environmental perspective there is a generic dilemma underlying all social processes -- that activities undertaken in the pursuit of legitimate ends (i.e., economic growth, industrialization, etc.) can be ecologically dislocating and environmentally threatening -- defines the global predicament. This dilemma is by now well-recognized in industrial societies. It is especially poignant in those developing countries where the demands of a rapidly growing population must be met, collide head on, and with the environmental consequences of industrialization.

The generic dilemma is driven by the fact that in all societies, population demands must be managed. If the demands of a population exceed the capacities of resources, land, and of the economy to meet demands, then environmental security is threatened. To the extent that demands are met, managed, postponed, diffused, or mitigated, then the essential conditions for environmental security can be met, at least in the short term. If population, in conjunction with prevailing technologies and social adaptation techniques, places pressures on resources in excess of the prevailing resource base or its capacity to meet pressures, then the viability and environmental security of the state and for the globe will be threatened.[16]

Climate as a Global Indicator

The importance of climate alteration as an indication of global environmental change is derived from considerations of scope, scale, and consequences.[17] The scope of change encompasses both *natural* and *social* systems and their interactions; in terms of scale climate alteration could conceivably be pervasive, affecting the planet as a whole; and the consequences may well be comprehensive in the sense of potentially altering the temperature of the planet and hence the most basic and sensitive mechanisms regulating conditions for life on Earth.

The climate's mechanisms are highly sensitive to a set of trace gases, labelled the "greenhouse gases." The greenhouse gases in the atmosphere absorb heat that radiates from the Earth's surface and emit some of the heat downward, heating the earth. Without this effect the earth would be about 30 degrees Centigrade colder than today. It is a basic natural process governing the earth's "thermostat"; but

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[16] See Keyfitz (1989); Choucri (1974). See also Mathews (1990).

[17] The focus on climate is for integrative purposes only, rather than to reduce the relevance or salience of other environmental processes. Some processes are global in scope, others are not; the differentiation remains to be demonstrated theoretically and empirically.

human activities are now increasing the atmospheric concentration of these gases on a global basis and, therefore, apparently intensifying the greenhouse effect.[18]

The most frequently cited pattern of change is the record of global temperature, showing a distinctly upward slope over the span of a century. The attendant trend in CO_2 emissions, also shows a notable increase. The concentration of CO_2 in the atmosphere today is roughly 25% higher than a century ago; it is generally agreed that with increases in CO_2 concentrations, the temperature of the earth's surface will also rise. In this sense climate serves as a "dependent" variable -- to be "explained" by patterns of human activity, and the greenhouse gases (CO_2 in this case) as intervening variables to be altered by conscious policy intervention in order to respond to the change in climate.

To the extent that the climate system is perturbed by human action, both the sources and the consequences are fraught with uncertainty.[19] In physical terms the climate system is a complex process governed by intricate feedback interactions among biota, air, sea, land, and ice components.[20] The system, driven by solar radiation, is "regulated" by natural feedback processes, such as changes in the earth's position in relation to the sun and changes in the gaseous composition of the atmosphere. Because of the complex interactions among the underlying natural processes -- and given uncertainty about the effects of social interactions of the distinctly human element -- separating out these effects is exceedingly difficult, if not impossible. The oceans and the biosphere, for example, play a major (and highly uncertain) role in the

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[18] In 1979 the National Academy of Sciences concluded that doubling of CO_2 concentrations relative to the pre-industrial atmosphere would result in warming of 1.5-4.5 degrees Centigrade, with a general range of 2-4 degrees Centigrade or 1.5-5.5 degrees Centigrade). Subsequent studies have pointed to the uncertainties in these estimates and to the profound methodological difficulties in making the resolution of uncertainty near impossible, but they have not invalidated the basic proposition of climate alteration due to human activity. Nonetheless, the consensus remains that disturbances of a wide range of geochemical and biogenic processes could alter the response of the climate system to perturbation in greenhouse gases. Even minor changes in temperature could have potentially significant impacts worldwide -- and most certainly on a regional, even local, basis.

[19] Most of the hypotheses about climate alterations are derived from atmospheric general circulation models exercised to date largely in terms of exploring the effects of doubling of atmospheric CO_2 -- a fairly dramatic intervention. For a discussion see Schneider and Rosenberg (1989).

[20] For a summary of key processes, see Schneider (1989b) and Graedel and Crutzen (1989).

climate system,[21] and the conclusions we reach depend on how we approach the extensive uncertainties about these interactions.[22]

Uncertainties and Global Policy Parameters

The uncertainties in both cause and effect are near overwhelming. In this context characteristic features of environmental alterations are shaped by five factors that together constitute crucial policy parameters. These are uncertainty parameters in the sense that the unknowns may well dominate the outcomes.

First, while the basic biogeochemical characteristics are generally understood, there are major uncertainties about the *feedback effects* on both the physical and social processes.

Second, environmental as well as social processes operate at multiple, unequal, and sometimes overlapping *time horizons*. Variability in time increments complicates assessments of the underlying processes. Fundamentally the long lead times in both social and environmental processes -- and the separation of "cause" and "consequences" -- themselves amount to major sources of uncertainty.

Third, there are a host of related uncertainties associated with inter-temporal effects. In particular, there are crucial *intergenerational* impacts of environmental change whereby future generations incur the environmental costs of the actions of past and present generations, which reflect the complexities associated with long lead times.

Fourth are the *irreversibilities*. It may well be that some patterns of environmental alterations cannot be "undone," nor can the underlying sources be eliminated either wholly or in part -- at least not within the frame of historical rather than geological time.[23]

Finally, given a major unevenness in both the sources of environmental perturbations as well as in the consequences, the differentials in the determinants of trace gas emissions and in their effects worldwide as well as regionally raise crucial issues of *international equity*. Not all countries contribute the same way to the global balances, nor are they affected uniformly. Some will benefit from climate

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[21] The ocean's ability to absorb CO_2 and heat is a major determinant of the rate and the extent of climate change. The oceans today absorb 45% of annual fossil fuel emissions. While the elementary chemistry is well understood, complex ocean/atmosphere feedbacks are not; further, the effects of the oceans can change as well, (possibly) due to climate change. Thus one of the most important pieces of the global climate puzzle is largely unknown, and it is unlikely that scientific closure could be achieved in the foreseeable future.

[22] See, for example, Wunsch (1984).

[23] For an analytical perspective, see Arrow and Fisher (1974).

alteration.[24] This unevenness may be a significant constraint in the development of international responses.

These features characterize some crucial uncertainties associated with global environmental change. Because human activities are incremental in historical time and therefore minuscule in geological time, they confound assessments of complex feedback, time horizon, and differentials in sources and in consequences.[25] Together these factors bear on the political issues and on the policy responses of the international community, as they serve also to frame analyses of the constituent components of the global issue -- both in terms of sources and of consequences.

III. EMPIRICAL PERSPECTIVE

The scope of the global problem is shaped by the fact that present emission rates of the major greenhouse gases may be *in excess of* the capacity of the tropospheric, oceanic, and terrestrial sinks to absorb them, creating the ecological imbalances, or "deficit." This outcome provides a junction of greenhouse gas emissions, a near perfect illustration of the complexities in interactions of social and natural processes. Observations on these individual trace gases -- CO_2, methane, chlorofluorocarbons, nitrous oxide, and others -- vary significantly in extent and reliability in quality and quantity; but with allowances for interactions, feedback, and substantial uncertainties, both the sources and the impacts of these gases can be gauged.

Global Indicators

The current scientific consensus converges roughly around the distributions in Table 1, showing relative contributions of select greenhouse gases to temperature change (global warming), residence time in the atmosphere for the 1980s, and annual growth rate (Hansen et al. 1988; Graedel and Crutzen 1989). The table also shows the differences among the trace gases along each of these factors and provides the basis for propositions about the linkages to human action.[26]

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[24] For example, global warming could alter the Siberian climate, enhancing agricultural prospects.

[25] The broad scientific task involves improving understanding of the underlying forces for each of the greenhouse gases as well as interactions with gases that are not themselves greenhouse gases but can significantly alter the chemistry of the atmosphere and hence affect the concentration of greenhouse gases.

[26] The problem of residence time in the atmosphere is under continued scientific scrutiny.

Table 1. Relative Contributions of Greenhouse Gases

Trace Gas	Relative Contribution(%)*	Residence Time (Years)	Growth Rates
CO_2	49	100	0.5%
Methane	18	10	1.0%
CFC11 and 12	14	60 - 100	7.0%
N_2O	6	170	.25%
Other	13	variable	variable

*Calculated from Hansen et al. (1988). The uncertainties in these figures must be underscored and are subject to revision.

Differentiating among the trace gases provides an initial entry point into identifying the relative sources by sovereign state. Differentiating among gases in terms of hypothesized relative contributions to climate alterations -- in conjunction with distribution by state source -- helps shape assessments of relative sovereign contributions to global alterations. The residence time of the individual greenhouse gases all but assures that *past* human effects cannot be eliminated, however effective either *present* policies or *future* commitments might be. In a very real sense, therefore, the broad contours of the global bargaining problem among states for environmental management are shaped by the variables in Table 1. Almost every country generates these trace gases, but in different amounts and in different proportions.

The major contributing trace gas to the global aggregates, carbon dioxide, is a necessary consequence of nearly all social processes in all parts of the world. *Carbon* emissions are due principally to energy use (74%); industry (cement and gas flaring) (3%); and deforestation (23%) (Marland et al. 1989; R. Houghton 1987).

By contrast *methane* is generated largely by activities in developing region -- rice paddies (29%), ruminant domestic animals (20%), biomass burning (15%), landfills (15%), and fossil fuel use (21%) -- as well as solid industrial wastes of developed societies (25%).

The *chlorofluorocarbons* (CFC 11 and CFC 12) are strictly industrial. Although CFCs are currently produced mainly in advanced societies (refrigerants, coolants, electronics, etc.), the largest-growing markets for these products are the developing countries, where nearly 80% of the world's population resides. CFCs contribute to the erosion of the ozone layer, and their residence time is among the longest.

Relative to the other emissions, *nitrous oxides* are the least well understood trace gas. It is generated largely by fossil fuels, biomass burning, fertilizer uses, and through contamination of aquifers. Since fossil fuels and fertilizers are used by almost every country in the world, the sources of nitrous oxide are distributed globally. The relevant fact for international politics is that there are major

differences in the volume, intensity, and productivity of greenhouse gases across nations and over time.[27]

Comparative Perspective

Disaggregating some summary indicators into national sources of global effluence provides a close view of the role of individual nations. Figure 1 shows the distribution of countries in terms of carbon emissions and energy use. Figure 2 shows population and carbon emissions. And Figure 3 shows the per capita distribution of carbon and gross national product.

These figures amply demonstrate that no single state can individually alter the global distributions of emissions; coordinated inter-state collaboration is required -- to influence the present trajectories of change in the global environment and to provide both the necessary, as well as the sufficient, interventions in prevailing patterns of human activities. Management of the global environment will require both national and international responses and in all likelihood the large-scale coordination of intra-state and inter-state policies.

When viewed in the parlance of dynamic feedback systems, the development trajectory implied in Figures 2 and 3 highlights the global policy dilemma, namely, in the absence of coordinated action, the persistence of unconstrained human activities degrading to the environment and unabated emissions of trace gases will exceed Nature's adaptive and absorptive abilities, effectively transforming conditions for life on Earth on an aggregate basis (temperature) as well as regionally, if not locally. Given the physical characteristics of the environmental processes at hand, the international community finds itself in a condition of mutual hostage.

By the same token the increased visibility of environmental degradation -- irrespective of the scale, scope, or uncertainties -- politicize global environmental issues as well as the processes shaping international responses. At issue, then, are the types of responses, their characteristic features, and prospects for effectiveness.

Planetary Players

From a global perspective human actions generating the greenhouse gases and other forms of environmental degradation are *mediated by the institutions and regulations of the state*. The state is the only legal entity empowered to act on behalf of its citizens. The actions of the constituent populations -- both the individual and the organized activities generating environmental byproducts -- are monitored through a variety of conventional statistical devices using only the *state* as the basic unit of account.

Competing conceptions of the state notwithstanding,[28] it is clear that states at different levels of industrialization generate different types and forms of

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[27] See, for example, Graedel and Crutzen (1989).

[28] See, for example, Krasner (1984).

Figure 1

CARBON EMISSIONS and COMM. ENERGY USE

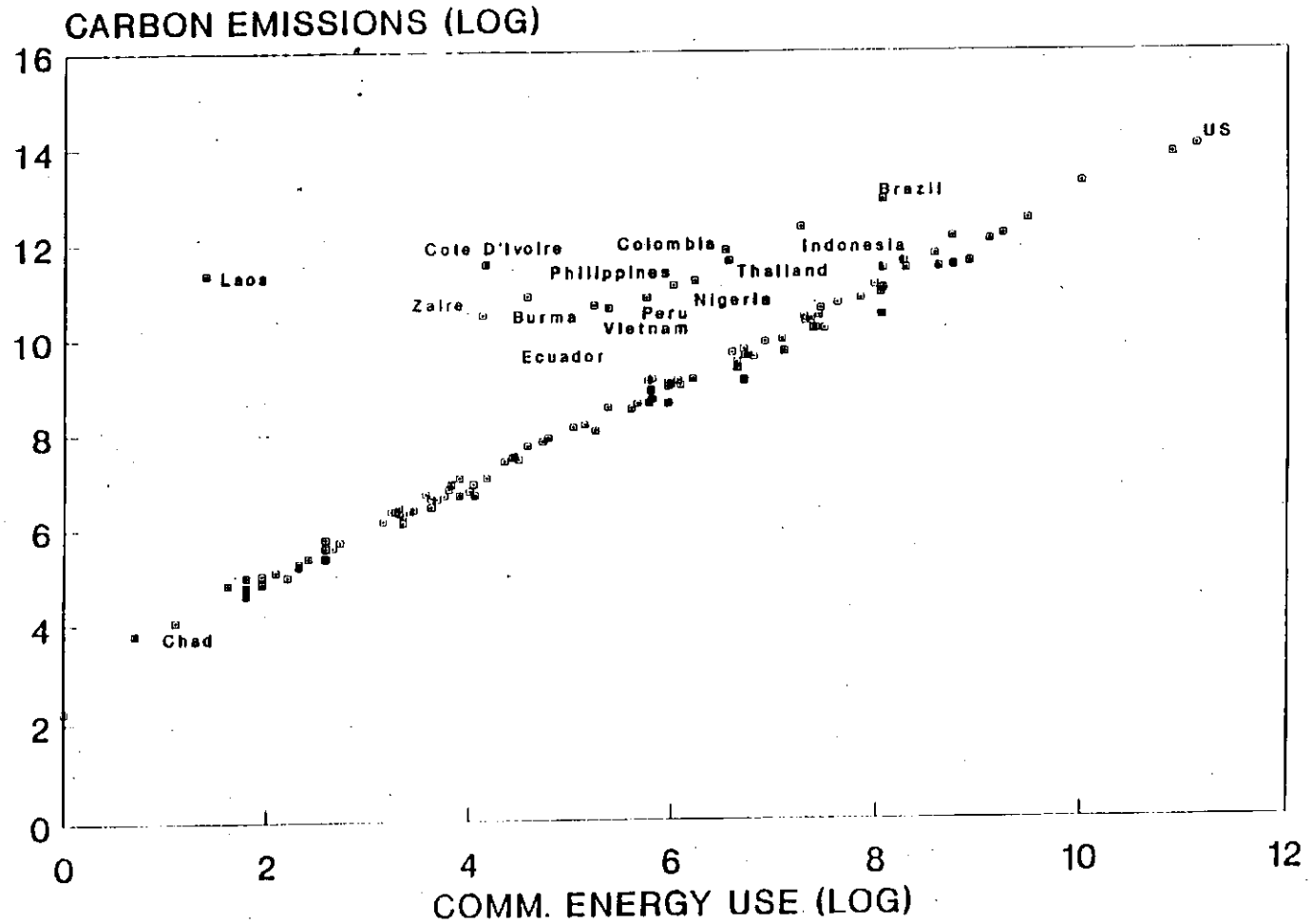


Figure 2

ALL COUNTRIES
CO2 and POPULATION

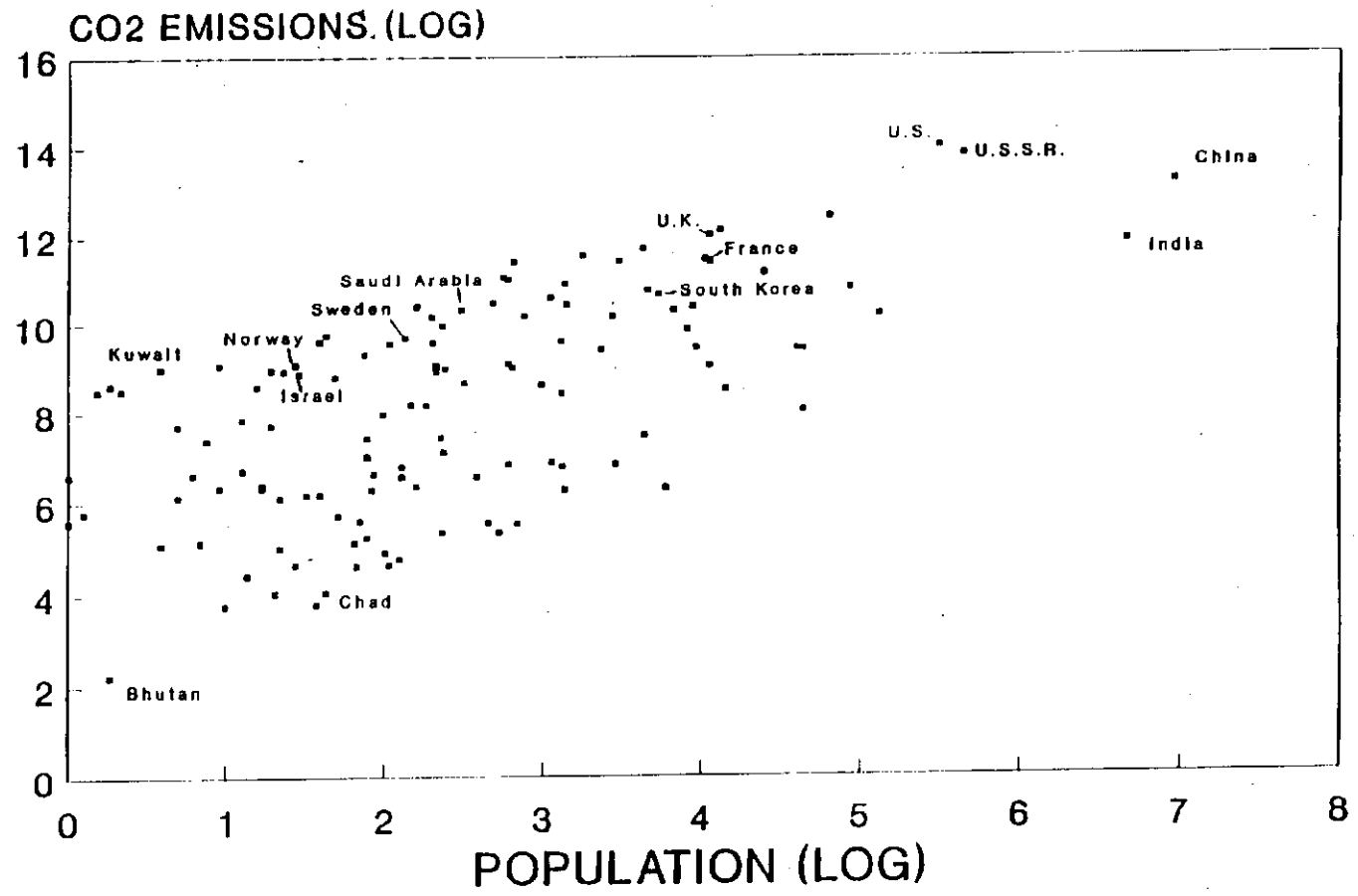
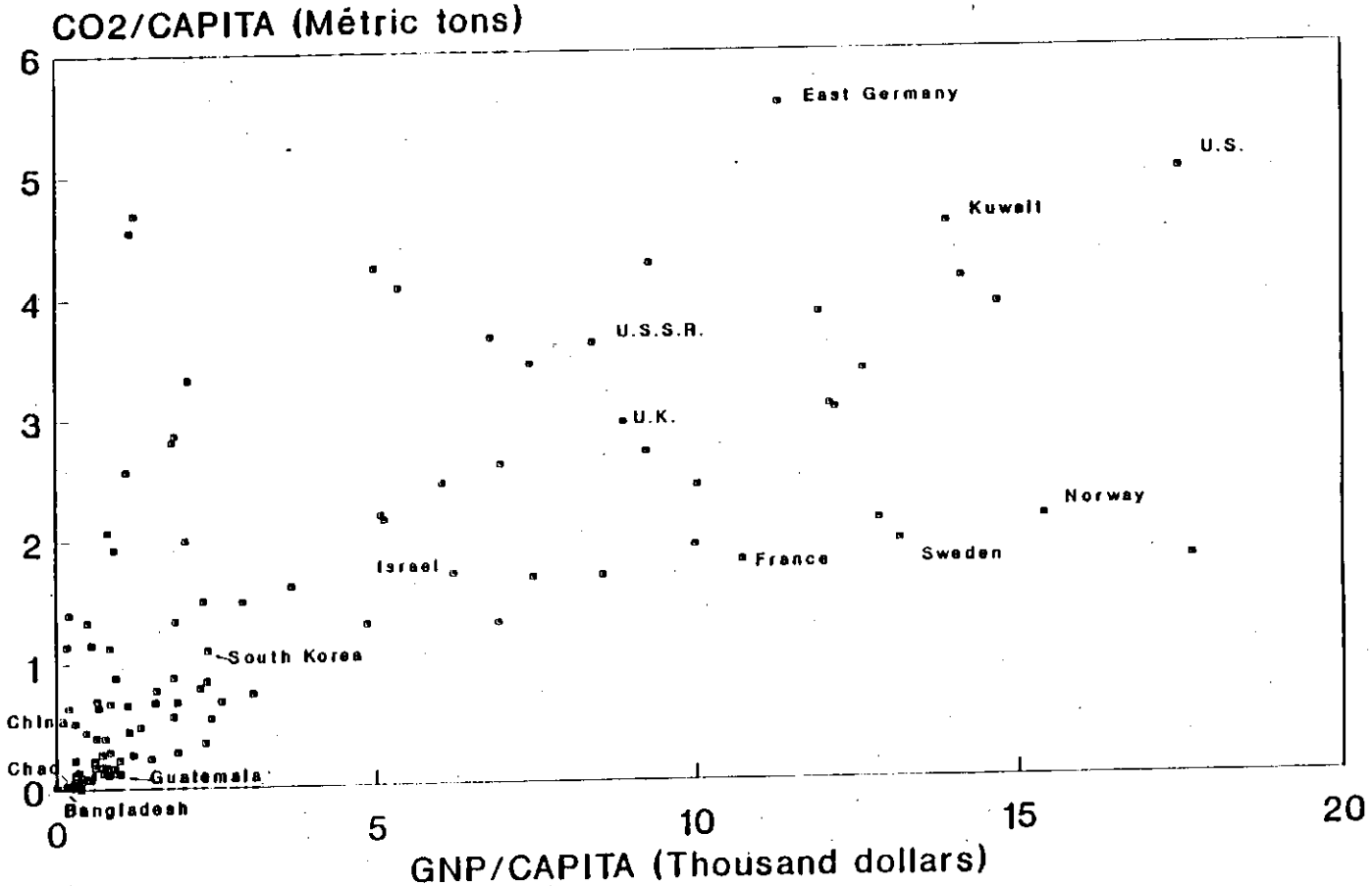


Figure 3

ALL COUNTRIES
CO2/CAPITA and GNP/CAPITA



environmental effluents and different combinations of greenhouse gases. These *differences* shape the respective interests of states in the global system. However crucial the states may be in this context, they are not the only actors and certainly not the only relevant ones. At least three other sets of planetary players emerge as crucial to bargaining over the management of global environmental processes: these are the multinational corporations, the "epistemic communities," the complex of nongovernmental organizations, and the established international governmental institutions. Each of these comes to global deliberations with particular capabilities, interests, and possibilities of leverage. As a consequence, the policies of states -- and their governments -- are shaped by bargaining and leveraging among those contending, and not always coordinated, groups. The growing participation of non-governmental groups -- of all sorts -- is of great importance in shaping international deliberations on global environmental management.

IV. INTERNATIONAL POLITICS AND INSTITUTIONAL RESPONSES

Once released, the diffusion, destination, and impact of effluents cannot be controlled. They are not accountable to human institutions and social conventions. And once effluents are released, environmental consequences could be pervasive in terms of scale and scope. Given a wide range of transmission modes -- natural as well as social -- the resulting environmental interdependence among sovereign states could be profound indeed. Both transmission modes and resultant environmental interdependence help frame the politics of international responses to global environmental change.

Transmission Mechanisms

The effects of human activities on the global environment are characteristically transmitted through *social* processes as well as through *natural* processes. Neither are well understood. Uncertainties on the social side are legion. These bear on the nature of market mechanisms (agreed-upon exchanges of goods and services at particular prices as well as the behavior of through various agents, private as well as public); by non-market of exchange; and through political allocations. The natural transmission mechanisms -- biogeochemical cycles, natural chains of transmissions, etc. -- are also fraught with uncertainty. Regardless of the mechanisms of transmission, the manifestations can be observed along three dimensions: first, *spatially*, in that effects are manifested across jurisdictions or are manifested across physical barriers; second, *temporally*, in that the impacts may be realized over time, in the future; and third, *functionally*, in the sense that causal effects can be generated in one area and then their consequences may be observed in other issue-areas.[29] While spatial manifestations of human activities, through natural or social forces, have generally received the most attention by analysts, the temporal (over time) and functional (across domains or issue areas) effects are evident in both social and ecological systems characterized by multi-loop, non-linear feedback systems.[30]

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[29] These dimensions of transmission were put forth by Peter M. Haas as a useful way of tracking transmission.

[30] See Forrester (1971).

The complexity of transmission internationally contributes to significant uncertainties on the sources and consequences of global change and, by extension, to the difficulties of framing appropriate international responses. When environmental interventions *within* one jurisdiction result in climate alterations in another, the consequences of transmission are inescapable.

Environmental Interdependence

Environmental interdependence is shaped mainly by a wide range of environmental degradations crossing borders. In addition, both the movements of goods and services across national borders embodying degradation potentials as well as the movements of population, of resources, and of technology generate and transmit environmental degradation. Consequently, the inability of states to control entry and exit of effluents across their borders constrains national autonomy in ways that had not earlier been apparent. (Closer to home we see that the flows of environmental effluents and pollutants often threaten relations between even the closest of political relations -- the United States and Canada, for example, with regard to acid rain. These cross-border impacts and the resulting complicated or complex interdependence are new in scope and scale.)

Clearly the state is not the only (and in some cases not the most important) agent or institution in generating effluents.[31] Indeed, some of the most serious forms of environmental degradation are facilitated (if not created) by non-state actors -- such as corporate strategies within and across jurisdictions. Since actions of individuals -- organized into collectivities within sovereign jurisdictions -- that generate environmental effluents, the aggregation of individuals into the state system generates differential sources of environmental perturbations and patterns of disturbances in natural processes.

A wide range of environmental alterations and the increased patterns of environmental interdependence shape the parameters for coordinated institutional responses. Under certain circumstances these pressures may even be articulated as "demands." The obvious fact that environmental effluents do not respect the sanctity of territorial boundaries defines the character of environmental interdependence. The diffusion of effluents across territorial borders and the inability of states to control the diffusion or destination place states in a bargaining stance where managing effluents -- their sources and consequences -- constitutes the issues of deliberations that may shape the choice of targets, of strategies, and of expected outcomes.

Furthermore, as indicated earlier, because of the long lead time, the complex feedback dynamics, and the irreversibility of many environmental changes, policy interventions set in place now have impacts only in the longer range.

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[31] See Keyfitz (1983); Keyfitz (1989); White (1990); and Choucri and North (1990) for the basic argument regarding the *individual* sources of environmental degradation. See United Nations Center for Transnational Corporations (1988) for the corporate sources of environmental degradation. See P. Hansen (1989) for a summary of recent trends on corporate activities globally; see Choucri, Haas, and North (forthcoming) for the role of the transnational corporations in generating environmental degradation.

In those terms international coordination becomes a *necessary condition* for influencing *future* trends of global environmental deterioration.[32]

Evolving Responses

While the issue of environmental alteration is relatively new in international forums, there has been a discernable trend toward regulation of environmental degradation.[33] Already the international community has concluded some 140 environmental treaties. The only global treaties, in the sense of addressing effluents of a global nature, are the Vienna Convention and the agreement on stratospheric ozone, and the Montreal Protocol, 1987, for regulation of chlorofluorocarbons.[34] The Protocol has codified some innovative provisions that represent a new phase along the path of international institutional developments.[35]

The Montreal Protocol originally controlled select chlorofluorocarbons and halons.[36] It stipulated a freeze of world production in 1990 at 1986 levels and a 50% reduction in CFC production worldwide by mid-1999. Also included was a freeze on the use of Halons (of a particular kind) at 1986 levels, starting in 1992. In June 1990 an added number of chemicals were added to the banned list. The principles of bargaining and compromise seems to be embedded in the Protocol design. For example, it provides for delay in compliance with the Protocol for developing states with a low per capita use of CFCs; it has a flexible legal structure, open to renegotiation; and it is considered by formulators as precedent-setting in terms of both framework of approach and flexibility of structure. Overall the international interactions and strategic deliberations leading to the Montreal Protocol provided novel developments in terms of the form, content, and process of cooperation for environmental management on a global scale.[37]

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[32] The alternative hypotheses are (1) that coordination among the most significant actors is sufficient to generate significant outcomes (in terms of imposing the corrective measures in Figure 1); and/or (2) that spontaneous, uncoordinated action could generate behavior modifications; and/or (3) that effective bilateral exchanges on a generalized scale could generate requisite behavior alterations.

[33] See Thacher (1989) for a brief survey of institutional responses.

[34] In June 1990, 93 nations adhered to the agreement to ban chemicals harmful to the ozone layer. This agreement goes far beyond the original. Despite a marked reduction of differences of views among industrial and developing states regarding recognition and approach to resolution of this global problem, significant problems remain.

[35] See Thatcher (1989) for a detailed discussion; see P. Haas (1990) for a regional analysis of these issues.

[36] These were CFCs 11, 12, 113, 114, and 115; and halons 1211, 1301, and 2402.

[37] See also Benedick (1989); Benedick (1990); Makhijani, Bickel, and Makhijani (1990).

The participants in the deliberation -- ranging from lobbying activity to signatory power -- included a wide range of state and non-state actors. Participating were representatives of 55 countries and the European Economic Community in addition to observers from six countries as well as from a large number of international agencies and non-governmental organizations.[38] The original signatories were 24 countries, including the United States, Japan, Canada, Germany, France, Italy, Sweden, the United Kingdom, and the European Community; 30 countries signed subsequently.

The most recent of the environmental protocols is the Basel convention for prevention of the export of hazardous materials, March 1989. It is important for our purposes, as it consciously seeks to prevent, even reverse, existing patterns of trade in hazardous materials. Currently industrial states export their hazardous waste to less industrialized countries (from Europe to Africa, or earlier from West Germany to East Germany) as a means of eliminating the hazardous byproducts of their own industrial activities. Exporting wastes to other jurisdictions reduces the national problem, but it does not reduce the global problem. In some cases it may even augment the global problem by encouraging the relocation and expansion of industries for recycling hazardous wastes in jurisdictions where environmental regulations are weaker and where standards for recycling are not fully established.

Both the Basel Convention and the Montreal Protocol are distinctive for the participation and strong influence of non-state actors, "epistemic communities,"[39] and a variety of non-governmental organizations during the deliberations, shaping the nature of the formal agreement.

Approaches to International Institutional Innovation

The record to date suggests that agreement on the global environment agreement involves an international developmental process, beginning with recognition of the problem; to agreement on goals and principles, identification of specifics for procedures, formulation of policy alternatives, and finally decision on policy. The most important achievement was the building of consensus between scientists and policy-makers in the development of a flexible framework designed to avoid obsolescence in the face of new scientific evidence.[40] This consensus and the

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[38] These included WMO, GATT, International Civil Aviation Organization, Organization of African Unity, OECD, ICC, Federation of E. Aerosol Assoc., European Chemical Industry Fed., CMA, NRDC, WRI, EDF, Greenpeace, Friends of the Earth, International Organization of Automobile Man., Alliance for Resp. CFC Policy, Air Conditioning & Refrigeration Institute (USA), Institute for European Environmental Policy, Produit Chemiques Allied Canada, among others.

[39] For the role and definition of "epistemic communities" as transnational coalitions, see P. Haas (1989).

[40] For examples of technological change and more scientific evidence, see Manzer (1990).

provision on incorporating scientific evidence served to strengthen the United Nations Environment Program as an international organization.

By 1992 the international community, committed to another institutional step at the Conference on Environment and Development, has also designed the post-1992 "Agenda 21."[41] The importance of cross-issue bargaining in the process of international cooperation is already being demonstrated.[42] And there are also some efforts, politically, to link environmental policy and debt reduction to aid to poor countries in return for stronger policy on the environment. It may even be reasonable to anticipate bargaining among states to reach agreement across forms of environmental degradation and to engage in trading concessions on behavior modifications toward more comprehensive agreements on global environmental issues.[43]

V. POLITICS OF GLOBAL POLICY RESPONSES

The global climate can no longer be taken for granted. It can no longer be viewed independently of human action. The underlying assumption of this paper is that growth and development tend to be environmentally degrading, but the extent of degradation *is not inevitable*; it is contingent on government policies, on perceptions of the environmental problems, and on the *management* of environmental variables.[44]

A simplified dynamic logic providing a sequential framework for policy responses is shown in Figure 4. This stylized sequence depicts both the processes and the

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[41] As with other United Nations conferences, the planning phase is undertaken by a Preparatory Committee to identify the issues and develop the agenda. At this writing two working groups have been established, focusing exclusively on the scientific and technical dimension of the sources and consequences of environmental degradation. A third group is planned at a later stage to focus on institutional and legal issues. The preparatory materials available to date suggest that the ubiquity of environmental degradation is not addressed head on or, alternatively, that every effort is being made to avoid direct confrontation of environment/development trade-offs.

[42] For a related theoretical analysis, see Sebenius (1983) and Tollison and Willett (1979).

[43] The literature on bargaining and negotiation is rich with propositions and directives for cross-issue bargaining. For background and strategic analysis, see especially Raiffa (1982); Fisher (1981). See also Young (1975). See Oye (in press) for a theoretically important and useful distinction between tactical and substantive cross-issue bargaining. On the issue of self-binding commitments, see Maoz and Felsenthal (1987). For a useful overview of approaches to regime analysis, see Haggard and Simmons (1987). Already there are efforts to articulate a viable transfer of technology to the developing countries in return for their compliance on pollution abatement measures.

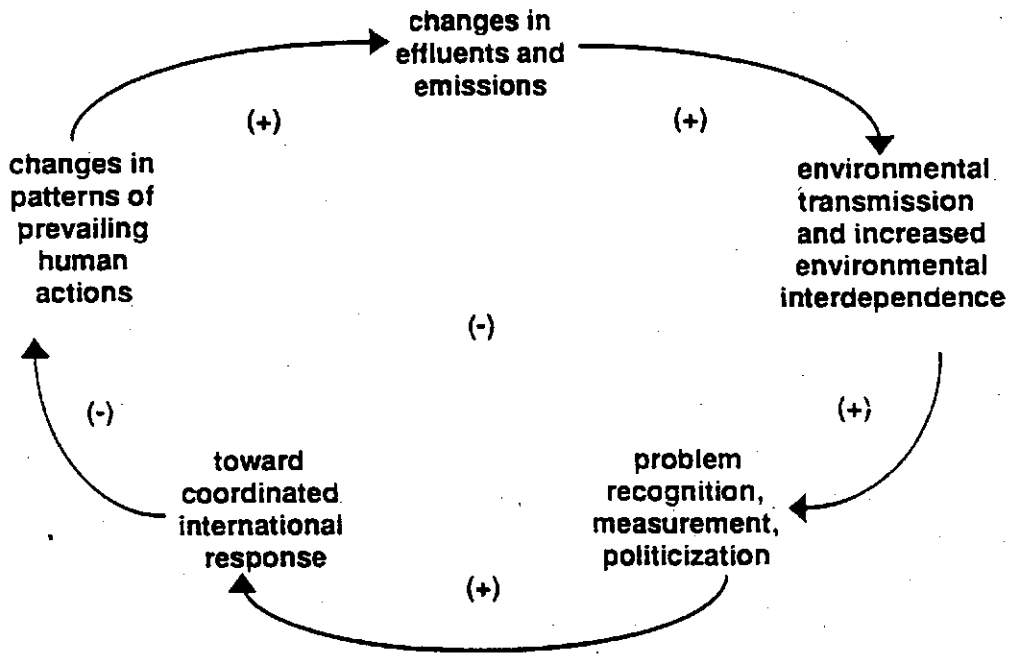
[44] For a detailed analysis in the context of the Mediterranean region, see P. Haas (1990).

crucial interventions or policy junctions. It is for heuristic purposes only and does not represent "reality" in any accurate manner. It is notional at best.

The purpose of the Figure is largely to highlight (1) the logic for *global* action; (2) the junction at which policy *interventions* may be crucial, and (3) the need for *consistency* both in conceptual terms and in framing international policy responses. The processes in Figure 4 are presented in a highly simplified form. Each component is itself composed of *complex non-linear and highly complicated processes fraught with uncertainty.*

Embedded in Figure 4 are the major intervention junctions, i.e. the junctions at which alterations in human action due to policy changes, different types of interventions, and different types of actors are salient in each phase. Government performance everywhere is shaped to administrative capabilities, political stability, and support of the population, all of which bear directly on its capacity to act. Different governments have different tools and policy preferences for meeting demands.[45]

Figure 4. Dynamic Perspective: Necessity for Policy Responses



There is an empirical reality to the proposition that changes in patterns of human activity worldwide lead to increases in emissions of trace gases, of all sorts (as well as pollution, wastes, different forms of toxicities). Depending on particular activities in specific environmental conditions, the relationship between activity and

[45] From a methodological perspective, this statement is best illustrated by the way in which different macroeconomic models rely on different types of "closure rules." For a detailed analysis of this issue, see Taylor (1983).

emission can be roughly identified, despite the uncertainties. Nonetheless, on the aggregate the greater the level of economic activity, technological change, and expansion of the world's population, the more rapid will be the expansion of effluents and emissions.[46] As a consequence, environmental degradation and environmental alteration contribute to increased environmental interdependence among nations. The ubiquity of the underlying sources of global environmental change shapes the logic Figure 4.

The minus (-) sign in the center of the diagram addresses the essence of the political problem: in the absence of concerted alterations in human activities, present patterns of behavior may be stressing ecological resiliency. Inducing behavior changes could alter current trajectories; without alteration, however, we can envisage greater environmental strains. Therefore, devising approaches to "correction" amounts to an imperative.

Politics of Response

Both the politics and the political science of international responses to global change are embedded in Figure 4. The contribution of political science at each phase of this stylized diagram can best be summarized by noting: who does what, when, and how; then by focusing on institutional underpinnings of social action, both the causes and the consequences of who does what, when, and how can be delineated.

Since different states at different levels of development generate different effluents, the developmental patterns become especially salient. The transmission of environmental effects have political importance -- and implications for political science -- in that it shapes new forms of linkages among states, over and above those conventionally defined as constituting interdependence.

The measurement issue poses serious challenges to polimetrics. We know how to measure "hard" variables or "behavior" variables. Political scientists are not yet versed in measuring effluents or extracting the political implications of effluence.

Theories of bargaining and negotiations are not central to the next phase of the simplified process in Figure 4. While political scientists have made major advances in both theory and measurement of bargaining and negotiation, there has been relatively little done to date applying the theory or measurement to the environmental domain.

The question of altering patterns of human action is a matter of incentives, regulations, legislation, negotiation, implementation, sanitation, compliance, and so forth. At the core is the political process, the complexity of national politics everywhere, and the diversity in the efficacy of political instruments and institutions.

VI. CONCLUSION: GLOBAL POLICY PRINCIPLES

Theory and evidence aside, there remains the overarching concern with addressing the normative question: identifying some global principles for pragmatic

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[46] See, for example, Keyfitz (1989); Keyfitz (1990); Keyfitz (1983).

action. There are the underlying political norms around which nations could agree to a common global environmental stance. Effective management of the global environment may well become the most significant institutional challenge for the twenty-first century. Because no one state can impose neither international order nor policy preferences, the search for principles becomes a requisite for action.

The importance of articulating global norms for environmental management derives from the realities of the highly dispersed sources of greenhouse gases and consequences in terms of environmental alterations. A global consensus on response to environmental changes due to human actions will be facilitated if the international community respects the integrity of five crucial principles. These are:

1. Legitimacy -- that responses be viewed as legitimate by all actors. Since different states are at different levels of development, conceptions of the priority given the global concern will differ.

2. Equity -- that responses be viewed as fair and appropriate to present and future generations and across states.[47] The element of fairness is salient, as developing countries have argued and will continue to argue that the "problem" was created by the industrial states and that they should "solve" it.

3. Efficacy -- that approaches and instruments be considered effective, rather than strictly efficient in economic terms, since the conventional precept of efficiency may impede prospects for agreement.

4. Volition -- that responses be voluntary, predicated on a shared recognition of the problems (based on scientific evidence), not coerced (based on negative leverage).

5. Universality -- that coverage encompass all states -- in that the ubiquity of human action generating the greenhouse bases imposes a logic of universality, despite differentials in extent or salience.[48]

Together these principles may provide pragmatic bases to facilitate effective global bargaining processes. These constitute essential requisites for shaping future agreement on coordinated responses to global environmental challenges.[49]

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[47] The second norm may imply the first, but not necessarily.

[48] See Choucri (1991) for an earlier discussion.

[49] For a discussion of both organizational and substantive aspects of the prospective convention on climate change in 1992, see Nitze (1990).

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