ENVIRONMENTAL INDICATORS: REGIONAL STABILITY AND THEATER ENGAGEMENT PLANNING

Steven R. Hearne
October 2001

AEPI-IFP-1001A

Army Environmental Policy Institute

The views expressed in this paper are those of the authors and do not necessarily reflect the official policy or position of the U. S. Government, the Department of Defense or any of its agencies.

Army Environmental Policy Institute
101 Marietta Street, Suite 3120
Atlanta, Georgia 30303-2711

ABSTRACT

Environmental stress is an important, but indirect, contributor to instability and potential conflict. It acts in combination with other socio-economic and institutional factors to produce the effects that lead to instability. Several theoretical and mathematical models of state instability and failure have been developed but are too complex for practical application. Thus, a simpler framework, the Stability Pyramid, is proposed to better identify and communicate the status of national and regional instability to geographic Commander-in-Chiefs, country teams, and ambassadors. This framework builds upon the positive linkages found between the environment, economic development, and state of institutional governance. Regional and international efforts to develop harmonized indicators and indices of environmental performance and sustainable development were reviewed in order to develop a Core Set of indicators for the Stability Pyramid framework that are believed representative of these multi-dimensional and complex linkages. This framework was then applied to reference countries representing three different regions within the United States European Command in an effort to determine its utility as an early warning tool in assisting policy makers to better identify, plan, and prioritize theater engagement activities and applicable interventions.

ACKNOWLEDGMENTS

I would like to express my appreciation to the faculty and staff of the Naval War College for a memorable academic year and for the unique opportunity to pursue a challenging and rewarding research topic during my final trimester. I am most grateful to Dr. Peter Liotta and Dr. Jim Miskel for their continued mentorship during both my Directed Research Project and subsequent Advanced Research Project. Their guidance and expertise throughout this entire process was invaluable. I shall always remain deeply indebted for their unwavering support.

Dr. John Hattendorf and Pat Cormier in the Advanced Research Department are commended for their superb administration during the trimester. They were instrumental in obtaining the necessary research tools that got things off to a great start. Alice Juda and other library staff were extremely helpful in conducting what evolved into a comprehensive literature search.

I am very grateful to those individuals in the many regional and international organizations who so graciously provided me information, reports, and studies important to my research, and who were always willing to share their opinions, perspectives, and time. I would like to specifically acknowledge the support provided by the following agencies: the Organisation for Economic Co-Operation and Development (OECD), the European Commission’s Joint Research Centre (JRC), the European Environment Agency (EEA), the United Nations Commission on Sustainable Development (UNCSD), the University of Maryland's Center for International Development and Conflict Management (CIDCM), the United States European Command's Plans and Policy Directorate (ECJ5) and Intelligence Directorate (ECJ2), and the Director of Central Intelligence's (DCI) Environmental and Societal Issues Center.

I dedicate this project to Laura, my loving wife of over 20 years, who has been my most loyal supporter of my academic and research interests. Lastly, I would like to express my appreciation to both the Defense Leadership and Management Program (DLAMP) and the United States European Command for supporting our attendance at the Naval War College.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Environmental stress is recognized as a contributor to instability and potential conflict in both the National Security Strategy and National Military Strategy. Both strategies focus primarily on the global environmental threats to our national interests. Understandably, geographic Commander-in-Chiefs (CINCs) and U.S. ambassadors are also concerned with more localized threats to regional stability and must have ready access to information that permits their staffs to monitor socioeconomic, political, and environmental stressors, so that appropriate intervention or engagement can be considered. The relationships between these different stressors and other contextual factors, and their effect on stability, are complex.

This paper examines an extensive recently completed body of research on state stability and failure, and ongoing efforts to develop improved indicators for use in related models. This synthesis was necessary in addressing two questions of concern to the policy maker.

1) *Can a Core Set of indicators and a simple framework be constructed to help identify instability?*

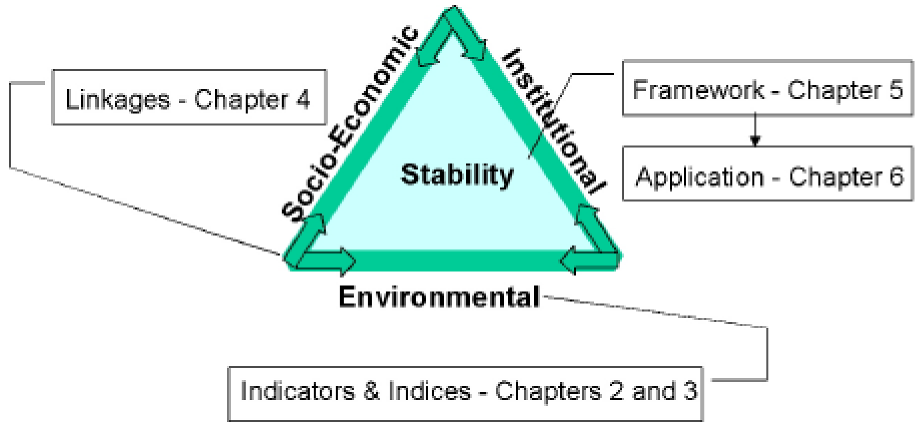
2) *If so, how might a CINC and other U.S. agencies, and potentially non-U.S. regional, international, and non-governmental organizations, employ such a framework to better prioritize engagement activities and leverage resources?*

This paper argues that the policy maker will benefit from the development of a user-friendly and simplified framework termed the “Stability Pyramid.” This framework will be developed in building block fashion, by chapter, as outlined in Figure 1-1. The scope of this research was confined to one geographic CINC command, the United States European Command, of which the author is most knowledgeable; however, the results and product are exportable to other commands. Given the extent of the European Command's area of responsibilities, which encompasses 92 countries, and the limited availability of information, the research effort was further constrained to select members of the Council of Europe, with emphasis given the nations of Central and Eastern Europe, the Baltic states, the Russian Federation, and the Newly Independent States. Three "reference" countries—Germany, Hungary, and Georgia—were selected for a more detailed analysis. These countries are viewed as representative of Western Europe, Central and Eastern Europe, and the Newly Independent States, respectively. The potential for instability in other regions assigned to the European Command, such as Sub-Saharan Africa, suggest that further application of the Stability Pyramid framework be conducted.

The significant progress made by several European academic consortiums and international organizations in developing harmonized, or “consensus,” indicators is discussed in **Chapter 2**. The challenge of aggregating these indicators into indices, or a single index, of environmental performance or sustainability is presented in **Chapter 3**. The initiatives researched were among the most respected within the international indicator community, and typically at the forefront of development. Many of the more common indicators are discussed in terms of their usage in terms of different frameworks and models of stability. Thus, these two chapters provide a crucial foundation for the remainder of the paper.

Figure 1-1

The "Stability Pyramid"



Chapter 4 reviews several recent reports issued by European institutions and the Director of Central Intelligence, summarizing the major environmental stressors to be faced over the next 20 years. The important relationships, or linkages, between the three key dimensions of economic development, governance, and the environment will be presented in turn. Supporting research is discussed that has examined these linkages. This is important as these relationships frame the Stability Pyramid, which is introduced in the next chapter.

Chapter 5 examines several conceptual and mathematical models of state instability and failure. These studies examine the complex manner in which socioeconomic, institutional stressors and other contextual factors interact and produce effects that can influence state and regional stability. Particular emphasis was given to that research which addressed whether environmental stress was a direct contributor to stability, or acts more indirectly in combination with other socioeconomic and political factors. Based upon this research, a Stability Pyramid is proposed as a simpler framework, or tool, for use in better illustrating and communicating conditions where state stability may be threatened.

Chapter 6 addresses how this simplified framework might be applied within the context of an existing CINC Theater Engagement Planning process. The concept of pivotal states is introduced as a means of highlighting those anchor or focus countries in different regions that have been determined to require special attention or resources. The proposed Stability Pyramid framework and a Core Set of indicators will be used to identify whether any conditions of instability exist within the three aforementioned reference countries.

The more significant conclusions reached during this investigation appear in **Chapter 7,** as they support the previously stated argument and answer the two major research questions posed at the outset of this section. An exhaustive literature search was conducted covering a number of disciplines and sources of information. Consequently, an extensive bibliography has also been prepared; most of the references are used in the paper.

This paper provides a unique synthesis of the literature as it concerns development of environmental and other applicable indicators that might be employed in a simple framework of stability. It is envisioned that this framework will also prove to be a practical policy tool.

CHAPTER 2

ENVIRONMENTAL INDICATORS

The importance of measuring the "state-of-the-environment" was highlighted at the 1992 Earth Summit by inclusion of provisions in Agenda 21 calling for the harmonization of environmental indicators that could better assess sustainable development at the national, regional, and international levels.[1] Recognized indicators have been successfully employed to monitor economic and social condition. Accountability for environmental decision-making, however, has suffered as a result of the unwieldy body of information available and a lack of accepted indicators for communicating progress to senior leaders, policy makers, and the public. Consequently, major environmental policy issues were often ignored or decisions delayed. This chapter explores progress made in establishing agreed upon environmental indicators, their function in various frameworks, and efforts to refine and aggregate these indicators into a smaller number of indices of environmental performance.

A. Defining Characteristics

An environmental indicator may best be characterized as a parameter that presents, in an understandable and summary fashion, the state of a particular environmental phenomenon that has significance beyond the property originally measured, and which requires little further explanation.[2] Generally, environmental indicators are expressed in a form that relates one reference variable to another equally important variable, such as pollutant emissions per capita. Two defining characteristics of such indicators are that they are first able to quantify information in such a way that their significance is well understood and, second, that the information can be simplified for easy communication.[3] One researcher offers a succinct view of environmental indicators as "executive summaries addressed to non-experts who want to get a quick impression of basic trends without the need for further interpretation."[4]

Environmental indicators can serve as powerful and relatively cost-effective tools for decision makers at different levels of government in helping with the following:

- Reporting on the state of the environment per national law or other agreements.
- Raising environmental issues onto the political agenda to promote further debate.
- Supporting policy development to address priority environmental concerns.
- Supporting efforts to address environmental problems during budget formulation.

---

[1] United Nations Division for Sustainable Development, Indicators of Sustainable Development: Framework and Methodologies. Background Paper No. 3, for the Ninth Session of Commission on Sustainable Development, 16-27 April 2001. 5 April 2001 <http://www.un.org/esa/sustdev/csd9/csd9_docs.htm>, p. 2.

[2] Organisation for Economic Co-Operation and Development, Towards Sustainable Development – Environmental Indicators (Paris: OECD, 1998), p. 107.

[3] Allen Hammond, Albert Adriannse, Eric Rodenburg, Dirk Byant, and Richard Woodward, Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development (World Resources Institute, 1995), p. 1.

[4] Jochen Jesinghaus, "A European System of Environmental Pressure Indices, First Volume of the Environmental Pressure Indices Handbook: The Indicators" (European Commission, Joint Research Centre, Draft. 20 April 1999), 3 April 2001 <http://esl.jrc.it/envind/theory/handb_.htm>, p. 5.

- Measuring environmental performance and the success of policy responses.
- Identifying trends by major sectors, e.g., energy, agriculture, transport, and industry.
- Establishing environmental targets at the sectoral and sub national levels.
- Providing early warning to prevent environmental damage.
- Measuring progress towards sustainable development.
- Facilitating national, regional, and international environmental planning.
- Prioritizing regional intervention and engagement activities.
- Communicating progress to the public and national and international institutions.

B. Hierarchy and Aggregation

A hierarchy of environmental information is depicted in Figure 2-1, which is an adaptation of an "information pyramid" suggested by Hammond et al.[5] and an "information iceberg" proposed by Jesinghaus."[6] This figure helps illustrate the distinct nature of the lower levels of environmental information, (the primary or raw data obtained from monitoring and measurement, processed or analyzed data, and national and regional statistics) from the environmental indicators and indices found at the top of the hierarchy. Hammond et al. further suggest that for indicators to be successful they must be user-driven, policy-relevant, and highly-aggregated, and designed to be used at many levels, e.g., community, sectoral, national, or international.[7] The selection of environmental indicators, however, has often been conducted in an "arbitrary and careless manner with little attention paid to the interrelationships between them" which has resulted in an overabundance of indicators and indices that more typically overwhelm and confuse senior decision makers and the general public, a situation characterized as being "indicator rich but information poor."[8]

In order to simplify and reduce the multidimensionality associated with complex environmental systems, researchers commonly employ an ordination procedure known as principal component analysis (PCA). This type of analysis helps to eliminate much of the extraneous noise in a data swarm, while having the opposite effect of illuminating the real pattern of the data.[9] Chang-Ching et al. investigated the effective dimensionality of 14 different environmental indicators across 33 nations of varying levels of economic development.[10] Indicators were limited because of data availability. Indicators were also

---

[5] Hammond et al., Environmental Indicators, p. 1.

[6] Jesinghaus, "A European System of Environmental Pressure Indices," p. 6.

[7] Hammond et al., Environmental Indicators, p. 2.

[8] Yu Chang-Ching, John T. Quinn, Christian M. Dufournaud, Joseph J. Harrington, Peter P. Rogers and Bindu N. Lohani, "Effective Dimensionality of Environmental Indicators: A Principal Component Analysis with Bootstrap Confidence Intervals," Journal of Environmental Management, May 1998, p. 117.

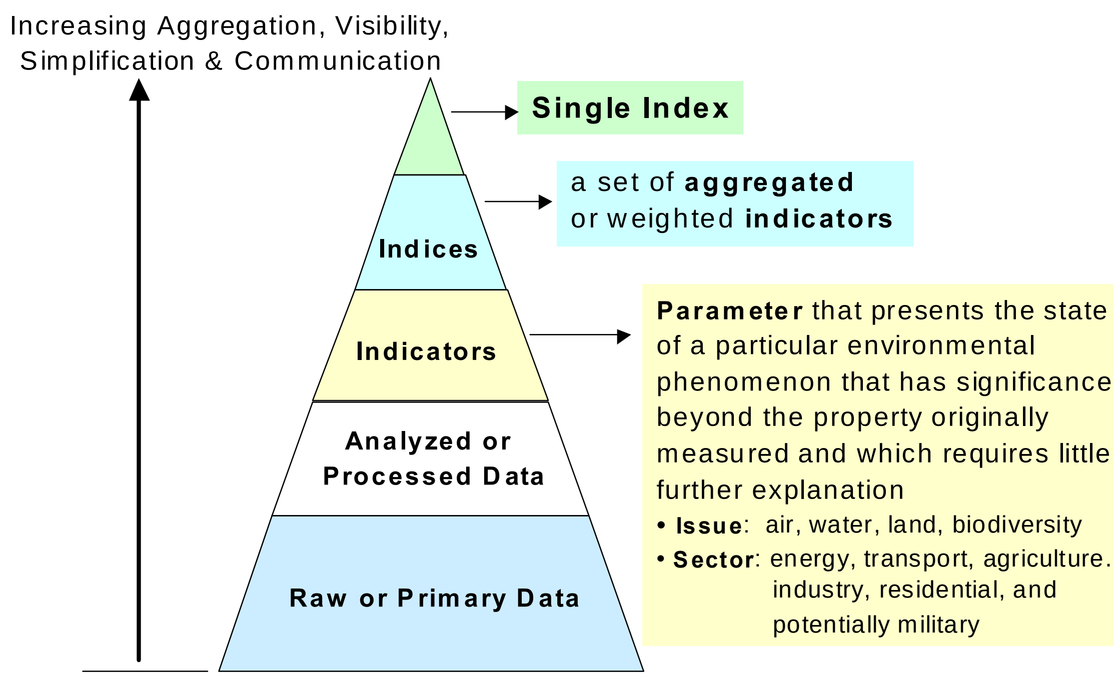
[9] Principal component analysis (PCA) is among the simplest of ordination methods used in transforming a multidimensional swarm of data (e.g., in *s*-dimensions) into a smaller number of uncorrelated variables called principal components. Generally, the original multidimensional swarm of data is projected onto a two- or three-dimension display, such that the intrinsic pattern of the original data becomes more apparent. In a two-dimension display, the original data swarm is displayed along the first and second principal components (e.g., along the x- and y-axis, respectively). The first and second principal components typically account for the majority of the variation in the data in a successful ordination using PCA. E.C. Pielou, The Interpretation of Ecological Data: A Primer on Classification and Ordination (New York: John Wiley & Sons, 1984), pp. 136-164.

[10] Chang-Ching et al., "Effective Dimensionality of Environmental Indicators," pp. 101-119.

selected to be representative of major environmental issues and problems, such as air and water pollution, land degradation, and loss of biodiversity. Indicators were eliminated if found to be highly correlated and, thus, overly duplicative, of others in the data matrix. Data were obtained from annual reports published by the United Nations Environmental Program, United Nations Development Program, the World Bank, and the World Resources Institute. An important result of this investigation was the suggestion that there is a large redundancy in the number of environmental indicators being used. The investigation conducted by Chang-Ching et al. led to the recommendation that decision makers and the public would be best served by the development of four indices reflective of each of the four major environmental components—air, biodiversity, land, and water—to capture the most salient aspects of national or regional environmental quality.

Figure 2-1

Information Hierarchy



In recent years, a concerted effort has been undertaken by a number of regional and international institutions to establish acceptable and consistent environmental indicators. The Organisation for Economic Co-Operation and Development (OECD) regularly collects and analyzes socioeconomic and environmental data provided by its member countries and produces a number of reports and publications.[11] It has established an approved Core Set of some fifty environmental indicators that are used primarily to measure performance across a broad range of environmental issues, while integrating environmental concerns into key sectors of energy, transport, and agriculture, using an approach common to its membership.[12] A listing of the OECD Core Set of environmental indicators is provided in

[11] The OECD also reports on selected indicators across a number of Central and Eastern European countries and Russia. Organisation for Economic Co-Operation and Development, Environmental Indicators: A Review of Selected Central and Eastern European Countries (Paris: OECD, 1996).

[12] OECD, Towards Sustainable Development – Environmental Indicators, pp. 3 and 109.

Appendix 1. Among the general criteria used in selecting these indicators were their policy relevance, analytical soundness, and measurability. Further, while they were developed primarily for use in national and international decision-making, it is suggested that a similar methodology can be employed to develop environmental indicators at a subnational and ecosystem level.[13]

In addition to its Core Set of environmental indicators, the OECD is also in the process of developing sets of indicators for specific sectors, e.g., energy, transport, and agriculture. Sectoral indicators would allow OECD member states to analyze the pressure exerted by different sectors on the environment, and the success of government and business responses, while also better integrating environmental concerns into sectoral policies.[14]

The European Union (EU) is also providing recognized leadership in the development of harmonized environmental indicators that can be used for a number of purposes. The EU recently published its first report[15] of 60 environmental "pressure" indicators in 10 major policy issues. They appear in Table 2-1. The need to aggregate these and other environmental indicators using appropriate weighting and valuation into a reduced number of indices, and possibly a single index of overall environmental pressure, is being followed with interest by other regional and international institutions.[16] An acceptable single index is likely beyond reach for some time to come. However, efforts are already underway to produce a small set of indicators and indices that will be more easily understandable to non-experts, while helping to ensure that they will be taken more seriously and used more extensively.

The European Environment Agency (EEA) recently issued the first edition of its indicator-based *Environmental Signals* report, which is to be published annually as a means of communicating progress on selected policy areas to European policy makers and the general public.[17] This report contains environmental indicators for the energy, transport, agriculture, and industry sectors, as well as for a number of major environmental policy areas, to include climate change, ozone depletion, and air pollution. The report clearly states that, in addition to policy relevance, the other main criteria used in selecting indicators was the availability of data for most member countries. The EEA also recommends that each future report "should make its own selection and its own presentation of this family of indicators" until such time as agreements are reached on the indicators to be used.[18] Given the temporal nature of the environment, some indicators will not change significantly from year to year. This affords an opportunity to expose other concerns in future *Environmental Signals* reports.

---

[13] OECD, Towards Sustainable Development – Environmental Indicators, p. 106.

[14] OECD, Towards Sustainable Development – Environmental Indicators, pp. 110-111.

[15] European Commission, Towards Environmental Pressure Indicators for the EU (Belgium: European Communities Publication, 1999), p. 8.

[16] An index is defined by OECD as a "set of aggregated or weighted parameters or indicators." OECD, Towards Sustainable Development – Environmental Indicators, p. 107.

[17] The EEA also maintains a database called STAR that is an inventory of current environmental policy targets and sustainability reference values which apply in the European Union and in several countries in Central and Eastern Europe, as well as the Newly Independent States. European Environment Agency, Sustainability Targets and Reference Value (STAR) Database. <http://star.eea.eu.int/asp/default.asp>.

[18] European Environment Agency, Environmental Signals (Copenhagen: EEA, 2000), p. 7.

TABLE 2-1

SUGGESTED INDICATORS OF ENVIRONMENTAL PERFORMANCE

Major Policy Issues	*EU Environmental Pressure Indicators	** EU Environmental Headline Indicators
Air Pollution	Nitrogen oxide emissions Sulfur dioxide emissions Particle emissions Primary energy consumption NMVOC emissions Consumption of gas and diesel oil by road vehicles	Emissions of acidifying gases Ozone exposure above EC targets Urban exposure to particulate matter
Climate Change	Carbon dioxide emissions Methane emissions Nitrous oxide emissions Chlorofluorocarbon emissions Sulfur oxide emissions Nitrogen oxide emissions	GHG emissions: CO_2, methane, NO_x
Loss of Biodiversity	Protected area loss and damage Wetland loss through drainage Agricultural intensity Fragmentation of forest and landscapes Clearance of natural and semi-nat. forests Change in traditional land-use practices	
Marine Environment and Coastal Zones	Eutrophication Fishing pressure Development along shore Discharges of heavy metals Oil pollution at coast and at sea Discharges of halogenated organics	
Ozone Layer Depletion	Bromofluorocarbon emissions Chlorofluorocarbon emissions Hydrochlorofluorocarbon emissions Nitrogen oxide emissions Chlorinated carbon emissions Methylbromide emissions	Emissions of ozone precursors
Resource Depletion	Water consumption per capita Use of energy per capita Increase in territory permanently occupied Nutrient balance of the soil Electricity produced from fossil fuels Timber balance: new growth/harvest	

TABLE 2-1 (Continued)

SUGGESTED INDICATORS OF ENVIRONMENTAL PERFORMANCE

Major Policy Issues	*EU Environmental Pressure Indicators	** EU Environmental Headline Indicators
Dispersion of Toxic Substances	Consumption of pesticides Persistent organic pollutant emissions Consumption of toxic chemicals Index heavy metal emissions to water Index heavy metal emissions to air Radioactive material emissions	
Urban Environmental Problems	Energy consumption Share of private car transport Non-recycled municipal waste Non-treated wastewater People endangered by noise Land use change: natural to built-up	Gross inland energy consumption Passenger transport by mode
Waste	Waste landfilled Waste incinerated Hazardous waste Municipal waste Waste per product Waste recycled/material recovered	
Water Pollution and Water Resources	Nutrient use: nitrogen and phosphorus Groundwater abstraction Pesticides/ hectare of agricultural area Nitrogen/ hectare of agricultural area Water treated/water collected Organic matter (as BOD) emissions	Nitrogen and phosphorus in large rivers Total freshwater abstraction

Sources:

* European Commission, Towards Environmental Pressure Indicators for the EU (Belgium: European Communities Publication, 1999), p. 8.

** European Environment Agency, Environmental Signals (Copenhagen, EEA, 2000), p. 10.

Note: EU environmental headline indicators shown are not all-inclusive as several were under development during preparation of source document - *Environmental Signals*.

The report also introduces the term environmental "headline indicators," their term for indices, which are developed by the aggregation of different variables, e.g., combining the emissions of all greenhouse gas emissions using a carbon dioxide equivalent, to explain what are generally complex issues to senior policy makers and ministers located outside of the environmental community. The report provides a caveat that other headline indicators were still under development and, thus, did not appear in the first edition. The headline indicators that appear in the 2000 edition of *Environmental* Signals, generally presented in a simple graphic, are also listed in Table 2-1. As is evident from this table, headline indicators are not yet available for many of the major policy areas of concern to the EU. The development of suitable indices remains, very much, a work in progress.

C. Pressure, State, and Response

The OECD has been instrumental in the development of a Pressure–State–Response (PSR) model to help describe how both direct and indirect pressures from human activities can impact the state of the environment and of natural resources, and how society might respond through changes in policies and behavior. The OECD members, which include the United States and all of the European Union nations, have agreed to use the PSR model "as a common harmonized framework" for structuring their Core Set of indicators.[19] Specifically, the PSR "framework" provides a means for further classifying the Core Set of environmental indicators into three distinct categories: "pressure" indicators reflecting the direct and indirect impact of human activities on the environment; "state" indicators describing the condition of the environment; and "response" indicators reflecting the extent of societal response.[20] A schematic of the PSR model is provided at Figure 2-2. The OECD is also developing an adjusted PSR model for use with their sectoral environmental indicators.

The European Union member states have modified the PSR approach and adopted a Driving Forces–Pressure–State–Impact–Response (DPSIR) framework as a means to best structure its environmental information. The DPSIR framework is also helpful in describing, in simple terms, what are very complex causal relationships created by human activities on the state of the environment and the effectiveness of societal responses. While the OECD PSR model was considered "sufficient," the DPSIR framework was introduced because it provides a "better description of underlying economic trends" and ensures "compatibility" with other international models, such as the "Driving Forces—State—Response (DSR) model developed by the United Nations Commission on Sustainable Development (CSD)."[21]

---

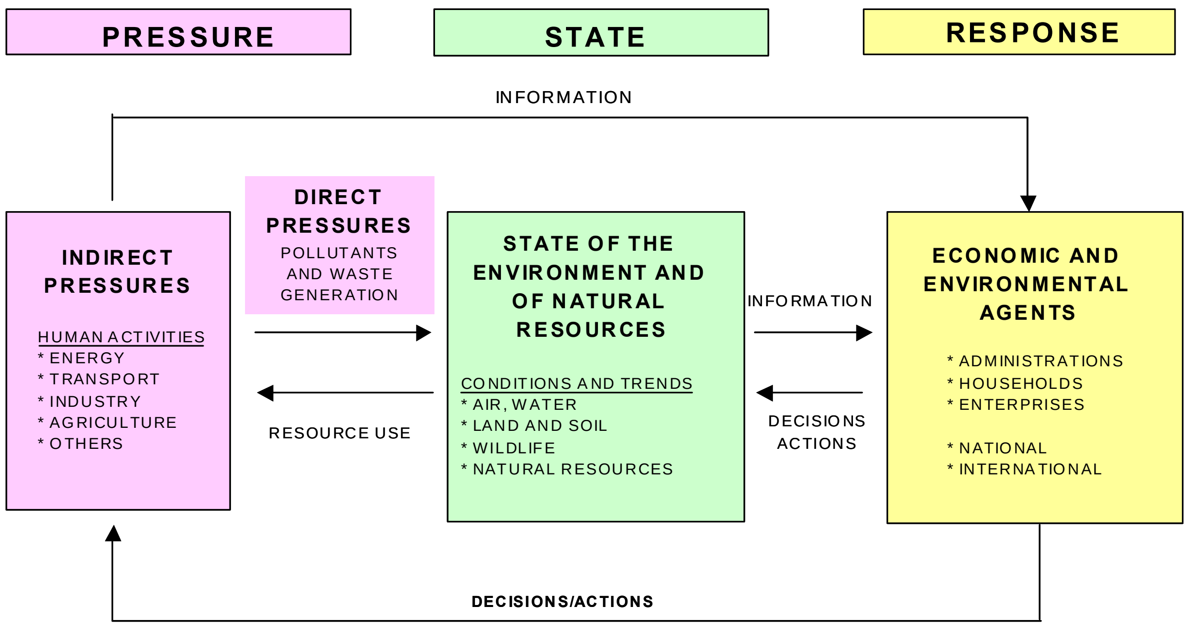
[19] OECD, Towards Sustainable Development – Environmental Indicators, p. 8. The terms "framework" and "model" are often used interchangeably in different publications; however, framework implies a conceptual or basic arrangement or structure, whereas, a model is representative of some existing system. Robert Keen and James Spain define a model as "any representation of a real system [involving] words, diagrams, mathematical notation, or physical structures in representing the system …[the term] may have the same meaning as concept, hypothesis, or analog … [and] it must always involve varying degrees of simplification or abstraction." They use the examples of the food chain and the ecosystem to illustrate a "conceptual model." Robert E. Keen and James D. Spain, Computer Simulation in Biology: A Basic Introduction (New York: John Wiley and Sons, 1992), pp. 2-3.

[20] OECD, Towards Sustainable Development – Environmental Indicators, p. 109.

[21] Jesinghaus, "A European System of Environmental Pressure Indices," p. 2.

Figure 2-2

Pressure State Response Model



Source: OECD ***Towards Sustainable Development – Environmental Indicators, 1998***

The DPSIR framework introduces a "Driving Forces" category to address the underlying environmentally relevant trends in various sectors of the economy, such as an increase in the number of vehicles per inhabitant in the transport sector, and an "Impact" category that addresses the effects arising from environmental change, such as a decrease in agricultural production.[22] Its application to climate change is illustrated in Figure 2-3. The EEA has also introduced a "typology"[23] of indicators to be used in further classifying its environmental indicators into four groups:

- Descriptive (Type A) that reflects what is happening to the environment.
- Performance (Type B) that compares current condition against a reference.
- Efficiency (Type C) that relates separate elements in the DPSIR causal chain.
- Total Welfare (Type D) that measures a component of total sustainability.

The latter type of indicator is stated as being outside of the EEA's current work program. Indicators of sustainability are examined in the next section of this paper.

---

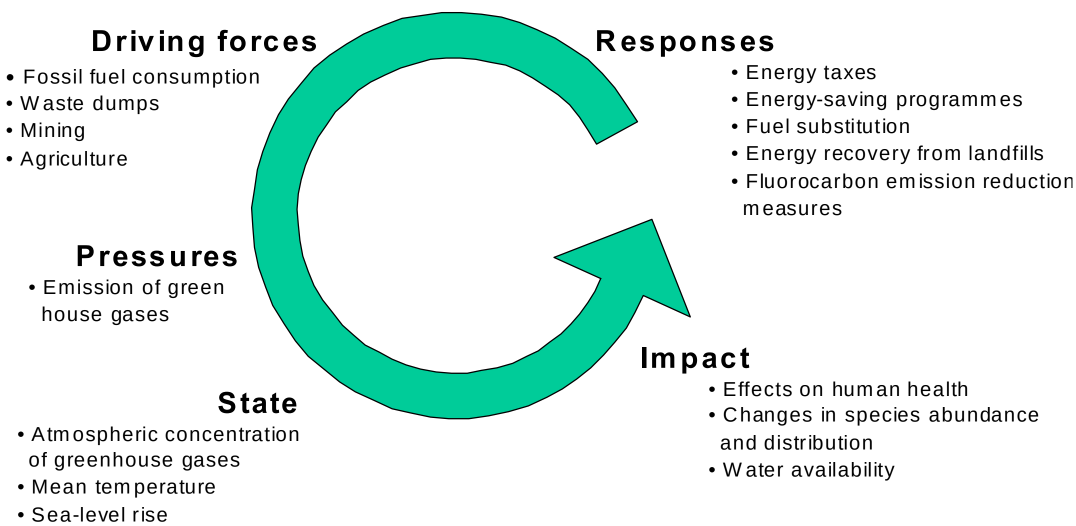
[22] European Commission, Towards Environmental Pressure Indicators for the EU, p. 5.

[23] Edith Smeets and Rob Weterings, Environmental Indicators: Typology and Overview, Technical Report No. 25 (Copenhagen: European Environment Agency, 1999), pp. 6-13.

Thus, EU members are generally employing a harmonized system for classifying environmental indicators both by "type," e.g., descriptive, performance, efficiency, and total welfare, and "category" within the DPSIR framework, e.g., driving force, pressure, state, impact, or response. However, the EEA admits that "no attempt has been made to provide indicators for each of the DPSIR categories [and since] most of the policy action is at the D [driving forces] and P [pressure] side of the causal chain, the most policy-relevant indicators show developments in Driving Forces or Pressures" categories.[24]

Figure 2-3

European Union DPSIR Model



Source: European Environmental Agency *Environmental Signals 2000*

The World Bank has also been active in structuring indicators within a framework that assists its managers in selecting and designing appropriate environmental performance indicators (EPIs) to evaluate the performance of its projects that address environmental problems as their primary emphasis and of other projects that have the potential to directly or indirectly impact the environment. The World Bank recognizes the widespread acceptance and utility of the OECD PSR framework for national-level indicator sets. It has also developed a project cycle framework that closely links project objectives to environmental problems being addressed.[25] Indicators under this framework are classified according to an Input-Output-Outcome-Impact approach. There is no small set of universally established indicators that can be applied in every case. Rather, it is suggested that EPIs be selected on a project-by-project basis. Particular focus is currently being given the design of appropriate indicators for the "Output" and "Impact" phases of the project cycle framework.

---

[24] European Environment Agency, Environmental Signals, p. 8.

[25] Lisa Segnestam, Environmental Performance Indicators: A Second Edition Note, Paper No. 71 (Washington DC: World Bank, October 1999), pp. 5-8.

The United Nations CSD also modified the PSR approach in their development of a Driving Force–State–Response (DSR) framework as the early basis for CSD selection of sustainable development indicators. In 1999, an expert group advising the CSD recommended a possible revision to the DSR framework to better highlight major policy issues that would be more useful for decision makers. The DSR framework and a working list of indicators were evaluated as part of a three-year testing program by 22 countries.[26] As a result of this testing, it was recommended that the working list of the CSD indicators be significantly reduced from 134 to approximately 54, and that a thematic, i.e., a theme-based indicator, framework be adopted. The thematic approach presents the CSD indicators in four major sustainable development dimensions—social, economic, environmental, and institutional. Several of the nations tested concluded that the DSR framework, "although suitable in an environmental context, was not as appropriate for the social, economic, and institutional dimensions of sustainable development."[27] This and other factors led to the recommendation that the CSD discontinue categorizing indicators by DSR framework. Table 2-2 presents the current CSD Core Set of indicators of sustainability by theme and sub-theme for each of the four major dimensions of sustainable development.

[26] United Nations Division for Sustainable Development, Indicators of Sustainable Development, p. 5.

[27] United Nations Division for Sustainable Development, Indicators of Sustainable Development, p.12.

TABLE 2-2

SUGGESTED INDICATORS OF SUSTAINABILITY

UNCSD Framework: Dimension/Theme	UNCSD Core Set of Indicators of Sustainable Development, 2001	World Economic Forum 2001 Environmental Sustainability Index
1. Environmental		
a. Atmosphere		
(1) Climate change	Emissions of greenhouse gases (GHGs)	CO_2 emissions (total tons/capita)
(2) Ozone layer deplt.	Consumption O_3 ozone depleting substances	CFC consumption (tons/capita)
(3) Air quality	Concentration of pollutants in urban areas [e.g., ozone, CO, NO_x, SO_2, TSP, etc.]	Urban SO_2, NO_2, TSP concentrations NO_x, SO_2, VOCs, coal consumption/ populated land area Vehicles/populated land area % country in acidification exceedence
b. Land		
(1) Agriculture	Use of fertilizers Use of agricultural pesticides Arable and permanent crop land area	Fertilizer consumption/arable land Pesticide use/hectare of crop land
(2) Forests	Forest area as a percent of land area Wood harvesting intensity	% change in forest cover 1990-1995
(3) Desertification	Land affected by desertification	
(4) Urbanization	Area of urban settlements	Severity of human soil degradation Land area affected by human activities as a % of total land area
c. Oceans, Seas, Coasts		
(1) Coastal Zone	Algae concentration in coastal waters Percent of population in coastal areas	
(2) Fisheries	Annual catch by major species	
d. Freshwater		
(1) Water quantity	Annual withdrawal of ground and surface water as % total available	Internal renewable water per capita Inflow from other countries per capita % territory under severe water stress Industrial organic pollutants/avail water
(2) Water quality	BOD in water bodies Concentration of fecal coliform	Dissolved oxygen concentration Electrical conductivity Suspended solids Phosphorus concentration
e. Biodiversity		
(1) Ecosystem	Area of selected key ecosystems Protected area as a % of total area	Number of sectoral EIA guidelines Percentage land under protected status
(2) Species	Abundance of selected key species	Percentage of mammals threatened Percentage of breeding birds threatened

TABLE 2-2 (Continued)

SUGGESTED INDICATORS OF SUSTAINABILITY

UNCSD Framework: Dimension/Theme	UNCSD Core Set of Indicators of Sustainable Development, 2001	World Economic Forum 2001 Environmental Sustainability Index
2. Social		
a. Equity		
(1) Poverty	Percent of population below poverty line Gini index of income inequality Unemployment rate	
(2) Gender equality	Ratio of average female to male wage	
b. Health		
(1) Nutritional status	Nutritional status of children	Daily calories/capita as % requirements
(2) Mortality	Mortality rate under 5 years old Life expectancy at birth	Under-5 mortality rate Death rate from intestinal diseases Child deaths from respiratory diseases
(3) Sanitation	% population adequate sewage disposal	
(4) Drinking water	Access to safe drinking water	% access to improved drinking water
(5) Healthcare	% population w/access to primary care Immunize infectious childhood diseases Contraceptive prevalence rate	
c. Education		
(1) Education level	Secondary or primary school completion	
(2) Literacy	Adult literacy rate	
d. Housing		
(1) Living conditions	Floor area per person	
e. Security		
(1) Crime	Recorded crimes per 100,000 population	Reducing Corruption
f. Population		
(1) Population change	Population growth rate Population of urban settlements	% change between 2000 and 2050 Total fertility rate

TABLE 2-2 (Continued)

SUGGESTED INDICATORS OF SUSTAINABILITY

UNCSD Framework: Dimension/Theme	UNCSD Core Set of Indicators of Sustainable Development, 2001	World Economic Forum 2001 Environmental Sustainability Index
3. Economic		
a. Economic structure		
(1) Performance	GDP per capita Investment share in GDP	ISO14001 firms/million dollars GDP Dow Jones sustainability group index Membership Average Innovest EcoValue'21 rating World Business Council for Sustainable Development members Levels environmental competitiveness
(2) Trade	Balance of trade in goods & services	
(3) Financial status	Debt to GNP ratio Average ODA given or received as % of GNP	Innovest EcoValue'21 rating ISO 14001 firms/million dollars GDP Dow Jones sustainability group index membership World Business Council for Sustainable Development members Levels environmental competitiveness
b. Consumption and Production Patterns		
(1) Material consump.	Intensity of material use	Consumption pressure per capita
(2) Energy use	Energy use per unit GDP Annual energy consumption/capita Intensity of material use Share of consumption of renewable energy resources	Efficiency: energy consumption/GDP Intensity of energy use by sectors: commercial/services, manufacturing residential, and transportation Subsidies for energy or material usage Renewable energy production as a % of total energy consumption Price of premium gasoline
(3) Waste generation & management	Industrial and municipal solid waste Generation of hazardous waste Generation of radioactive waste Waste recycling and reuse	Radioactive waste
(4) Transportation	Distance traveled/capita by mode transp.	

TABLE 2-2 (Continued)

SUGGESTED INDICATORS OF SUSTAINABILITY

UNCSD Framework: Dimension/Theme	UNCSD Core Set of Indicators of Sustainable Development, 2001	World Economic Forum 2001 Environmental Sustainability Index
4. Institutional		
a. Framework		
(1) Strategic	National sustainable devel. strategy	Environmental strategies & action plans Stringency & consistency of env regs Innovation promoted by env regulations
(2) International cooperation	Implement ratified global agreements	Compliance with env agreements Memberships in intergovernmental org. Participation of CITIES reporting Participation Vienna Conv & Montreal Montreal Protocol fund participation Global Env Facility (GEF) participation Historic cumulative CO_2 emissions Ecological footprint “deficit” FSC accredited forest area as % total [CO_2 emissions (total tons/capita) – already listed in 1a(1)] [CFC consumption (total tons/capita) – already listed in 1a(2)]
b. Institutional Capacity		
(1) Information access	Internet subscribers per 1000 people	Availability of SD info at national level Number of ESI variables missing
(2) Communications	Main telephone lines per 1000 people	
(3) Science & tech.	Expenditure on R&D as % GDP	Expenditure for R &D as % GDP R& D scientists & engineers/million Scientific and technical articles/million
(4) Disaster preparedness and response	Economic and human loss to disasters	
(5) Capacity for Debate		Civil and political liberties IUCN member organizations/million

Sources:

United Nations Division for Sustainable Development, Indicators of Sustainable Development: Framework and Methodologies. Background Paper No. 3, for the Ninth Session of Commission on Sustainable Development, 16-27 April 2001. 5 April 2001 <http://www.un.org/esa/sustdev/csd9/csd9_docs.htm>, pp. 15-16.

Global Leaders for Tomorrow Environmental Task Force, World Economic Forum, 2001 Environmental Sustainability Index, Report to Annual Meeting (Davos, Switzerland, 2001) <http://www.ciesin.columbia.edu/indicators/ESI/downloads.html>, pp. 10-11.

Note: The Environmental Sustainability Index (ESI) variables that utilize a measure of populated land area were calculated only by inclusion of land area having a population of five or more persons per square kilometer.

CHAPTER 3

INDICES OF SUSTAINABILITY

The search for a single index of sustainable development might be likened to the mythical quest for the Holy Grail, since many argue that no single number, "even one that vastly improved upon the [Gross Domestic Product] GDP as a proxy for overall national well-being — could have any real functional value as a policy tool [excepting that it] might force a disciplined effort at presenting the complexity of sustainable development in a simplified form."[28] The CSD has recently released a report reviewing several of the more respected initiatives to aggregate indicators of sustainable development into a lesser number of indices and possibly a single index.[29] A single index of sustainability, however, remains a daunting challenge given the complex array of factors to be considered and the need for international consensus on any weighting system. One option under consideration is having nations establish weights based on their respective vulnerabilities and capacities. In the spirit of this venture, a number of the more interesting regional and international initiatives are presented in this chapter.

The United Nations Human Development Index (HDI) is but one example of a single index that is being used widely by many policy makers today. The HDI is seen as a valuable aggregation of three different indices of the "social dimension" of sustainability—life expectancy, education, and GDP. Opponents caution that little consideration has been given the correlation between variables in the development of aggregated indices and the index is, thus, misleading. They argue that the HDI is developed from four highly correlated variables and is, therefore, also overly reflective of per capita GDP. As a result, countries with a higher GDP can be expected to have higher life expectancy, literacy, and primary education enrollment.[30] The CSD analysis acknowledges the skepticism surrounding the HDI's "lack of sensitivity in some components" by stressing that its use as a tool for "influencing and monitoring national policy-making needs to be further studied."[31] Such concerns must be considered when developing similar indices measuring environmental performance or sustainability.

The CSD analysis offers criteria and several different possibilities for aggregating data at higher levels.[32] Among their more favorable candidates that will be examined briefly in this paper are the Policy Performance Index, the Environmental Sustainability Index, and the Sustainability Dashboard. Each approach has its pros and cons, but all are viewed as contributing to the development of the CSD framework on sustainable development.

---

[28] Consultative Group on Sustainable Development Indicators, "Aggregated Indices," 1999. 16 March 2001 <http://www.iisd.org/ cgsdi/indices.htm>, p. 1.

[29] United Nations Division for Sustainable Development, Report on the Aggregation of Indicators of Sustainable Development, Background Paper No. 2, for the Ninth Session of Commission on Sustainable Development, 16-27 April 2001. 5 April 2001 <http://www.un.org/esa/sustdev/csd9/csd9_docs.htm>, pp. 2-5.

[30] Chang-Ching et al., "Effective Dimensionality of Environmental Indicators," p. 102.

[31] United Nations Division for Sustainable Development, Report on the Aggregation of Indicators of Sustainable Development, p. 21.

[32] United Nations Division for Sustainable Development, Report on the Aggregation of Indicators of Sustainable Development, pp. 5-20.

A. Policy Performance Index

The Policy Performance Index (PPI)[33] has been under development by the European Commission's Joint Research Centre for a number of years. It is based on the aggregation of three separate indices covering the environmental, social, and economic dimensions. The Environmental Pressure Index (EPI) is based on the aggregation of 10 policy field indices. Each of these 10 indices is developed from the aggregation of six environmental pressure indicators. The 10 policy field indices and resulting 60 environmental pressure indicators were previously discussed and presented in Table 2-1. This initiative is being coordinated closely with the Consultative Group on Sustainable Development Indicators (CGSDI) at the International Institute for Sustainable Development (IISD). The intent is to substitute the PPI for other more commonly used indicators, such as GDP and unemployment rates.[34]

This approach may contribute to future CSD aggregation efforts by its distinct application of both a "weighting" system, based on surveys from experts and stakeholders at each level of aggregation, and a "valuation" system expressed in a simple graduated color scale.[35] Currently, an equal weighting system is being used. There is some concern by the CSD that the composition of the stakeholder constituency, used in the weighting surveys, might be controversial. Indices are presented in a user-friendly pie chart of concentric circles, where the size of a particular segment reflects its assigned weighting, and the color its valuation. The indicator set being used in this initiative is similar to that of the CSD Core Set of indicators of sustainability that was presented in Table 2-2. The CSD believes the PPI approach to be "an interesting initiative that the countries of the CSD framework may wish to consider if they wish to assign weights to the sub-themes and themes."[36]

B. Dashboard of Sustainability

The Joint Research Centre is working closely with the IISD-based CGSDI to develop a Dashboard of Sustainability that builds on the PPI initiative. The term "Dashboard" was coined to reflect how the clusters of indicators are displayed, e.g., in a manner not unlike the dials and gauges on a car's dashboard.[37] As in a dashboard, the dials and gauges are used to provide critical feedback, using key indicators, to monitor environmental quality, social health, economic performance, and institutional factors. The CSD analysis found the indicators used in the IISD/CGSDI approach to be "very basic," lacking sufficient detail that

[33] Jochen Jesinghaus, "Indicators for Decision Making," Draft of 12 December 1999. 3 April 2001 <http://esl.jrc.it/envind/idm/idm_e_.htm>, p. 1.

[34] United Nations Division for Sustainable Development, Report on the Aggregation of Indicators of Sustainable Development, p. 15.

[35] United Nations Division for Sustainable Development, Report on the Aggregation of Indicators of Sustainable Development, p. 16.

[36] United Nations Division for Sustainable Development, Report on the Aggregation of Indicators of Sustainable Development, p. 16.

[37] Peter Hardi and Alan AtKisson, "The Dashboard of Sustainability," Draft Design Specifications Document for the Consultative Group on Sustainable Development Indicators, October 1999. 3 April 2001 <http://www.iisd.org/cgsdi/dashboard.htm>, pp. 3-4.

limits its utility as a policy tool.[38] Specifically, there was little information provided as to how the aggregation was done for environmental quality. The indicators and aggregation for the remaining two dimensions were also seen as too broad and not simplistic. The visual nature of the dashboard has significant appeal, but it needs to incorporate the "Institutional" dimension to conform to the new CSD framework.

The Joint Research Centre appears to have addressed this latter deficiency in the development of a new generation "Dashboard of Sustainability."[39] An illustration of the Dashboard is provided at Figure 3-1 (next page) for the nation of Georgia. The methodology used in this version also appears to incorporate many of the strengths of the related PPI approach.[40] With few exceptions, the indicators used in the Dashboard closely match those currently under development by the CSD for the major dimensions of sustainable development: environmental, social, economic, and institutional (see Table 2-2). Numerical values for the indicators are available for over one hundred nations. Presently, all indicators within the Dashboard are weighted equally, however, the software allows for adjustments to weightings based on surveys among expert groups or other methods. Performance valuation is provided for each indicator, and across all four dimensions, using a seven-color code (dark red for worst, dark green for best). Policy performance in each dimension is also scored using a point system ranging from zero (worst case, dark red) to 1,000 (best, dark green). Finally, the software calculates an overall Sustainable Development Index (SDI) for each country.

The SDI and scores for performance in the four major dimensions of sustainability are presented for select member states from the Council of Europe in Table 3-1 (page 21). This table is organized primarily on a regional, rather than rank-ordered, basis. In reviewing Table 3-1, there does not appear to be the widespread variation among nations that one might expect. However, the institutional scoring is lower for the transitional economies of South East Europe and the Newly Independent States, but the numbers of indicators used in calculating the score are limiting factors. This concern is addressed in a later chapter in the development of a representative number of indicators for the institutional dimension of the framework underlying the Stability Pyramid.

Somewhat surprising is the low environmental score for the Netherlands, which was subsequently confirmed as being attributable to agricultural stress. The scoring of most nations' social component of the SDI is also generally higher compared to the other three components. This is likely a result of the equal weighting being used in the current software.

---

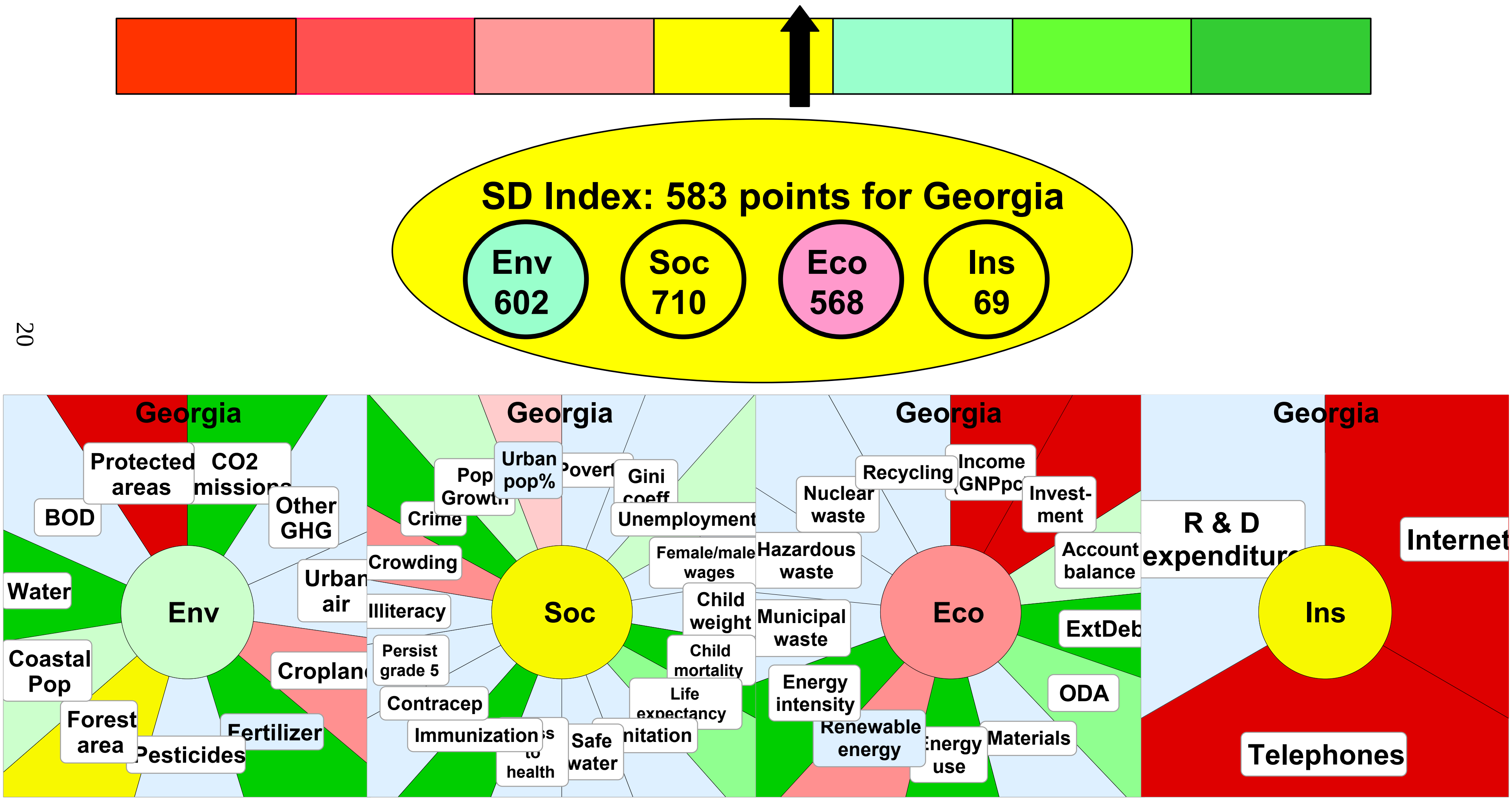
[38] United Nations Division for Sustainable Development, Report on the Aggregation of Indicators of Sustainable Development, pp. 117-18.

[39] Joint Research Centre, "The CGSDI Dashboard of Sustainability - Version 3.3," 16 March 2001 <http://esl.jrc.it/envind/dashbrds.htm>, p. 1.

[40] Joint Research Centre, "The Methodology Used for the Dashboard Software Tool," 16 March 2001 <http://esl.jrc.it/envind/db_meths.htm>, pp. 1-3.

Figure 3-1

Dashboard of Sustainability



Note: light blue color indicates missing or incomplete data

Source: http://esl.jrc.it/envind/dashbrds.htm

TABLE 3-1

SINGLE INDEX SCORES

Country	GDP/capita	Single Indices		SDI Components			
	('98in '95 $)	**ESI**	**SDI**	ENVR	SOCL	ECON	INST
France	27,975	65.8	657	660	761	577	450
Germany	31,141	64.2	671	695	726	640	486
Italy	19,574	54.3	626	534	807	589	392
United Kingdom	20,237	64.1	644	528	800	606	465
Spain	15,644	59.5	654	587	818	646	264
Belgium	28,790	44.1	573	424	750	567	389
Greece	12,069	53.1	609	492	797	566	263
Netherlands	28,154	66.0	637	386	821	665	525
Portugal	11,672	61.4	628	618	783	591	233
Austria	30,869	67.8	709	733	827	631	383
Sweden	27,705	77.1	705	642	812	605	745
Denmark	37,449	67.0	677	617	794	607	591
Finland	28,075	80.5	719	644	834	634	780
Ireland	23,422	64.0	582	420	784	538	358
Hungary	4,920	61.0	656	635	803	594	218
Poland	3,877	47.6	646	708	753	617	167
Czech Republic	5,142	57.2	678	726	788	634	272
Slovakia Republic	3,822	63.2	657	724	783	586	216
Slovenia	10,637	59.9	608	513	809	544	304
Croatia	4,846	54.1	630	604	789	587	234
FYR Macedonia	1,349	39.2	540	547	718	433	119
Bulgaria	1,372	47.4	625	603	773	549	183
Romania	1,310	44.1	637	702	722	601	130
Moldava	614	47.4	610	566	785	555	139
Albania	795	44.2	611	571	741	668	18
Russian Federation	2,138	56.2	597	657	690	542	159
Ukraine	837	36.8	641	692	729	571	115
Belarus	2,198	48.0	677	672	861	611	191
Armenia	892	50.6	581	631	700	527	94
Azerbaijan	431	46.4	542	455	751	576	53
Estonia	3,951	57.7	605	591	726	594	232
Latvia	2,328	56.3	630	693	715	608	170
Lithuania	2,197	60.3	639	702	735	586	189
Georgia	703	na	583	602	710	568	69
Luxembourg	46,591	na	675	na	759	607	479
Correlation: GDP/capita		r = 0.67	r = 0.48	r = -0.22			

ESI Environmental Sustainability Index calculated from 22 indicators - World Economic Forum' s Global Leaders Task Force's *2001 Environmental Sustainability Index Report*
SDI Sustainability Development Index - CGSDI's Dashboard of Sustainability
ENVR Environmental component of SDI SOCL Social component of SDI
ECON Economic component of SDI INST Institutional component of SDI

The Dashboard of Sustainability has some real promise as a policy tool. The current version allows the user to determine performance in a specific area (carbon dioxide emissions) or for a major SDI component (environmental). The Dashboard can also be used to compare the performance of different countries in a particular region or sub-region.

Once data are provided using an agreed to framework and methodologies, it will be possible to track trends over time, an issue that continues to plague researchers today. The Dashboard is relatively easy to use and can be shared across the Internet. Data and software can be updated on a regular basis. In an effort to ensure that their indicator set conforms to an international standard, the Dashboard researchers monitor development of the CSD Core Set of sustainable development indicators. In fact, the latest prototype of the Dashboard was demonstrated as recently as April 2001 during the Ninth Session of the CSD[41] where it was received favorably by many CSD participants and the indicator community. The concern remains that a "dedicated institution" be established and appropriately funded to take over the initiative on a full-time basis, to ensure this prototype policy tool will continue and succeed.[42]

C. Environmental Sustainability Index

An environmental task force of the World Economic Forum, working in collaboration with two academic institutions,[43] released their Environmental Sustainability Index (ESI) at its annual meeting in January 2001, ranking 122 countries as to their overall progress toward environmental sustainability. This team of researchers made a deliberate choice to focus strictly on the environmental dimension of sustainability. While not discounting the importance of the social, economic, and institutional dimensions, the researchers concluded there was not "sufficient scientific, empirical or political basis for constructing metrics that combine all of them along with the environment."[44] Further, the environment has also been typically "overshadowed" when attempts have been made to fold it into an aggregated index of total sustainability. Environmental sustainability is defined as the ability to produce enduring high performance across five core components: Environmental Systems; Reducing Environmental Stresses; Reducing Human Vulnerability; Social and Institutional Capacity; and Global Stewardship.[45]

The research team constructed the ESI as a "comparative index" because of the difficulty in defining the level and duration for acceptable sustainability. The ESI is calculated from 22 core indicators and 67 variables that are assigned across the aforementioned five core

[41] International Institute for Sustainable Development, "Dashboard of Sustainability" Demonstration during Ninth Session, United Nations Commission on Sustainable Development (CSD 9) Meeting, United Nations Headquarters, 16-27 April 2001. 27 April 2001 [E-mail to Steve Hearne <mailto:hearnes@nwc.navy.mil>.

[42] International Institute for Sustainable Development, "Dashboard of Sustainability" Demonstration during Ninth Session, United Nations Commission on Sustainable Development (CSD 9) Meeting.

[43] The Environmental Sustainability Index (ESI) was developed as a collaborative effort between the World Economic Forum's Global Leaders for Tomorrow (GLT) Environmental Task Force, the Yale Center for Environmental Law and Policy (YCELP), and the Columbia University Center for International Earth Science Information Network (CIESIN). Global Leaders for Tomorrow Environmental Task Force, World Economic Forum, 2001 Environmental Sustainability Index, Report to Annual Meeting (Davos, Switzerland, 2001) <http://www.ciesin.columbia.edu/indicators/ESI/downloads.html>.

[44] GLT Environmental Task Force, 2001 Environmental Sustainability Index, p. 8

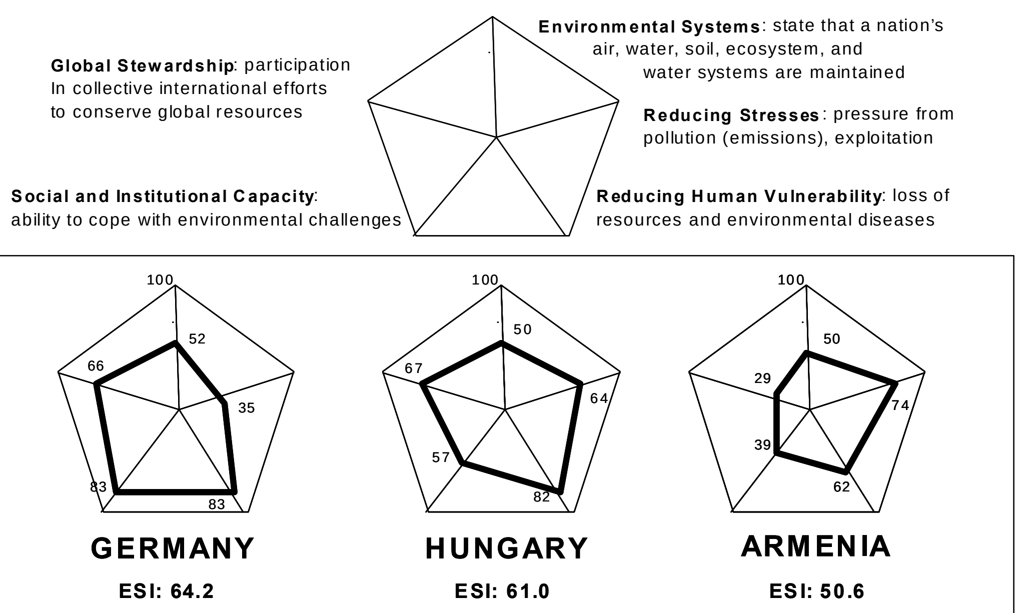
[45] GLT Environmental Task Force, 2001 Environmental Sustainability Index:, p. 9.

components.[46] The 67 ESI variables are also shown in Table 2-2, where they have been placed according to the CSD thematic framework, e.g., dimension, theme, and sub-theme. The CSD analysis found the ESI structure of components, indicators, and variables to be closely related to the CSD thematic framework of dimensions, themes, and sub-themes. However, the frameworks differ in that the ESI framework places considerable focus on the relationship between human activities and the environment while giving little emphasis to social or economic development.[47]

The ESI report also included country profiles for each of the 122 nations studied, presenting a graphical "snapshot" of each country's performance across the 5 components of environmental sustainability. Country profiles are graphed for Germany, Hungary, and Armenia at Figure 3-2. No ESI was available for Georgia. Each of the axes radiating from the pentagon represents a single component of sustainability. A country's score is marked along the appropriate axis and the points (scores) connected. The size of the enclosed area is stated as being representative of the "measure of [a country's] overall performance on these five components…[while providing]… a means of comparing performance in a slightly more precise manner than the single Index score." [48] The ESI scores for a number of select member states from the Council of Europe are also provided in Table 3-1.

Figure 3-2

Environmental Sustainability Index



Source: http://www.ciesin.columbia.edu/indicators/ESI/downloads.htm

[46] GLT Environmental Task Force, 2001 Environmental Sustainability Index, Annex 1 and 4. The statistics describing how the Environmental Sustainability Index (ESI) was calculated are provided in more detail in these annexes. Variable values are presented in the form of Z scores reflecting the distance above and below the mean in a normal distribution. The 22 indicators are then calculated by averaging these Z scores. Finally, the ESI is calculated by taking the average of the 22 indicators and then converting this value to a standard normal percentile.

[47] United Nations Division for Sustainable Development, Report on the Aggregation of Indicators of Sustainable Development, p. 17.

[48] GLT Environmental Task Force, 2001 Environmental Sustainability Index, p. 63.

The ESI research team admits that the ESI is not without its weaknesses and remains a work in progress. Serious gaps in data, for example, limited their ability to measure the ESI for some one hundred nations. These data gaps, and the need for consistent reporting, is seen as priority issues to be addressed by policy makers at different levels. Other important self-criticisms include the "weighting system" used and the issue of scale. Generally, equal weighting was given all of the input variables. However, an "implicit weighting"[49] exists by virtue of the difference in the number of indicators used for each of the five components, e.g., five indicators are used to describe the Environmental Systems component while only two indicators are used for the Reducing Human Vulnerability component. Scale was also stated to be of concern because environmental sustainability "rarely unfolds" on a national level.[50] Rather, environmental sustainability is better characterized on a smaller scale, e.g., sub-national, watershed, and ecosystem. The researchers' concern regarding scale is apparent when measuring water abstraction against recharge. In this example, localized water shortages may not be readily apparent from a review of only national level data.

The ESI comparability scoring ranks Finland, Norway, Canada, and Sweden at the top, while placing Ethiopia, Burundi, Saudi Arabia, and Haiti at the bottom of 122 nations. These and other rankings appear plausible, but there are some anomalies that have invited criticism.[51] For example, the Russian Federation is ranked 33rd, while Singapore is ranked only 65th. The score for Russia was higher than expected, but was attributed to poor and missing data and questionable self-reporting. The low ranking for Singapore was also surprising given the international recognition this nation has received for its progress in environmental protection and performance. The researchers, however, defend the ESI score for Singapore as reflective of the potential stress arising from water issues facing the country. The research team also countered other criticisms that the index ranking favors rich countries and is biased in favor of countries with large land areas. The ESI methodology is also not capable of addressing the causal linkages between environmental sustainability and economic development.[52] Regardless of such criticisms, the ESI research team believes the data that underpins the index can assist policy makers as a tool for early warning in identifying a "watch list of countries facing potential environment-driven crises."[53] The next chapter also explores the relationship, or linkage, between economic development and the environment, and uses the ESI, SDI, and SDI environmental component indices as a basis for comparison.

---

[49] GLT Environmental Task Force, 2001 Environmental Sustainability Index, p. 17.

[50] GLT Environmental Task Force, 2001 Environmental Sustainability Index, p. 23.

[51] Economist, "Green and Growing: Sustainable Growth," Economist, January 2001, p. 77.

[52] Economist, "Green and Growing: Sustainable Growth," p. 77.

[53] GLT Environmental Task Force, 2001 Environmental Sustainability Index, p. 15.

CHAPTER 4

ENVIRONMENTAL TRENDS AND LINKAGES

Futurists, scholars, and pundits offer conflicting visions of the global environment and humankind well into this century. Technological advances will most certainly provide more cost-efficient and less polluting systems, but it is difficult to project beyond a single generation the impact that such advances will have in solving many current and projected environmental problems. Optimists who suggest such advances, coupled with the "resilience, variability, and adaptability"[54] of society, as a panacea may be placing future unborn generations at risk. Based on observed consumption patterns and unbridled economic growth of Western democracies, Neo-Malthusians, deep-ecologists, and others with comparable opposing viewpoints suggest the earth's carrying capacity is fast approaching. They are especially alarmed by similar trends among less developed and transitional economies, many with burgeoning populations, vying to improve their standards of living and to share in any future distribution of wealth. This chapter identifies major environmental stressors reportedly facing many nations over the next two decades, and the linkages between the environment, wealth, and governance that, when pinned together, form a "framework of stability" that will be developed in the next chapter.

A. Environmental Outlook

The National Intelligence Council, in what was admittedly a non-traditional approach, issued an assessment on global trends through 2015 in collaboration with outside experts from academia, think tanks, and business. "Natural resources and environment" was among the 7 "global drivers" identified as important in shaping the next 15 years.[55] Nation states will remain the dominant actors on the world stage, however, national governments will have less control over information flow; while non-state actors, representing the interests of business, non-governmental organizations (NGOs), and other international organizations, will be increasingly influential at both the national and international level. While the United States will remain the major international economic and military power, "diplomacy will be more complicated" making it difficult to harness this power to achieve policy goals.[56]

The world's population is expected to reach 7.2 billion by 2015, an increase of over one billion from the year 2000, with most nations experiencing increased life expectancies.[57] *Global Trends 2015* estimates that 95 percent of this population growth will be in developing countries, with most of the increase occurring in urban areas. This combination of growth and rapid urbanization is seen as fostering instability in already weakened states.[58] The growth of "youth bulges,"[59] in combination with weakening economies, will also be a destabilizing force in several regions, such as Sub-Saharan Africa and the Middle East.

---

[54] Thomas Homer-Dixon, Environment, Scarcity, and Violence (Princeton NJ: Princeton University Press, 1999), p. 25.

[55] National Intelligence Council, Global Trends 2015: A Dialogue About the Future with Nongovernment Experts, NIC Paper 2000-02, December 2000, p. 5.

[56] National Intelligence Council, Global Trends 2015, p. 13.

[57] National Intelligence Council, Global Trends 2015, p. 8.

[58] National Intelligence Council, Global Trends 2015, p. 8.

[59] "A country is considered to have a youth bulge if the ratio of population aged 15 to 29 to the population aged 30 to 54 exceeds 1.27." National Intelligence Council, Global Trends 2015, p. 25.

While total world population is increasing, the actual rate of growth is expected to decline from 1.3 percent to about 1 percent in 2015.[60] This downward trend is similar for the more developed as well as the less developed nations. Growth rates will vary significantly between nations, especially the less developed, based on a number of social, economic, and cultural factors. At least for the foreseeable future, these rates will need to be watched very closely as one of the key indicators of instability. It has also been suggested that the world is about to confront a "global baby bust." What was once a population explosion should be rethought in terms of a "population implosion,"[61] as evidenced by the birthrates of modern societies that are now well below the replacement rate of 2.1 children per woman [couple].[62] Consequently, the actual growth of the world population, and its impact on the earth's natural resources, is being hotly debated.[63] Absent natural or technological catastrophes and major world wars, well over one-third of today's population will still be alive in 2050.[64]

Environmental stressors are seen as worsening, especially where exacerbated by rapid population growth, urbanization, and economic development. Deforestation, continued pollution, and the need for additional croplands will increase loss of habitats and, thus, loss of biodiversity, e.g., species. Intensive land practices will contribute to soil degradation and continued loss in arable land. Climate warming will remain a major issue for the foreseeable future, while a 50-year global effort to restore stratospheric ozone is viewed as "on track."[65]

Whereas the National Intelligence Council study approached its assessment from the viewpoint of a national security policy maker, the OECD released its *Environmental Outlook* to 2020 from an entirely different "economy-based" perspective.[66] The report suggests that the context of environmental policy making has been evolving over recent decades, shifting from issues primarily focused on short-term public health threats to those issues with the potential to threaten "strategic natural resources and common resources." The following issues were seen as becoming important over the next 25 years, requiring new policy tools to address issues typically more diffuse, long-term, and with more difficult strategic tradeoffs:[67]

---

[60] National Intelligence Council, Global Trends 2015, p. 19.

[61] Nicholas Eberstadt, "The Population Explosion," Foreign Policy, March-April 2001. 19 March 2001 <http://www.foreignpolicy.com/issue_marapr_2001/eberstadt.html>, pp. 1-8.

[62] Max Singer, "Global Population Will Decrease After 2050," Population: Opposing Viewpoints [excerpted from the Atlantic Monthly, August 1999], (San Diego: Greenhaven Press, 2000), p. 75.

[63] A number of interesting and opposing positions on the question of whether there is a population problem are presented in Population: Opposing Viewpoints, pp. 16-142.

[64] Homer-Dixon, Environment, Scarcity, and Violence, p. 10.

[65] National Intelligence Council, Global Trends 2015, p. 31.

[66] Organisation for Economic Co-Operation and Development, OECD Environmental Outlook (Paris: OECD Environmental Directorate, 2001), p. 28.

[67] OECD, OECD Environmental Outlook, p. 28.

- Climate change - greenhouse gas emissions.
- Food security (topsoil) – soil degradation, loss of habitat, harmful subsidies.
- Fisheries – exploitation, harmful subsidies, degradation of marine ecosystems.
- Forests – increasing demand for wood products, degrading quality, monoculture.
- Biodiversity – natural ecosystems destroyed or altered, pollution, exotic species.
- Water – freshwater scarcity and pollution.
- Biotechnology – genetically-modified organisms.

The OECD's report, while significantly more detailed than *Global Trends 2015*, reaches similar conclusions about future major environmental stressors. Likewise, the EU's recent state-of-the-environment report, *Environment in the European Union at the Turn of the Century*, is also generally issue- and sectoral-based. The EU report includes an assessment of "future pressures" by major issue, using a similar valuation system to that of the OECD, e.g., a green, yellow, or red color to denote either a positive, insufficient, or unfavorable development across each of the major environmental issues. [68] The EU's ratings up to 2010 are also generally comparable to those made by the OECD, and are as follows:

- Climate change – unfavorable development [rated thru 2050].
- Ozone depletion – some positive development but insufficient [rated thru 2050].
- Hazardous substances – unfavorable development.
- Transboundary air pollution – some positive development but insufficient.
- Water stress – some positive development but insufficient.
- Soil degradation – unfavorable development.
- Waste generation and management – unfavorable development.
- Natural and technological hazards – uncertain, lack of expert analysis.
- Genetically modified organisms – uncertain, lack of expert analysis.
- Biodiversity – unfavorable development.
- Human health – some positive development but insufficient.
- Urban areas – some positive development but insufficient.
- Coastal and marine areas – unfavorable development.
- Rural and Mountain areas – uncertain, lack of expert analysis.

The National Intelligence Council, OECD, and EU assessments all reach similar conclusions as to which environmental stressors will be prevalent over the next 20 years. As will be seen in the next chapter, these stressors are important, albeit indirect, contributors to stability when combined with other socioeconomic and political factors.

---

[68] European Environment Agency, Environment in the European Union at the Turn of the Century, (Copenhagen: EEA, 2000), p. 23.

B. Wealth and Democratization

It has been recommended that the wealth of a nation be more broadly defined in terms beyond that of produced assets, the common measure of wealth, to include human and social capital, and devaluation of the natural resource base. The World Bank has prepared a report that explores potential indicators of sustainable development based on this newly expanded definition.[69] Properly valuing these forms of capital is difficult and beyond the scope of this paper. Consequently, macroeconomic variables of economic condition, such as Gross Domestic Product, will be used throughout as indicators of the wealth of a nation state.

TABLE 4-1

INDICATORS OF WEALTH, DEMOCRACY, AND CORRUPTION

Country	1998 GDP/capita (in '95 US $)	Democracy Rating	Corruption Rating
Hungary	4,920	1.75	2.50
Poland	3,877	1.44	2.25
Czech Republic	5,142	1.75	3.25
Slovakia Republic	3,822	2.50	3.75
Slovenia	10,637	1.94	2.00
Croatia	4,846	4.19	5.25
FYR Macedonia	1,349	3.44	5.00
Bulgaria	1,372	3.31	4.75
Romania	1,310	3.19	4.25
Moldava	614	3.88	6.00
Albania	795	4.38	6.00
Russian Federation	2,138	4.25	6.25
Ukraine	837	4.31	6.00
Belarus	2,198	6.44	5.25
Armenia	892	4.50	5.75
Azerbaijan	431	5.50	6.00
Estonia	3,951	2.06	3.25
Latvia	2,328	2.06	3.50
Lithuania	2,197	2.00	3.75
Georgia	703	4.00	5.00
Correlation		(1) r = -0.55	(2) r = -0.75

(1) Democracy & GDP/capita
(2) Democracy & Corruption
Democracy ratings and corruption scores are provided by Freedom House *Nation's in Transit 1999-2000* Report; data is for year 1999.

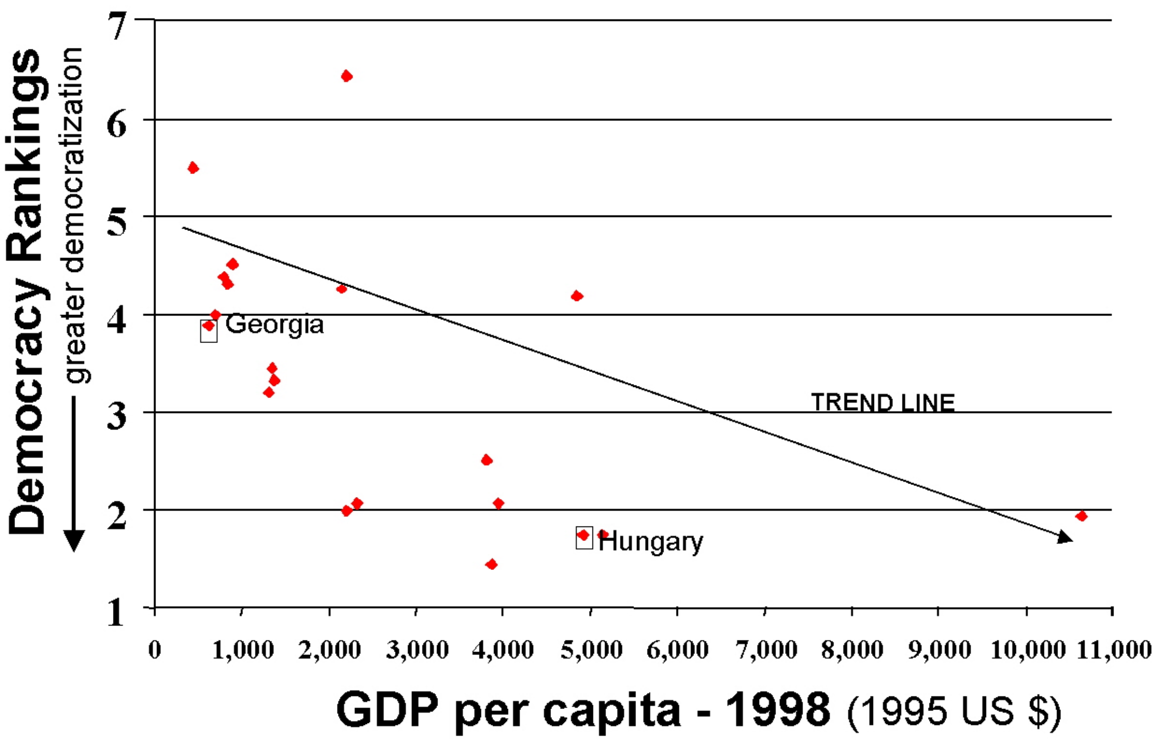
[69]The World Bank defines human and social capital as follows: "Human capital is the knowledge, experience, and skills embodied in a nation's populace [whereas] social capital consists of the norms, networks, and organizations through which people gain access to power and resources, and through which decision making and policy formulation occur." World Bank, Environmental Department, Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development, (Washington DC: World Bank, 1997), pp. 13 and 78.

In their most recent report of *Nations in Transit,*[70] Freedom House comprehensively reports on certain key economic and political indicators for the states of Central Europe and Eastern Europe and the Russian Federation. Table 4-1 lists GDP per capita, democracy ratings, and corruption scores for the countries being considered in this paper. These scores for democratization were based on an average of several other ratings, e.g., political process, civil society, independent media, and governance and public administration. The resulting score for each of these countries is not that dissimilar from that reached by averaging the two scores from Freedom House's other annual survey for "political rights" and "civil liberties."

The level of democratization is shown as a function of economic development in Figure 4-1. The general trend, although not strongly correlated, suggests that greater national output per capita is more likely in a more democratic state. A stronger correlation is evident in Figure 4-2 (next page), when comparing corruption and democratization for each of the nations being considered in this paper. It is important to note that the sloped lines shown for each figure is provided as an indication of general trend, not as a line of best fit for the data.

Figure 4-1

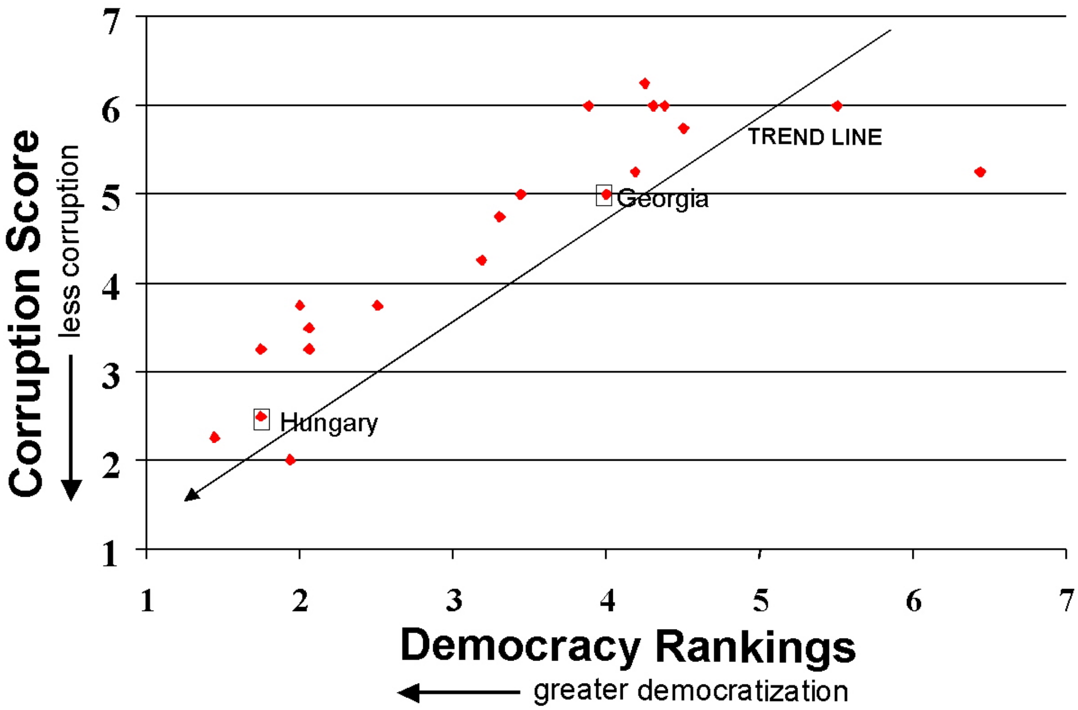
Wealth and Democratization



70 Freedom House, Nations in Transit: 1999-2000, 28 April 2001 <http://www.freedomhouse.org/research/nitransit/2000/ pdf_docs.htm>, p. 9.

Figure 4-2

Corruption and Democratization



The results of the *Nations in Transit* report led Freedom House to suggest that, “economic and political reform appear to go hand in hand.”[71] A similar finding is presented in the European Bank for Reconstruction and Development’s (EBRD) *Transition Report* for 1999, which shows a very strong positive correlation between economic reform and democratization.[72] Economic reform was measured using internal EBRD “transition indicators” that measure specific aspects of the economic transition process, e.g., degree of privatization, enterprise restructuring, and price liberalization. Democratization was measured by the EBRD using Freedom House’s annual survey for “political rights” and “civil liberties.”

Another popular measure of democratization employs the Polity Dataset, which is currently maintained at the University of Maryland’s Center for International Development and Conflict Management (CIDCM).[73] The Polity III Dataset was found to be highly correlated with Freedom House’s “political rights” and “civil liberties” datasets, and was used extensively by Jaggers and Gurr to track global and regional democratization trends.[74]

---

[71] Freedom House, Nations in Transit: 1999-2000, p. 14.

[72] The EBRD produces an annual *Transition Report* on the status of the nations of Central and Eastern Europe, the Baltic States, the Russian Federation, and the Newly Independent States. European Bank for Reconstruction and Development, Transition Report 1999: Ten Years of Transition (London: EBRD, 1999), p. 113.

[73] Earlier versions, e.g., Polity II and III, have been updated recently with the Polity IV Dataset. University of Maryland, Center for International Development and Conflict Management, Polity IV Project: Dataset and User’s Manual, 26 March 2001 <http://www.bsos.umd.edu/cidcm/polity/polreg.htm>.

[74] Keith Jaggers and Ted Robert Gurr, "Tracking Democracy's Third Wave with the Polity III Data," Journal of Peace Research No. 4 (1995), pp. 469-482.

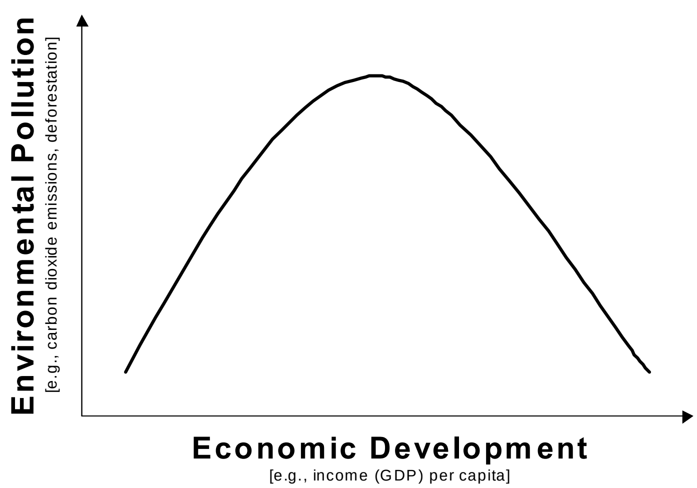
Jaggers and Gurr found a precipitous drop in the number of highly autocratic societies since the end of World War II, while the reverse is true, as evidenced by the growth in the number of coherent democracies. The researchers caution that those countries that are neither fully autocratic nor democratic (i.e., incoherent polities) are "particularly vulnerable to institutional crisis and a return to coherent autocratic rule."[75] Kaplan has suggested that "democracy may do its best job when it emerges last," and that stability must be maintained during economic and political transition for democracy to flourish.[76] That partial democracies are at particular risk to failure will be discussed in the next chapter.

C. Economic Development and the Environment

It has been postulated that the relationship between economic development, in terms of income per capita, and environmental quality is best represented by an inverted U-shaped curve known as the Environmental Kuznets Curve (EKC). The EKC recognizes the analogous relationship between social inequality and economic development suggested by the work of Simon Kuznets in 1955, from which it was adapted. The EKC is illustrated in Figure 4-3, reflecting the underlying hypothesis that the income-environment relationship, "whether positive or negative, is not fixed along a country's development path [and] indeed it may change sign from positive to negative as a country reaches a level of income at which people demand and afford more efficient infrastructure and a cleaner environment."[77] The policy implications of the EKC hypothesis are significant and have met with controversy. For example, the EKC has been oversimplified in justifying rapid economic development so as to move rapidly beyond a period of unfavorable environmental degradation.

Figure 4-3

Environmental Kuznets Curve



[75] Jaggers and Gurr, "Tracking Democracy's Third Wave with the Polity III Data," p. 479.

[76] Robert D. Kaplan, "2001 Jerome E. Levy Lecture in Economic Geography and World Order," Lecture Notes (Newport RI: Naval War College, 9 April 2001).

[77] Theodore Panayotou, "Economic Growth and the Environment," Center for International Development at Harvard - Working Papers No. 56, July 2000, p. 5.

In an effort to better understand the relationship between economic development and environment quality, Panayotou recently completed a critical review and synthesis of the literature, which included a review of different empirical approaches relating selected indicators of environmental degradation to income per capita. Some of the studies used single environmental indicators, e.g., carbon dioxide emissions, deforestation, and urban sanitation, while others used "composite indexes of environmental degradation."[78] Many of the selected studies, while supportive of the EKC for certain pollutants, suggested that environmental degradation may also increase linearly upward or downward with income, depending on the indicator of environmental degradation under consideration.[79] Policy response is dependent on the specific income-environment relationship. If the observed relationship were linear upward, then strict environmental regulations would likely be needed with consideration given to controlling economic growth. If the income-environment relationship were linear downward, then a "hands-off" policy would be warranted, since any action would be counterproductive to improving environmental conditions. Other researchers have even hypothesized a "two-hump" curve as a means of better describing the relationship between environmental degradation and income per capita.[80]

Panayotou's exhaustive review, however, concluded "the macroeconomic models generally support the empirical findings of the Environmental Kuznets Curve literature."[81] Admittedly, he also suggested that the EKC is still not representative of all pollutants since it is based on an empirical relationship. Bradford et al., using a new specification, also reached a similar conclusion that supports the EKC for some pollutants but rejects it for others.[82]

Panayotou also suggested that there may be nothing "inevitable or optimal" regarding the shape and height of the EKC and that the "downturn of EKC with higher incomes may be delayed or advanced, weakened or strengthened by policy intervention."[83] Additionally, it might take decades to transit through the unfavorable period of environmental degradation to reach the downward slope of the EKC. This would place the environment and the future value of depleted natural resources at considerable risk that would not be economically justified in the long-term. Further, the higher the peak of the EKC, the greater the risk that an "ecological threshold" might be irreversibly crossed, e.g., species extinction, denuding of forests.[84] In this case, policies should be implemented that would help to ensure that the EKC is lowered sufficiently below the ecological threshold by the elimination of subsidies that support such destructive practices or by the introduction of green accounting practices that internalize environmental costs. Such approaches are not discussed in detail in this paper.

---

[78] Panayotou, "Economic Growth and the Environment," p. 8.

[79] Panayotou, "Economic Growth and the Environment," pp. 16-20.

[80] Alan Bousquet and Pascal Favard, "Does S. Kuznets' Belief Question the Environmental Kuznets Curves?", 6 November 2000. 15 March 2001 <http://idei.asso.fr/Commun/WorkingPapers/F2000/107-00.pdf>, p. 1.

[81] Panayotou, "Economic Growth and the Environment," p. 1.

[82] David F. Bradford, Rebecca Schlieckert, and Stephen H. Shore, "The Environmental Kuznets Curve: Exploring a Fresh Specification," National Bureau of Economic Research Working Paper, No. W8001, November 2000. 15 March 2001 <http://www.nber.org/papers/w8001>: 19-20.

[83] Panayotou, "Economic Growth and the Environment": 60.

[84] Panayotou, "Economic Growth and the Environment": 61.

As regards international trade and the environment, Panayotou suggests there is little support for concluding the downward sloping portion of the EKC at higher income is a direct result of the “pollution-haven hypothesis,” that is, that developed countries are relocating their polluting activities to those developing countries having less stringent environmental regulations than themselves. Rather, the researcher concludes that, in general, “open economies tend to be cleaner than closed economies” and, that while production patterns in developed nations have led to improved environmental conditions, consumption patterns remain a future concern.[85]

The poverty-environment interaction has also been the subject of much study and controversy following the influential Brundtland Commission, where poverty was seen as a major underlying cause of global environmental degradation. There has since been a widespread belief that the poor must often exploit their renewable resources to survive and, thus, are most at risk from such exploitation and other environmental degradation.

The World Bank’s Environment Group responsible for the Africa Region has continued to explore this poverty-environment linkage using selected environmental indicators. In a discussion paper entitled *Poverty and Environment: Evidence of Links and Integration into the Country Assistance Strategy Process*, the authors tested the following set of hypotheses using empirical examples, arguments, and other evidence:[86]

- H1: Poor people are the main victims of a bad environment -“victims hypothesis.”
- H2: Poor people are agents of environmental degradation.
- H3: Higher incomes increase some environmental pressure.
- H4: Incomplete property rights reinforce the vicious poverty-environment circle.
- H5: Population pressure exacerbates both poverty and environmental degradation.

The researchers found support for their first four hypotheses. Using South Africa as a case study, inequality in wealth was shown to reinforce environmental pressure.

The third hypothesis runs counter to the findings reached by several other researchers, as presented in the literature review by Panayotou. The World Bank discussion paper provides several examples to support the hypothesis that higher incomes can increase environmental pressure. Examples include worsening of air pollution results from an increasing pool of automobiles in developing countries and elevated levels of carbon emissions results from increasing use of fossil fuels. The World Bank authors acknowledged the possibility of the EKC, but they caution that, where such an inverted-U relationship exists, it “may very well be influenced by policies, and should not be taken as an excuse for a laissez-faire attitude; [that is] it is not a given that one ‘must wait’ for a certain income level before taking measures to mitigate environmental loss.”[87] The authors further caution that even in cases where their hypothesis is invalidated, (for example, if pollution were to decline at a higher income) the effect of environmental degradation is “still positive and may be cumulative.”[88]

---

[85] Panayotou, “Economic Growth and the Environment”: 32-33.

[86] Anders Ekbom and Jan Bojo, Poverty and Environment: Evidence of Links and Integration into the Country Assistance Strategy Process, Discussion Paper No. 4 (Environmental Group, Africa Region, The World Bank, 1999), pp. 3-14.

[87] Ekbom and Bojo, Poverty and Environment, p. 10.

[88] Ekbom and Bojo, Poverty and Environment, p. 10.

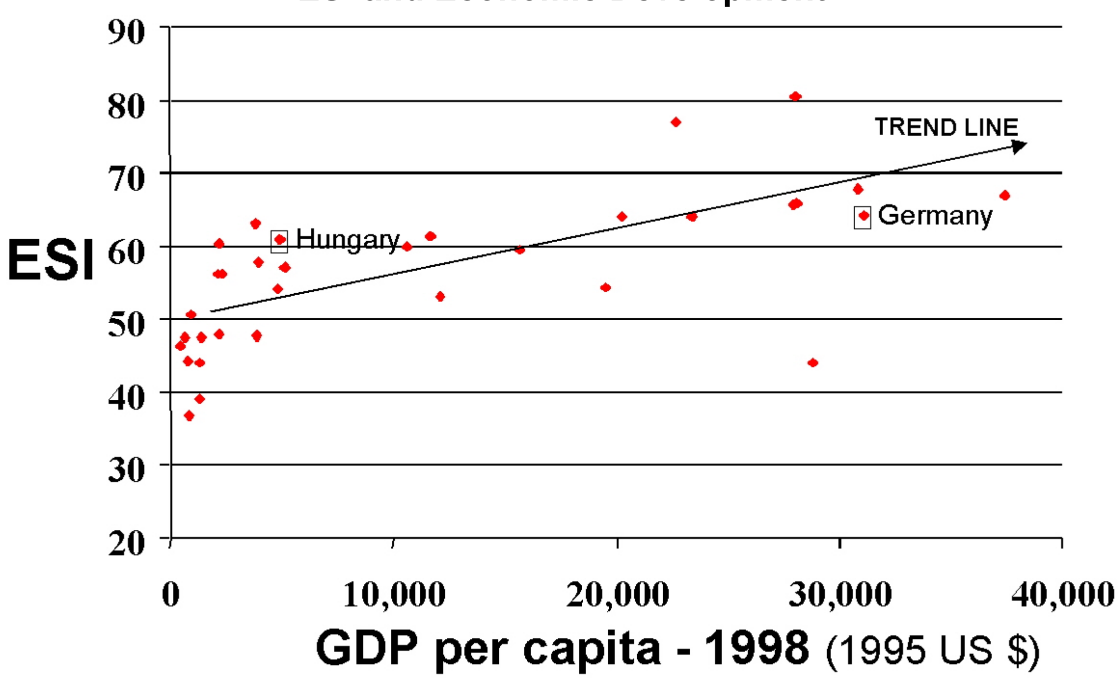
Interestingly, the World Bank concluded that the fifth hypothesis was not supported by available evidence; specifically, that "it is not possible, *a priori*, to say that population growth or high density will result in environmental degradation."[89] It is acknowledged, while not being the root cause of this degradation, population growth is a major factor in determining both the quality and quantity of natural capital. Thus, the policy implications required are suggested to be more market-improvement oriented rather than population control.

In exploring the relationship between poverty and environment, the World Bank could not confirm with any certainty the underlying causation, e.g., whether poverty causes environmental degradation or vice-versa. However, it believes there is "enough experience worldwide to conclude that the two characteristics are commonly associated."[90]

Whereas the above income-environment relationships typically have utilized selected single environmental indicators to measure the extent of pollution with increases in per capita income, the following discussion explores possible relationships between income and the Environmental Sustainability Index (ESI) and the Sustainable Development Index (SDI) that were previously introduced in Chapter 3. Information is taken from Table 3-1 to graph the income-single index relationships and to determine if the variables exhibit a particular trend.

Figure 4-4

ESI and Economic Development



The relationship between the ESI and per capita income is depicted in Figure 4-4 for the select countries of the Council of Europe listed in Table 3-1. A strong correlation, r = 0.67, between ESI and income was found for the nations under consideration. This would seem to support the ESI report's finding that "clearly levels of per capita income exert a significant

---

[89] Ekbom and Bojo, Poverty and Environment, p. 13.

[90] World Bank, Expanding the Measure of Wealth, pp. 3 and 94-98.

effect on environmental sustainability as measured by the ESI."[91] An upward sloping arrow is also depicted to help reinforce this relationship but, as previously mentioned for an earlier figure, this is provided only to show a general trend and should not be construed as a line of best fit for the data. Of the three reference countries, only Hungary and Germany are highlighted in the figure, as an ESI value was not available for Georgia. The nations of South East Europe and the Caucasus, Ukraine, and Belarus are tightly grouped at the lower portion of the figure, depicting a lower valued ESI and per capita income.

The precise relationship between income-ESI, however, requires additional attention. In the original ESI report, for example, a similar strong relationship was found between ESI and income. However, the relationship between the index and economic growth, measured as the percentage change in per capita income, was only weakly correlated. This led the ESI researchers to conclude that "economic growth rates, in spite of common complaints about their impacts on the environment, are in general not consistently associated with poor environmental performance [suggesting] that countries that are growing quickly need not degrade their environments."[92] The ESI report also found that for countries of similar economic development, some manage the environment better than others. This is evident when comparing Belgium and the Netherlands, each having relatively equivalent income levels but significantly different values of ESI, 44.1 and 66.0, respectively, as provided in Table 3-1. The ESI researchers suggest no tradeoff is needed when it comes to making choices between "environmental and economic performance [rather] the choices appear to be distinct and separable [that] high levels of environ mental performance are compatible with high levels of economic growth, and may even encourage the innovation that supports growth."[93]

In a separate annual report published by the World Economic Forum, a strong correlation between the ESI and the 2000 Current Competitiveness Index was also found.[94] This report concluded that strengthening environmental regulation could lead to increased environmental improvement without adversely impacting [microeconomic] competitiveness.

The relationship between the SDI and per capita income is depicted in Figure 4-5 (next page) for the select countries of the Council of Europe listed in Table 3-1. A weaker correlation, r = 0.48, between SDI and income was found as compared to the relationship between ESI and income. Again, a sloped arrow is provided to reflect what appears to be a general upward trend in overall sustainable development with increasing per capita income. The three reference countries of Georgia, Hungary, and Germany are depicted in the figure. Again, there appears to be a clustering of developing nations similar to that observed in the previous figure. Interestingly, a very weak correlation, r = -0.22, was found between the "environmental component" of the SDI and per capita income, as reflected in the scatter-plot shown in Figure 4-6 (next page). No attempt was made to provide a trend line for this comparison.

---

[91] Global Leaders for Tomorrow Environmental Task Force, World Economic Forum, 2001 Environmental Sustainability Index, Report to Annual Meeting (Davos, Switzerland, 2001) <http://www.ciesin.columbia.edu/indicators/ESI/downloads.html>, p. 15.

[92] GLT Environmental Task Force, 2001 Environmental Sustainability Index, p. 14.

[93] GLT Environmental Task Force, 2001 Environmental Sustainability Index, pp. 16-17.

[94] Michael E. Porter, Jeffrey D. Sachs, Andrew M. Warner, Peter K. Cornelius, Macha Levinson, and Klaus Schwab, ed., The Global Competitiveness Report 2000 (New York: Oxford University Press, 2000), p. 63.

Figure 4-5

SDI and Economic Development

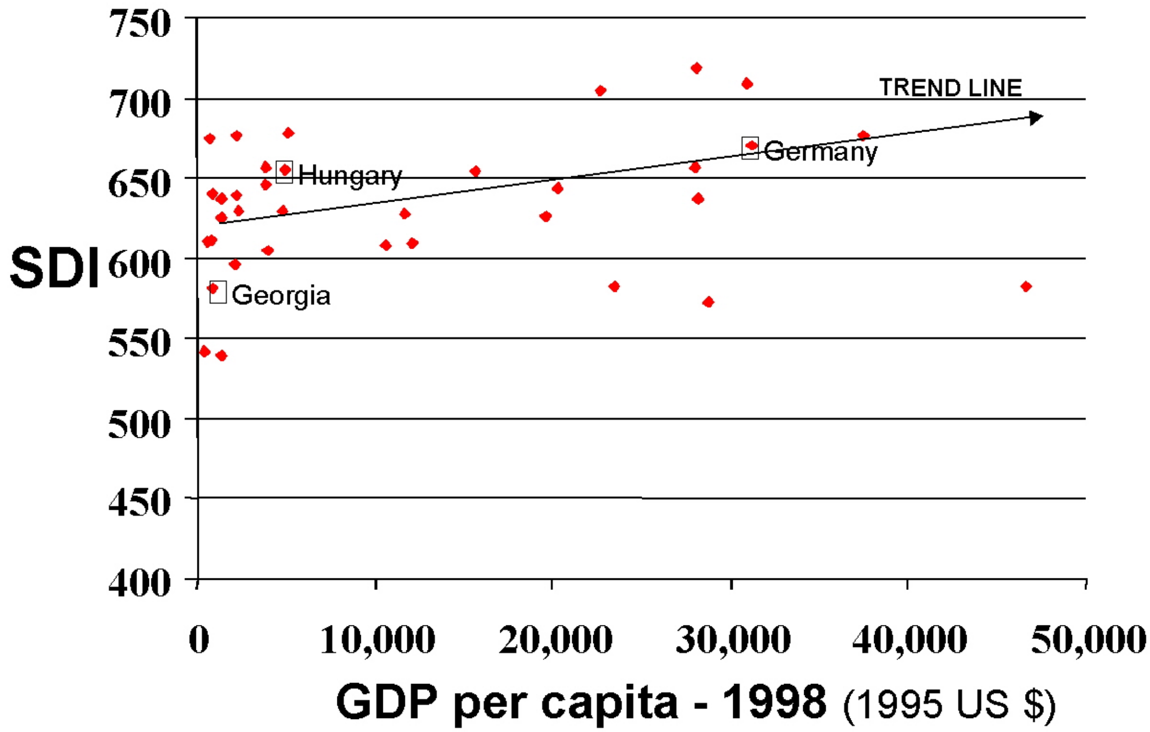
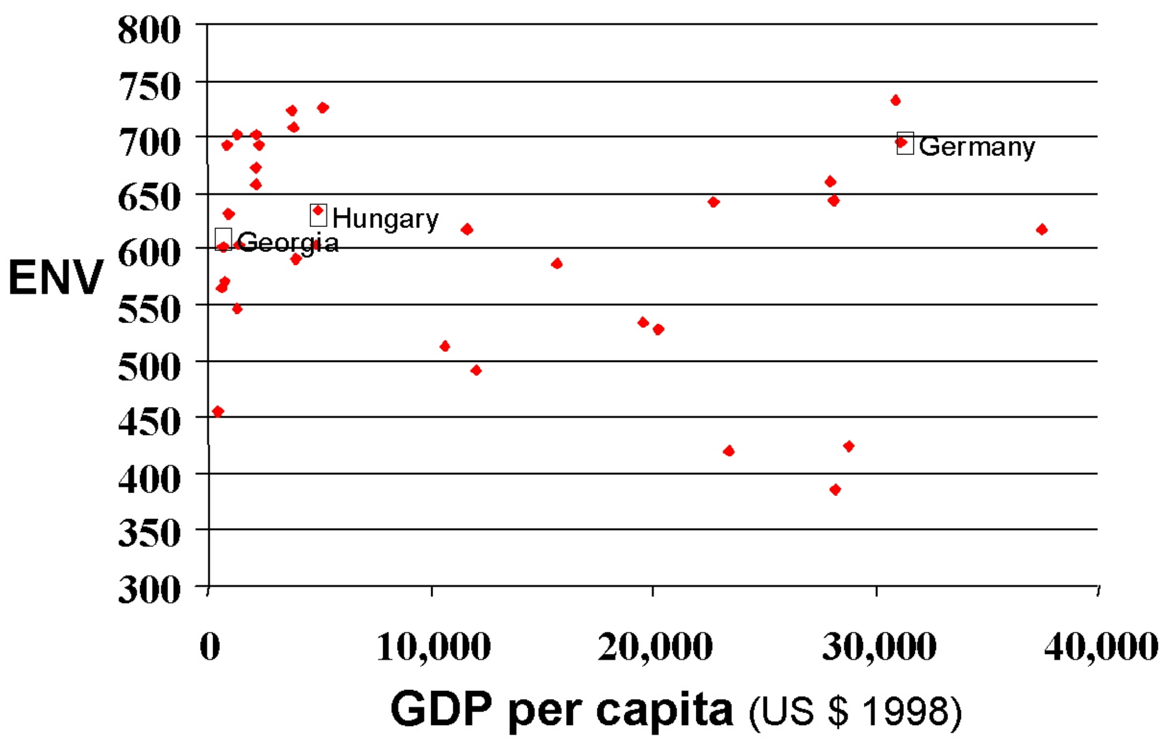


Figure 4-6

SDI Environmental Dimension



The aforementioned studies and reports suggest that environmental quality can be achieved with economic reform and that this improvement does not necessarily have to come at the expense of economic competitiveness. Economic reform, however, is not a panacea. In a policy brief entitled *Environmental Trends in Transition Economies,*[95] the OECD highlights the efforts made by Central and Eastern European countries to adopt a regional Environmental Action Plan following the fall of communism. While it is acknowledged that economic reform can generate “efficiency gains” that will reduce pollution and other environmental pressures, what is needed are reforms to “eliminate the perverse incentives that generated many of the environmental problems of centrally planned economies” and “effective environmental policies, institutions, and investments to harness the forces of market reform.”[96] The importance of such institutional capacity is discussed in the next section.

D. Governance and the Environment

The term governance as used in this paper reflects the associated institutional capacity necessary to govern effectively and responsibly and, thereby, to respond to environmental stress in a timely manner by leveraging national and other regional resources. As previously discussed, and as illustrated in Figures 4-1 and 4-2, democratic governance is characterized as relatively less corrupt and generally more economically advanced. Interestingly, the aforementioned ESI report found that the variable that measured the “reduction in corruption” had the highest correlation, r = 0.75, with the ESI. This led the ESI researchers to conclude, “good governance broadly conceived enhances environmental sustainability.”[97]

The relationship between democracy and environment has been a subject of some debate in the literature, especially in the wake of recent democratization. Using empirical analysis, Gleditsh and Sverdrup argue that democratic institutions are more effective in responding to national environmental problems and stressors, and are better at participating in cooperative ventures at the international level in solving global environmental problems than are autocratic societies.[98] The selection of environmental indicators for use in their study was, admittedly, not a simple matter because applicable international data sets are still in an elementary stage and not easy to find for many non-democracies or for those nations that had recently transitioned to a democracy. It was also recognized that the use of only one or two indicators would be insufficient in assessing environmental performance.

Consequently, Gleditsh and Sverdrup selected a set of what they termed direct and indirect problem environmental indicators. The researchers used the aforementioned Polity III Dataset to derive their measure of democracy. The bivariate analysis explored the relationship between democracy and environment, using different environmental indicators. A positive relationship was found for a majority of the environmental indicators, such as deforestation, biodiversity of mammals, and water and sanitary services; however, a negative relationship was observed for the emission of climate gases, especially carbon dioxide.

---

[95] Organisation for Economic Co-Operation and Development, Environmental Trends in Transition Economies, Policy Brief (Paris: OECD, 1999).

[96] OECD, Environmental Trends in Transition Economies, p. 2.

[97] GLT Environmental Task Force, 2001 Environmental Sustainability Index, pp. 13-14.

[98] Nils Petter Gleditsh and Bjorn Otto Sverdrup, "Democracy and the Environment," Paper Presented to the Fourth National Conference in Political Science (Geilo, Norway, January 1996).

The researchers analyzed the carbon dioxide variable in more detail in a multiple regression involving four independent variables: GDP per capita, oil production, the Human Development Index discussed in Chapter 3, and democracy rating. The results suggested "democracies have lower CO_2 emissions than non-democracies after the effects of the level of development and oil production have been isolated" and, as confirmed from other analyses, that "democracies tend to be less harmful to the environment than non-democracies."[99]

Midlarsky conducted a similar empirical assessment, employing multiple regression analyses throughout and similar environmental indicators, but reached different conclusions. He found no uniform relationship between democracy and the environment.[100] In contrast to what had been hypothesized, the association between democracy and indicators of carbon dioxide emissions, deforestation, and soil erosion by water were found to be significantly negative, while no significant correlation was found with respect to freshwater availability and soil erosion by chemicals. Of the six environmental indicators considered in his study, only protected land area demonstrated any positive relationship with the democracy variable.

It is noteworthy that both the Gleditsh and Sverdrup and Midlarsky studies provided caveats as to the insufficiency of an international set of environmental indicators available for use in their analyses. This was of particular concern for the relatively new democracies.

There is a growing consensus that there is "some kind of positive linkage" between democracy and environmental quality.[101] Panayotou, for example, experimented with different indicators reflective of institutional quality as proxies representing environmental policies in order to determine their resulting impact on environmental quality, such as sulfur dioxide emissions. Improvements in the quality of institutions were found to lead to enhanced environmental performance, suggesting that "the efforts of pro-environmental reforms should focus on improving the quality of institutions and policies rather than attempting to slow down economic or population growth."[102]

The relative strength of relationships between each pairing of dimensions— environment, wealth, and institutional governance—was discussed in this chapter, and was generally found to be positive. These components will be examined further in the next chapter to determine how they might individually, or in some combination, contribute to instability and possibly state failure. A Stability Pyramid is also proposed in Section C of Chapter 5 to help simplify what will be shown to be a very complex multi-dimensional relationship among these same three components, or dimensions. A balanced Core Set of applicable indicators is also proposed that is believed representative of the environment, socioeconomic, and institutional dimensions that comprise this simplified framework.

---

[99] Gleddish and Sverdrup, "Democracy and the Environment," p. z.

[100] Manus I. Midlarsky, "Democracy and the Environment: An Empirical Assessment," Journal of Peace Research No. 3, May 1998, p. 358.

[101] Wenche Hauge and Tanja Ellingsen, "Beyond Environmental Scarcity: Causal Pathways to Conflict," Journal of Peace Research No. 3, May 1998, p. 304.

[102] Reference is made to an earlier 1997 study conducted by the same author. Panayotou, p. 66.

CHAPTER 5

FRAMEWORK FOR ASSESSING STABILITY

The reasons why certain nation states fail while others succeed have long perplexed senior policy makers. This has become increasingly important since the end of the Cold War with the emergence of many newly independent states. It has only been within the last few years that the stressors associated with environmental change have received significant attention as to their contributions to both national and regional instability. Prior focus had been on the more recognized and, thus, better-understood social, economic, and political factors. This chapter will review several conceptual and mathematical models developed to explain the factors that lead to a weakened and, if not ultimately strengthened, failed state. A framework for viewing stability–the Stability Pyramid–is proposed for use as a "simpler" tool for communicating the complex linkages between the major contributory stressors: socioeconomic, political, and environmental. Emphasis in this chapter is placed on the linkage between environmental stress and the stability of nation states. Social scientists commonly approach the study of this linkage from either a strict statistical perspective, or employ a more descriptive approach. This chapter examines several of the more relevant and interesting studies in some depth.

A. Conceptual Models of Causality

Among the most quoted, and often debated, research in this area is that emanating from the Peace and Conflict Studies Program at the University of Toronto. In a seminal book entitled *Environment, Scarcity, and Violence,*[103] the author examines the causal links between these same factors and proposes the "Core Model" depicted in Figure 5-1 (next page). Researchers have regularly cited earlier versions of the environmental scarcity model, however, this latest version is a marked improvement in helping to highlight the complex nature of the causal relationships, illustrated by the various feedback loops and different stages for intervention.

The term "environmental scarcity" as used in the Core Model reflects the scarcity of renewable resources, e.g., fish stocks, croplands, resulting from one or more of the following:

- Depletion or degradation of renewable resources - supply-induced scarcity."
- Increased consumption of renewable resources – "demand-induced scarcity."
- Unequal distribution of renewable resources – "structural scarcity."

The Core Model is helpful in illustrating how the multiple effects of environmental scarcity might "weaken" a nation state, especially in poorer and less developed countries. This weakening only further reduces the capacity for the state to either adapt or respond with the technical ingenuity needed to address the environmental scarcity (see Second Stage Interventions).[104] Importantly, should the scarcity become irreversible, it could easily become a continuing burden on the socioeconomic and political fabric, i.e., stability, of the nation state. The Core Model served as the baseline from which a simpler framework of stability will be developed later in this chapter as a means for more easily assessing stability, communicating that status to policy makers, and structuring an appropriate intervention.

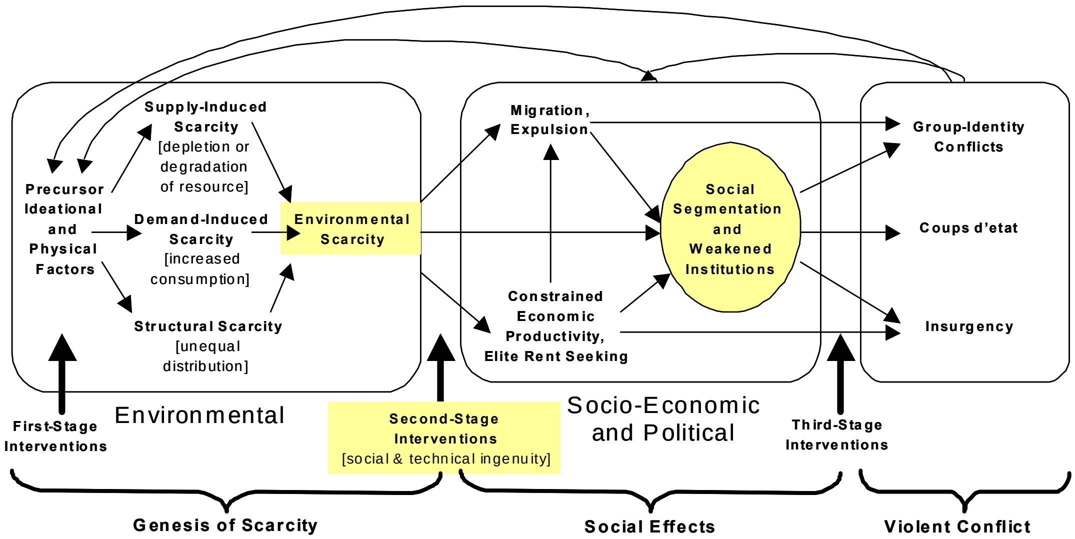
---

[103] Thomas Homer-Dixon, Environment, Scarcity, and Violence (Princeton NJ: Princeton University Press, 1999), p. 134.

[104] Homer-Dixon, Environment, Scarcity, and Violence, p. 98.

Figure 5-1

Homer Dixon Core Model of Casual Links



Source: Adapted from Homer-Dixon, Environment, Scarcity, and Violence, 1999

The Toronto research team employed a method of "process tracing," a step-by-step analysis of the causal processes across a variety of national and regional case studies, in an effort to identify general patterns associated with the environmental-conflict linkage.[105] Specifically, the research focused on investigating "if" and "how" environmental scarcity contributes to violent conflict and, if so, the significance of its contribution. Individual case study results have typically been reported in a descriptive or narrative fashion.[106] These cases suggest that environmental scarcity is mainly an indirect cause of violent conflict. Further, any conflict resulting from such environmental scarcity will most likely be contained within the borders of the nation state.[107] Another important conclusion reached from this extensive body of case studies was that "environmental scarcity by itself is neither a necessary nor sufficient cause of violent conflict."[108] Rather, "it always joins with other economic, political, and social [contextual] factors to produce its effects."[109] This multi-dimensional relationship forms the basic framework of the Stability Pyramid proposed later in this chapter. Among the most threatening environmental scarcities identified by the Toronto research team was loss of cropland, freshwater, biodiversity, and deforestation. These and other threats were also considered in the selection of applicable indicators to be used in the Stability Pyramid.

---

[105] Homer-Dixon, Environment, Scarcity, and Violence, p.9.

[106] The Toronto research team has published a number of case studies on individual countries. In the specific case study of South Africa, environmental scarcity was found to have played a role in the turmoil, e.g., social instability, which preceded national general elections. The contribution of environmental scarcity to violence was reportedly difficult to discern because environmental scarcity is "always enmeshed in a web of social, political, and economic factors." Val Percival and Thomas Homer-Dixon, "Environmental Scarcity and Violent Conflict: The Case of South Africa, " Journal of Peace Research No. 3, May 1998, pp. 294-295.

[107] Homer-Dixon, Environment, Scarcity, and Violence, p. 18.

[108] Homer-Dixon, Environment, Scarcity, and Violence, p. 7.

[109] Homer-Dixon, Environment, Scarcity, and Violence, p. 16.

Other researchers have reached similar conclusions. In a parallel research effort, a Swiss Peace Foundation research team proposed a model of environmentally-caused violence and seven key factors considered important in early warning.[110] This model has many similarities to the Homer-Dixon model previously discussed. The term "environmental transformation" is used in a much broader sense than is environmental scarcity to reflect the more fundamental and permanent change that the environment can have on a society.

"Environmental discrimination" is also introduced to reflect the inequalities affected by different actors. This latter term would appear closely related to the concept of "structural scarcity," i.e., unequal distribution, used by the Toronto research team in its case studies. Of particular interest, however, is the introduction of indicators to address the following:

- Socioecological discrimination.
- Politicoecological discrimination.
- Environmental dependence.
- Group cohesion.
- Decline of traditional methods in societal conflict regulation.
- Population pressure.
- State performance.
- State repression and violence.
- External influences contributing to escalation.

Many of these proposed indicators are similar to those presented in Table 2-2.

The Swiss research team generally concurs with the findings of the Toronto group that, for a majority of cases to date, "environmental transformation is a contributing rather than a necessary condition" [of violent conflict].[111] They caution that the socioecological trends deserve close observation else they may quickly change for the worse, possibly leading to more severe conflicts induced by environmental transformation. They also suggest that environmental degradation, being an integral component of the causation process leading to violence, can be used to "enhance the predictive capacity of early warning systems."[112]

The North Atlantic Treaty Organization's (NATO) Committee on the Challenges of Modern Society (CCMS) has been increasingly interested in the relationship between the environment and its relationship to security at both the regional and international levels. The CCMS sponsored a multi-year Pilot Study co-chaired by Germany and the United States. A final report was released in 1999, its purpose to summarize state-of-the-art research on the relationship between environmental change and security.[113] Environmental change is not adequately defined in the report. Rather, it is conceived in "terms of the nature and extent of environmental stress," while environmental stress is subsequently defined as characterizing both environmental degradation and environmental resource degradation.[114]

---

[110] Gunther Baechler, "Early Warning of Environmentally Caused Conflicts," Chapter 10, Preventive Measures: Building Risk Assessment and Crisis Early Warning System, Edited by J. L. Davies and T. R. Gurr (Lanham MD: Rowman & Littlefield Publishers, Inc., 1998), p. 136.

[111] Baechler, "Early Warning of Environmentally Caused Conflicts," p. 140.

[112] Baechler, "Early Warning of Environmentally Caused Conflicts," p. 133.

[113] North Atlantic Treaty Organization, Environment & Security in an International Context, Committee on the Challenges of a Modern Society Report No. 232 (NATO, 1999), p. 1.

[114] NATO, Environment & Security in an International Context, p. 96.

Three subgroups were formed reflecting the structure of the CCMS Pilot Study: "Definition and Modeling," "Definition and Development of a Database and a Decision Support System," and "Policy Responses." The second subgroup is of particular interest because it was also responsible for compiling information on environmental indicators and exploring how they might be used as predictors in early warning. The report also includes a conceptual model of key linkages. This model appears to be a simpler representation of the Core Model discussed earlier, however, it is useful in that it highlights the "contextual factors"—patterns of perception by actors, political stability, economic vulnerability, and resource dependency—that are reflective of a nation's capacity to handle environmental stress and the vulnerability of its resources to such stressors.[115] While these contextual factors were considered by the Toronto research team,[116] they are not depicted in Homer-Dixon's Core Model.

The NATO CCMS report also concludes that the "development of early warning indicator systems, databases, and decision support systems is feasible and warranted."[117] They provide examples of potential indicators and database sources. Many of these indicators were considered for inclusion in this paper. The proposed Decision Support System is admittedly more a "Security Profiling Checklist" than the more characteristic software- or hardware-based system used by policy and decision makers in early warning systems. This report was found to be relevant and useful for its detailed treatment of the contextual factors, its discussion of potential indicators and database sources, and the socioeconomic and political consequences arising from environmental stress. Generally, the Pilot Study reached similar conclusions to those discussed above from the Homer-Dixon research.

There are researchers, however, who have been critical of the Toronto research on methodological grounds. Specifically, the research approach has been hotly debated for its selection of case studies where environmental scarcity and violence must both be present. It is argued that by not allowing for variation in the dependent variable (e.g., violent conflict) and for appropriate controls (e.g., cases where violence is present but where environmental stress is not discernible), it is "impossible" to make appropriate comparisons.[118] In response, Homer-Dixon admits that, while case selection on the independent and dependent variables is "contentious" and may be interpreted as "violating the strict canons of political science [research]," he suggests his process-tracing approach was justified. His response is based on the difficulties in the early stage of environment-conflict research of applying the more rigid and orthodox research approaches of correlation analysis or controlled case comparison, and on practical resource considerations and inefficiencies associated with performing detailed case analysis for an especially large number of what are generally highly complex causal systems, involving multiple environmental, political, and socioeconomic contextual factors.[119]

---

[115] NATO, Environment & Security in an International Context, pp. 102-108.

[116] Homer-Dickson, Environment, Scarcity, and Violence, pp. 16-18.

[117] NATO, Environment & Security in an International Context, p. 130.

[118] Wenche Hauge and Tanja Ellingsen, "Beyond Environmental Scarcity: Causal Pathways to Conflict," Journal of Peace Research No. 3, May 1998, p. 302.

[119] Homer-Dixon, Environment, Scarcity, and Violence, pp. 170-175.

B. Mathematical Models of State Failure

Correlation analysis is a more traditional statistical methodology used by political and social scientists to test hypotheses using applicable dependent and independent variables. It is important that one understand that while "correlation is a necessary feature of a causal relation, it is not sufficient to prove that a causal relation exists."[120] One is further cautioned when drawing conclusions from "a given correlation observed in the data [when there may actually be] no correlation in the real world between the variables in question."[121] Cognizant of these limitations, two mathematical approaches are now presented that examine the underlying relationships and impact of environmental stress on state failure.

The first reported empirical large-scale study to investigate the critical factors most responsible for state collapse and failure was requested in 1994 by then-Vice President Al Gore.[122] At the time, there was a sense of increasing instability and collapse of governance in many nations of the world following the end of the Cold War. It was hoped that research into state failure might provide applicable indicators of early warning to facilitate appropriate international intervention. In response, the Central Intelligence Agency established the State Failure Task Force, a group of independent researchers and contractors, to conduct a comprehensive examination as to why certain states succeed while others seem to fail. The research has been conducted in phases. This paper focuses on the Phase II findings from the most recent Task Force report to have been formally released to date.[123]

State failure—the dependent variable in the analyses—was identified by one of the following types of political crisis: revolutionary war, ethnic war, genocide and politicide, and adverse or disruptive regime transitions. Some 127 state failure cases were identified for the period 1955 to 1996, and were subsequently evaluated against the independent variables that are listed in Table 5-1 (next page). Three control cases were randomly selected for every state failure case, the control cases having demonstrated stability, i.e., no crisis, for at least five years.

The Phase II methodology employed three analytical techniques—logistic regression, neural network analysis, and genetic algorithm modeling — all of which identified the same three variables as being "best" able to systematically discriminate between stable and failure cases.[124]

These three indicators include level of democracy, trade openness, and material well-being as measured by infant mortality. All three indicators are also listed in Table 5-1. Task Force members often refer to the "three-factor model" as the "global model."

---

[120] John L. Phillips, Jr., How to Think About Statistics (New York: W.H. Freeman and Company, 1992), p. 143.

[121] Homer-Dixon, Environment, Scarcity, and Violence, p. 170.

[122] Daniel C. Esty, Jack A. Goldstone, Ted Robert Gurr, Barbara Harff, Marc Levy, Geoffrey D. Dabelko, Pamela T. Surko, and Alan N. Unger, "State Failure Task Force Report: Phase II Findings," Environmental Change and Security Project Report, Issue 5, Summer 1999, p. 49.

[123] Daniel C. Esty, Jack A. Goldstone, Ted Robert Gurr, Barbara Harff, Marc Levy, Geoffrey D. Dabelko, Pamela T. Surko, and Alan N. Unger, "State Failure Task Force Report: Phase II Findings," (McLean VA: Science Applications International Corporation, 1998).

[124] Esty et al., Environmental Change and Security Project Report, p. 50.

Reportedly, the model has a predictive accuracy of about 67 percent.[125] It has been suggested that this level of accuracy may limit the model's usefulness as an early warning tool by policy makers, given the potential number of "false alarms" that might be generated.[126]

TABLE 5-1

SUGGESTED INDICATORS OF STATE FAILURE

Category	* The State Failure Project: Significant Independent Variables	** Global State Failure [3-Factor] Model: Key Discriminators of Failure/Stability
Demographic/ Social	Calories/capita/day	
	Military personnel/physicians ratio	
	Civil liberties index	
	Infant mortality	Level of material living standards: as measured by infant mortality (reported deaths of infants under one year old per 1000 live births)
	Life expectancy	
	Extended longevity	
	Percent of children in primary school	
	Percent of teens in secondary school	
	Girls/boys ratio in secondary school	
	Youth bulge	
	Labor force/population	
Economic/ Environmental	Defense expenditures/total government expenditures	
	Government revenues/GDP	
	Investment share of GDP	
	Trade openness (imports + export)/GDP	Level of trade openness: as measured by (imports + exports)/GDP
	Real GDP/capita	
	Cropland area	
	Land burden (farmers/croplands) x (farmers/labor force)	
	Reports of famine	
Political/ Leadership	arty legitimacy	
	Party fractionalization	
	Executive dependence on legislature	
	Separatist activity	
	Years since major regime change	
	Ethnic character of ruling elite	
	Religious character of ruling elite	
	Political rights index	
	Maximum ethnic cleavage	
	[Level of] Democracy	Level of Democracy: as measured using Polity III Global Data Set (determine whether full democracy, partial democracy, or autocracy)

Sources:

* Daniel C. Esty, Jack Goldstone, Ted Robert Gurr, Barbara Harff, Pamela T. Surko, Alan N. Unger, and Robert Chen, "The State Failure Project: Early Warning Research for U.S. Foreign Policy Planning," Conference Proceedings: Failed States and International Security: Causes, Prospects, and Consequences, Purdue University, 25-27 February 1998, <http://www.ippu.purdue.edu/info/gsps/FSIS_CONF/gurr_paper.html>, pp. 5 of 11.

** Daniel C. Esty, Jack A. Goldstone, Ted Robert Gurr, Barbara Harff, Marc Levy, Geoffrey D. Dabelko, Pamela T. Surko, and Alan N. Unger, State Failure Task Force Report: Phase II Findings, 1998, p. 9.

[125] Esty et al., Environmental Change and Security Project Report, p. 50.

[126] John Steinbruner, Principles of Global Security (Washington DC: Brookings Institution Press, 2000), p. 151.

Among the other major findings from the Phase II research were the following:

- Partial democracies are particularly vulnerable and at an elevated risk of state failure.
- Gradual transition to democracy will likely improve the chances for success.
- Ethnic discrimination alone may not be the most critical factor leading to conflict as was evident in a modified global model developed for Sub-Saharan Africa.

In an unpublished paper,[127] King and Zeng have conducted what they believe to be the first independent scholarly review of the State Failure Project research. They identified several methodological errors, which they suggested exaggerate the forecasting performance of the global model, and can result in "biased and unpredictable" causal inferences. They also reanalyzed the Phase II data, reportedly using more advanced statistical methodologies, and offer recommendations to improve on future models and analytical approaches. They conclude that the three key discriminators of state failure identified by the State Failure Task Force are, in fact, "indirect indicators" that the state may already have failed. They suggest the four types of crisis used by the Task Force to characterize state failure were actually more indicative of the "disastrous consequences" of state failure and, thus, "a more tailored, operational definition of state failure [and a] different data collection strategy" is required.[128]

The State Failure Project Phase II research also investigated the role of environmental factors in state failures. The Task Force developed the "mediated" environmental model, depicted in Figure 5-2 (next page). This model was structured to address the impact of environmental change on material well-being as a function of national resource vulnerability and a state's institutional capacity to respond to the stressors associated with environmental change.

The impact of "infant mortality" as a key discriminator of state failure was previously discussed as part of the global model. This, and the availability of data, led the Task Force to select infant mortality as the dependent variable to be used in their mediated environmental model. A number of independent variables, or indicators, were considered for use in this model for each of the major model categories: environmental change, vulnerability, and capacity. The independent variables are listed in Table 5-2 (page 47). It is important to note that a lack of data limited the number of indicators to only a few. For example, neither air nor water quality could be addressed because of data deficiencies.

Those indicators that were actually used in the mediated environmental model are also appropriately annotated in Table 5-2. Among the more important findings from this model were that:[129]

- Environmental change does not appear directly linked to state failure, rather it is part of what has already been described as complex linkages and interaction among a number of socioeconomic, political, and environmental stressors.
- Environmental change demonstrated a strong association with quality of life, as measured by infant mortality - the latter a key discriminator of state failure.

[127] Gary King and Langche Zeng, "Improving Forecasts of State Failure," Unpublished Paper, 30 March 2001 <http://gking. harvard.edu/>, pp. 1-3.

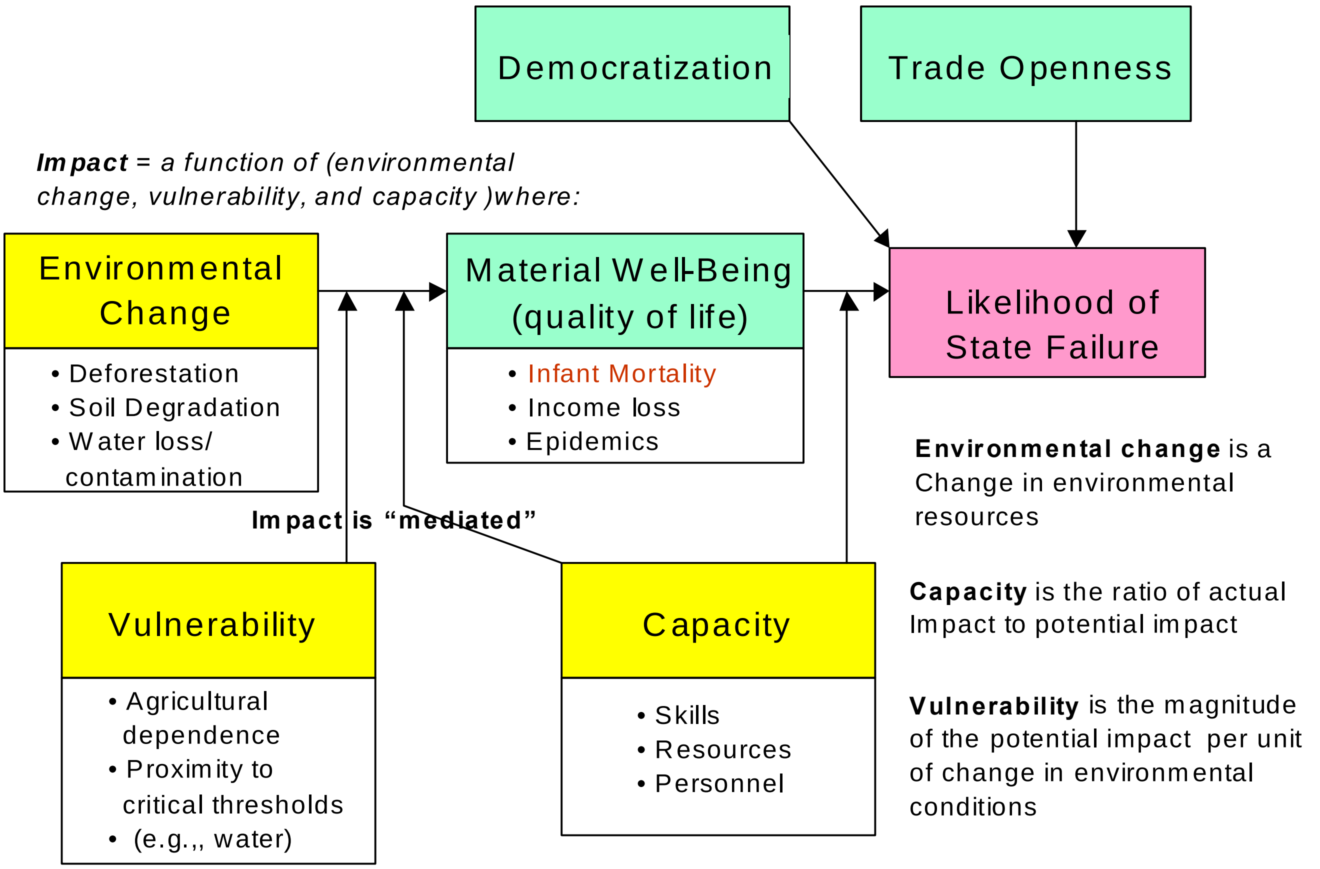
[128] King and Zeng, "Improving Forecasts of State Failure," pp. 19-20.

[129] Esty et al., State Failure Task Force Report: Phase II Findings, pp. 24-28.

- Environmental degradation effects are likely mediated by a nation's capacity to respond and by the degree to which its resources are vulnerable to environmental shock.
- Analyses are being hampered by a paucity of time series environmental data.

Figure 5-2

Mediated Environmental Model



Source: State Failure Task Force Report: Phase II Findings, 1998

Data limitations forced the Task Force to scale back from a time series of 40 years, used in the global model, to the period of 1980 to 1990 for the mediated environmental model. The lack of data further prevented the Task Force from analyzing a majority of the identified independent variables listed in Table 5-2.[130] Given these data limitations on the statistical models, the above findings do not appear fully supportable. The State Failure Task Force was aware of only one other study conducted by Hauge and Ellingsen, that used statistical methodologies to examine the direct impact between the environment and state failure.[131]

---

[130] Esty et al., State Failure Task Force Report: Phase II Findings, p. 103.

[131] Esty et al., State Failure Task Force Report: Phase II Findings, p. 26.

TABLE 5-2

COMPARISON OF INDICATORS USED TO ASSESS STATE FAILURE

Category used in State Failure Project		* State Failure Project: Independent Variables in Multiple Linear Regression – Environmental Model	** Hauge and Ellingsen: Independent Variables in Multivariate Analysis
Environmental Change	***	Deforestation	Change in forest coverage
	***	Soil degradation	Land degradation
		Change in agricultural land	
		Access to freshwater (urban, rural, and total population)	Freshwater availability per capita
		Fraction of freshwater reserves withdrawn	
		Sulfur dioxide emissions	
		Population density	Population density
Vulnerability	***	Percent of population engaged in Subsistence agriculture	
	***	Land burden: (farmers per area of cropland)x(farmers per labor force)	
		Share of national income by lowest 20 percent of population	Income inequality
Capacity		Secondary school enrollment ratio	
		Adult female literacy	
		Public expenditures on education	
	***	Telephone lines per capita	
		Bureaucratic quality	
		Corruption	
		Number of bribery cases	
		Law and order tradition	
		GDP per capita	GNP per capita
		Debt service	
		Rail mileage per square mile	
		Rail-ton miles per capita	
		Road density	
--------------------		--	
Political [Global Model]		Level of Democracy: as measured using Polity III Global Data	Type of political regime Political instability
Social [Global Model]		Level of material living standards: as measured by infant mortality	
Economic [Global Model]		Level of trade openness: as measured by (imports + exports)/GDP	

Sources:

* Daniel C. Esty, Jack A. Goldstone, Ted Robert Gurr, Barbara Harff, Marc Levy, Geoffrey D. Dabelko, Pamela T. Surko, and Alan N. Unger, State Failure Task Force Report: Phase II Findings, 1998, pp. 23-28 and 103-111.

** Wenche Hauge and Tanja Ellingsen, "Beyond Environmental Scarcity: Causal Pathways to Conflict," Journal of Peace Research No. 3, May 1998, p. 309.

Note: A lack of data limited ability to test all variables in the model to the variables indicated by *** in table.

These researchers employed multivariate analysis to test a number of hypotheses over the period 1980 to 1992.[132] Domestic armed conflict observed during this time frame was used as the measure, or indicator, of state failure. In this respect, the incidence of domestic armed conflict served as the dependent variable in the subsequent analyses. In this study, two measures of domestic armed conflict were used in parallel analyses: incidence of civil war and incidence of armed conflict. Land degradation, deforestation, and freshwater availability were used as the independent variables of environmental degradation. The other independent variables included measures of economic growth and income equality, political regime and stability, and population density. The variables are presented in Table 5-2.

Hauge and Ellingsen formulated and tested seven hypotheses. The first three (H1 to H3) were based on the research of Homer-Dixon and his Toronto team and were categorized as "supply-induced scarcity."[133] Hauge and Ellingsen hypothesized that countries experiencing the following environmental and socioeconomic stressors were more likely to experience domestic armed conflict than those countries where the stressors were not present:

- (H1) Land degradation.
- (H2) Deforestation.
- (H3) Low freshwater availability per capita.
- (H4) High population density.
- (H5) High income inequality.

Economic development and stability were seen as important indicators, specifically:

- (H6) Democratic and stable countries as less prone to domestic armed conflict.
- (H7) Highly developed economies as less prone to domestic armed conflict.
- (H8) Economic development and regime type as better indicators than scarcity.

The results of this study suggest that land degradation, deforestation, and freshwater scarcity, "alone and in combination with high population density, increase the risk of domestic armed conflict, especially low-level conflict."[134] However, economic development and type of political regime were found to be "more decisive" than any of the independent variables for environmental scarcity as a predictor of the incidences of domestic armed conflict, the dependent variable.

This study can be criticized for its questionable treatment of filling "data gaps" for a number of variables. For example, data on soil degradation was based only on a single 1990 estimate and repeated for all of the years 1980 through 1992. The researchers admitted the difficulties in obtaining available and consistent national data over a long time series, and highlighted the "urgent need for a fuller and broader collection of environmental data."[135] They also concluded that additional investigation is needed into what are believed close linkages between political, economic, and environmental variables.

---

[132] Hauge and Ellingsen, "Beyond Environmental Scarcity: Causal Pathways to Conflict," pp. 299-300.

[133] Hauge and Ellingsen, "Beyond Environmental Scarcity: Causal Pathways to Conflict," pp. 302 and 305.

[134] Hauge and Ellingsen, "Beyond Environmental Scarcity: Causal Pathways to Conflict," p. 299.

[135] Hauge and Ellingsen, "Beyond Environmental Scarcity: Causal Pathways to Conflict," p. 314.

These findings are at odds with the State Failure Task Force, which did not find any significant direct linkage between environmental change, as measured by deforestation and freshwater supply. The Task Force found deforestation "statistically significant" only when tested in the mediated environmental model, which included indicators of both capacity and vulnerability.[136] The Task Force suggested that the strength of the key discriminators of state failure in their Phase II research—level of democracy, trade openness, and infant mortality—may have "masked any impact of environmental deterioration." [137] Further, they suggest that their findings most likely differed from those of Hauge and Ellingsen because of "differences in how the dependent variables are operationalized and how the independent variables are used."[138] The independent variables used by both research teams can be compared in Table 5-2. Neither team was able to incorporate a broader range of indicators because of their need for data over particularly long time series and the difficulties in obtaining data. As presented in an earlier chapter, regional and international organizations are attempting to fix this problem by harmonizing indicators for policy use across three major environmental, socioeconomic, and institutional dimensions.

C. Simplified Framework of Stability

The need for a simpler framework to better illustrate and communicate the status of national and regional stability is heavily dependent upon the identification of an acceptable Core Set of such harmonized indicators for each of these three major dimensions. The previous environment—conflict and environment—state failure research investigated the complex and multi-dimensional relationships, or linkages, among these three dimensions and have generally concluded that environmental stress is an important, albeit "indirect," contributor to state stability. Environmental stress alone was seen neither as a necessary nor sufficient cause leading to state weakening or failure. Consequently, environmental stress is best viewed as joining with other socioeconomic and political factors to produce an impact. It is in this context that a simpler framework of stability—the Stability Pyramid—is proposed.

The Stability Pyramid and a Core Set of indicators are presented in Figure 5-3 (next page). The strength of linkage between each pairing of dimensions was discussed in Sections B, C, and D of Chapter 4 for socioeconomic and institutional, socioeconomic and environment, and institutional and environment, respectively. The Core Set of indicators was developed based on an exhaustive review of ongoing efforts to develop indicators of environmental performance and sustainable development (Chapter 2), and initiatives related to aggregating these indicators further into indices, or a single index, of sustainability (Chapter 3). A concerted effort was made to provide "implicit weighing" by ensuring a balance in the number of key indicators selected for each of the three dimensions. It was also considered important to select indicators reflective of the four major components of the environmental dimension—air, land, water, and biodiversity—in a manner suggested by Chang-Ching et al.[139] Thus, every effort was made to select core indicators that were properly "balanced" across, and within, the environmental, socioeconomic, and political dimensions, taking into consideration the stressors and linkages discussed in Chapter 4.

---

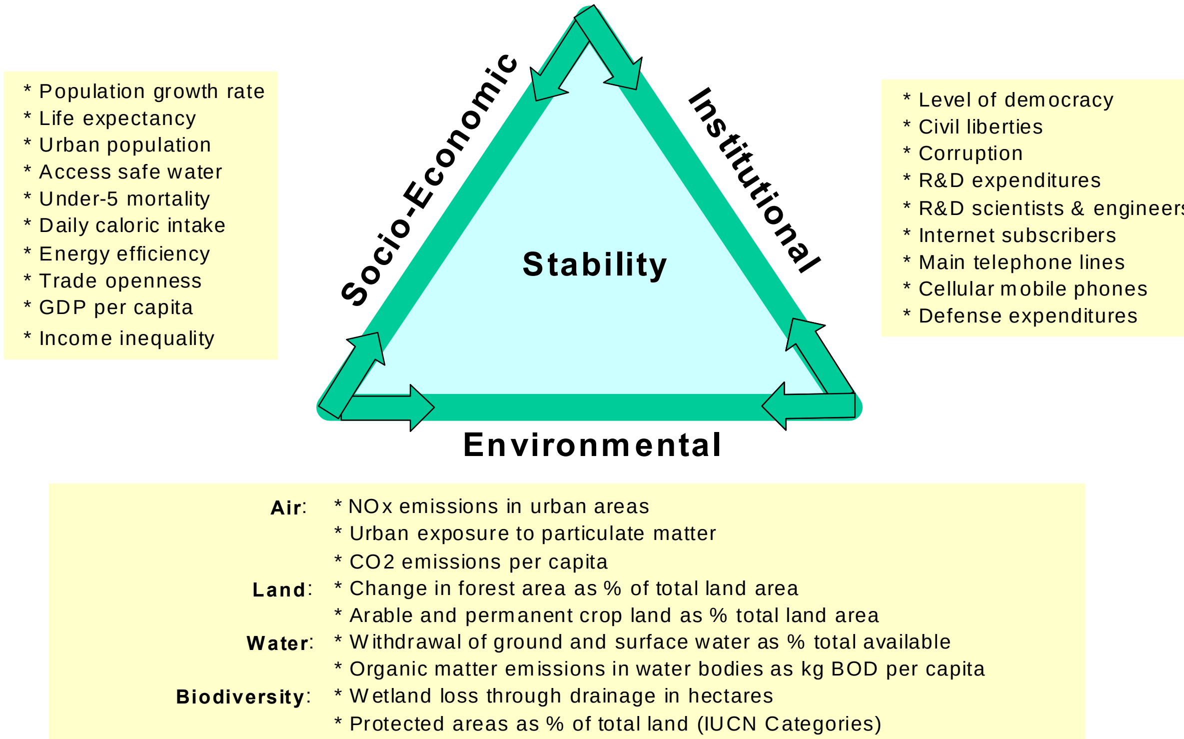
[136] Esty et al., State Failure Task Force Report: Phase II Findings, p. 27.

[137] Esty et al., State Failure Task Force Report: Phase II Findings, p. 26.

[138] Esty et al., State Failure Task Force Report: Phase II Findings, p. 26.

[139] Yu Chang-Ching, John T. Quinn, Christian M. Dufournaud, Joseph J. Harrington, Peter P. Rogers and Bindu N. Lohani, "Effective Dimensionality of Environmental Indicators: A Principal Component Analysis with Bootstrap Confidence Intervals," Journal of Environmental Management, May 1998, pp. 101-119.

Figure 5-3
The Stability Pyramid Framework



The recommended Core Set of indicators is presented in Table 5-3 (next page). This table also lists each institution or researcher that has used, or is still using, that indicator. As reflected in the table, the European Environment Agency and the Organisation for Economic Co-Operation and Development are heavily involved in monitoring environmental performance (first two columns), whereas the United Nations Commission for Sustainable Development and the World Economic Forum (third and fifth columns, respectively) continue to be more active in pursuing harmonized indicators of sustainability across all three dimensions. Indicators being considered for the Dashboard of Sustainability (fourth column) are, not surprisingly, almost identical to those used by the CSD. The last two columns of the table highlight the lack of depth of environmental information considered by both previously presented mathematical models investigating the complex environment—state failure linkage.

Nitrogen oxide emissions in urban areas were selected as a key environmental indicator because of their importance as a contributor to eutrophication, acidification, deforestation, and to a lesser degree, climate change. Road transport and urban populations are projected to grow, especially in developing countries. These factors make this a good indicator of the "pressure" of air pollutants on the environment. Urban exposure to particulate matter is also a valuable indicator of the impact of the exposure of air pollutants on human health. Carbon dioxide emissions comprise the bulk of greenhouse gases, which is estimated at 79 percent for the European Union.[140] The change in forest area is an indicator of the "state" of sustainable practices in both the forest and agriculture sectors and

[140] European Environment Agency, Environmental Signals (Copenhagen, EEA, 2000), p. 41.

TABLE 5-3

CORE SET OF INDICATORS FOR ASSESSING STABILITY

Indicators by Major Dimension	Institutions and Researchers Using Indicators						
	EEA	OECD	CSD	SDI	ESI	SFP	H&E
Environment							
NO_x emissions in urban areas (kg per capita)	X	X	X	X	X		
Urban exposure to particulate matter (micrograms per M3)	X		X	X	X		
CO_2 emissions (metric tons per capita)	X	X	X	X	X		
Change in forest area (% of total land area)	X	X	X	X	X	X	X
Arable and permanent crop land (% total land area)	X	~	X	X		X	~
Withdrawal of ground and surface water (% total available)	X	X	X	X	X	X	~
Organic matter emissions in water bodies as kg BOD/capita	X	X	X	X	~		
Wetland loss through drainage in hectares	X						
Protected areas (% of total land - IUCN Categories)	X	X	X	X	X		
Socio-Economic							
Population growth rate as %		X	X	X	X		
Life expectancy at birth (years)			X	X		X	
Urban population (% of total population)			~	X			
Access to safe drinking water (% of population)			X	X	X		
Under-5 mortality (reported deaths to 1000 live births)			X	X	X	~	
Daily per capita supply of calories			~	~	X	X	
Energy intensity (GDP output per kg (US$)-oil equivalent)	~	X	X	X	X		
Trade openness (imports + exports as % of GDP)			~	~		X	
GDP per capita (for 1998 in 1995 US $)		X	X	X		X	X
Income inequality (Gini coefficient)			X	X		~	~
Institutional							
Level of Democracy (Polity IV Dataset: range -10 to 10)						X	X
Civil liberties (Freedom House: range 1 to 7)					X	X	
Corruption score (Freedom House: range 1 to 7)						X	
Research and development (R&D) as % of GDP			X	X	X		
R&D scientists and engineers per million population					X		
Number of internet hosts per 10,000			X	X			
Main telephone lines per 1000 population			X	X		X	
Cellular mobile phone subscribers per 1000 population							
Defense expenditures (% of GDP)						X	

Acronyms:

- EEA European Environment Agency -*Towards Environmental Pressure Indicators for the EU (Pressure Indicators)*
- OECD Organization for Economic Co-Operation and Development - *OECD Core set of Environmental Indicators*
- CSD UN Commission for Sustainable Development - *CSD Core set of Sustainable Development Indicators*
- SDI Sustainable Development Index - *Indicators used in the Dashboard of Sustainability*
- ESI Environmental Sustainability Index - *Indicators used by World Economic Task Force in developing the ESI*
- SFP State Failure Project - *Independent Variables used in Multiple Linear Regressions*
- H&E Hauge and Ellingsen - *Independent Variables used in Multivariate Analysis*

Notes: X denotes that the indicator is being used by the listed institution; ~ denotes a similar indicator being used.

of the "state" of diverse ecosystems.[141] The change in arable and permanent cropland provides an indicator of the "pressure" imposed on agricultural lands to produce food[142] and, thus, is a measure of food security. Appropriate indicators were selected to take into consideration both water quantity, e.g., potential scarcity, and quality in terms of the internationally accepted biochemical oxygen demand (BOD). Biodiversity is best measured by species count, but this information is often of varying quality and, therefore, indicators are proposed that are more easily measured, yet provide valuable information on the "state" of existing national protected lands and wetlands.

The Core Set of indicators for the socioeconomic dimension was taken primarily from those under consideration by the CSD. Many of these were also used to develop the Environmental Sustainability Index. Indicators for the institutional dimension were carefully selected after considering those used by the State Failure Project in Phase II. Additional institutional indicators were added from those also under consideration by the CSD. Main telephone lines per 1000 population serves as a representative indicator of the state's ability to support various infrastructure platforms that fulfill the public's demand for goods and services.[143] Cellular mobile phones and Internet subscribers per 1000 population were selected as representative of institutional capacity to provide services that are capable of bringing education and information resources to a majority of a state's population. Cellular mobile phones and other wireless systems are rapidly becoming more available,[144] and will likely provide the main form of communication and information access in many less developed countries. The value a nation places on research and development also provides indicators that reflect its capacity to intervene with sufficient social and technical ingenuity in addressing environmental stress and other shocks.[145]

This chapter has discussed several complex conceptual and mathematical frameworks that model instability and state failure, with the potential for violent conflict. A simpler framework, the Stability Pyramid, has been proposed that incorporates the close linkages found among the three major components discussed in Chapter 4: socioeconomic, institutional (such as governance), and environmental. A balanced Core Set of indicators was also proposed based on research of environmental indicators discussed in both Chapters 2 and 3, and from actual use in the conceptual and mathematical models that were discussed in this chapter. Chapter 6 illustrates how this Core Set of indicators can be used to identify conditions of instability and, thus, assist policy makers in developing appropriate intervention or engagement initiatives and programs. Specifically, this Core Set of indicators will be applied against the three previously identified "reference" countries, representative of Western Europe, Central and Eastern Europe, and the Newly Independent States, in order to demonstrate the utility of a simplified framework in identifying instability.

---

[141] United Nations Division for Sustainable Development, Indicators of Sustainable Development: Framework and Methodologies, Background Paper No. 3, for the Ninth Session of Commission on Sustainable Development, 16-27 April 2001. 5 April 2001 <http://www.un.org/esa/sustdev/csd9/csd9_docs.htm>, p. 135.

[142] A country may be considered "land scarce" when more than 70 percent of its arable land is under cultivation. Homer-Dixon, p. 63.

[143] Richard J. Norton and James Miskel, "Spotting Trouble: Identifying Faltering and Failing States," Naval War College Review, Spring 1997, p.887.

[144] United Nations Development Programme, Human Development Report 2000 (New York: Oxford University Press, 2000), p. 201.

[145] Homer-Dixon, Environment, Scarcity, and Violence, pp. 107-109.

CHAPTER 6

FOCUSED INTERVENTION AND ENGAGEMENT

The importance of environmental threats to national security has been hotly debated for over a decade between extremists opposing any redefinition of security that would include nonmilitary threats and those desiring the term be broadened to raise environmental stressors to a commensurate footing with other threats to national interests. More recently, there has been a growing recognition and acceptance that such environmental stress, in combination with other threats, is important to a nation's stability. This is evidenced in the most recent National Security Strategy, which acknowledges that environmental scarcity can "trigger and exacerbate conflict."[146] The National Military Strategy also recognizes "environmental strain" as a contributor to instability and potential violence.[147] Not every environmental problem, however, can be presented as a threat to stability, or it runs the risk of being trivialized.[148] Those environmental stressors believed to be of greatest concern to many of the nations considered in this paper have been presented in some detail in Chapter 4.

America's interests are generally best served by regional and international stability. Thus, this chapter focuses on how the Stability Pyramid, and its accompanying indicators, can be used as a policy tool for assessing instability and structuring appropriate interventions, such as prioritizing initiatives during the theater engagement planning process. Environmental engagement is an important component, along with other socioeconomic and institutional assistance, that if proactively employed, may help to defuse situations that may threaten a state's stability or peace. Homer-Dixon's Core Model, shown in Figure 5-1, suggests several points of intervention, which are best made early. The alternative is over-reliance on third-stage interventions to restore peace and to avoid spillover effects. Such late interventions are characteristically messy, unpopular, and costly. Increasingly, they involve the use of external peacekeeping forces that are difficult to extract once emplaced. The expanding role of external actors has also led to the questioning of longstanding international norms respecting national sovereignty. This chapter introduces the concept of pivotal states as a means of leveraging limited resources, and discusses different intervention approaches.

A. Pivotal State Framework

The term "pivotal states" was coined by Chase et al. to reflect the need for the United States to better protect its interests abroad by focusing on a lesser number of nation states whose future is unclear, yet whose influence could significantly impact both regional stability and security. They claim that "chaos and instability may prove a greater and more insidious threat to American interests than communism ever was."[149] Overpopulation, environmental

---

[146] White House, A National Security Strategy for a Global Age, December 2000, p. 18.

[147] National Military Strategy, Shape, Respond, Prepare Now – A Military Strategy for a New Era, 1997. 16 October 2000 <http://www.dtic.mil/jcs/core/strategi.html>, p. 8.

[148] Peter H.Gleick, "Environment and Security: The Clear Connections," The Bulletin of the Atomic Scientists, April 1991, p. 124.

[149] Robert S. Chase, Emily B. Hill, and Paul Kennedy, "Pivotal States and U.S. Strategy," Foreign Affairs, January/February 1996, pp. 34-36.

degradation, and economic instability are provided as examples of some of the new threats facing the pivotal states. In reality these threats, while not traditional in the political or military sense, are no longer really new. They are, however, more difficult to communicate to policy makers and the public, since their impact on regional stability is generally long-term. Using the criteria of large population, strategic location, and economic potential, the authors identified the following nine pivotal states: Mexico, Brazil, Algeria, Egypt, South Africa, Turkey, India, Pakistan, and Indonesia. A more pragmatic refocusing of assistance was recommended to target these pivotal states so as to instill public confidence that U.S. interests are best being served, and that resources are being put to effective use.

Esty, in a subsequent paper, examined Chase et al.'s pivotal state theory and their identified nine pivots through an environmental lens. He focused on those threats having the potential to cause either a direct or an indirect environmental effect on U.S. national security. He hypothesized that certain nations be given "special focus" in environmental diplomacy based on "size, demographic weight, and resource richness or pollution-causing potential."[150] Given the complexity associated with many major environmental issues, he concluded that a framework based on a "floating set" of environmental pivotal states would best serve the interests of the United States. This set of states would not, necessarily, be identical to those identified by Chase et al. based on a traditional national security approach. Further, a list of environmental pivotal states would likely change as issues mature with time. Likewise, he suggested that U.S. environmental diplomacy should be more issue-specific and focused on that pivotal state most impacted, yet best able to provide regional leadership for a specific threat, e.g., the Ukraine and the Baltic States as pivots for nuclear safety in their regions.

Esty identified the following criteria for identifying an environmental pivotal state:

- Capacity for the environmental issue to affect state and regional stability.
- Potential spillover that may inflict harm on the United States.
- Centrality to achieving success in global environmental diplomacy.

He then applied these criteria against the Chase et al. set of nine pivotal states, as well as Russia and China to determine if they also fulfilled the definition of an environmental pivotal state.[151] Not surprisingly, not all of the above criteria were met for many of these 11 countries.

Among the three "reference" countries considered in this paper, Georgia is singled out for further discussion as a pivotal state given its geopolitical role in the troubled Caucasus region and its importance to vital long-term U.S. national security interests.

B. Georgia – A Pivotal Caucasus State

A Newly Independent Nation State, Georgia suffers from both economic and political ills, as is evident from the low per capita income and poor democracy and high corruption ratings provided earlier in Table 4-1. *Global Trends 2015* projects the South Caucasus region will remain very much "in flux because of unresolved local conflicts, weak economic

[150] Daniel C. Esty, "Pivotal States and the Environment" in United States and the Pivotal States: Testing an Intellectual Hypothesis, Edited by Paul M. Kennedy et al. (New York: Norton, 1998), pp. 291-292.

[151] Esty, "Pivotal States and the Environment, " p. 310.

fundamentals and continued Russian meddling."[152] In this report, the National Intelligence Council foreshadows improvements in both economic and political stability for Georgia by 2015, a result of increased energy transit—primarily pipeline—revenues. Russia's interest in Georgia will thus likely strengthen as it strives to regain its faltering position in the region.

There has been a resurgence of interest in rebuilding the Silk Road, a new East-West Eurasian Corridor, to serve as a major transport thoroughfare that would bypass many of the overloaded and inefficient routes through Moscow. This transport corridor would not only provide a major source of energy supplies from the Caspian nations to the West but also would open other important trade and increase investment in regional infrastructure for ports, highways, airports, and railroads to support the projected increased volume in flow of goods.

The Eurasian Corridor is fast becoming the center of a new geopolitics that will require the restructuring of relationships between East and West. Access to the vast supplies of oil and natural gas reserves in the region will become increasingly vital to the interests of the United States, Western Europe, and other developing nations. To ensure the continued exploration and development, and to protect the supply, of critical energies, the West will have to commit itself in some fashion to the stability of the region. The unsettled nature of the region is evidenced by the fact that the five Caspian nations have yet to formulate a firm plan for the allocation of offshore energy resources in the Caspian Sea.[153] Without stability, there will be no regional security, and without security, the continued flow of oil westward becomes problematic. Georgia stands at the crossroads in this restructuring process as a pivotal state in the re-establishment of an important continental link between East and West.

Huntington has painted a dismal picture of the Caucasus as a historically plagued region where civilizations have traditionally collided, and which continues as a flashpoint for both cultural and racial conflict.[154] Kaplan has also questioned the capacity of the Georgians to self-rule, highlighting their difficulty in shedding Marxist ways and their inability to unload themselves of other Soviet baggage.[155] Realistically, this process will take decades to achieve. Russia will not sit idly by as other external actors (more developed nations and global corporations) push to develop the energy reserves of the region. The neighboring Chechnya conflict and ethnic turmoil have led to continued strained relations with Russia. Not surprisingly, it has been suggested that Moscow will work to keep Georgia destabilized in an attempt to protect its own national interests in the Caucasus and Central Asia regions.[156]

---

[152] National Intelligence Council, Global Trends 2015: A Dialogue About the Future with Nongovernment Experts, NIC Paper 2000-02, December 2000, p. 69.

[153] Michael T. Klare, "The New Geography," Foreign Affairs, May/June 2001, p. 57.

[154] Samuel P. Huntington, The Clash of Civilizations and the Remaking of the World Order (New York: Simon and Schuster, 1996), p. 62.

[155] Robert D. Kaplan, "Where Europe Vanishes," The Atlantic Monthly, November 2000. 9 April 2001 <http://www.theatlantic.com/issues/2000/11/kaplan.htm>, p. 1.

[156] Member of Georgian Parliament and head of Georgian Defense Committee at the time, Revaz Adamia, was interviewed by Robert Kaplan and quoted in his article "Where Europe Vanishes," p. 9.

C. Focused Intervention

Conventional remedies to save independent failing states have often met with "scant success," while efforts to save failed states have generally proven to be "wholly inadequate."[157] A noted exception was the Marshall Plan that provided massive economic aid to war-ravaged Western Europe following the Allied victory in 1945. In addition to this aid, the plan also stressed the restoration of a democratic polity in each of the former Axis powers. Reviewing such past interventions, Helman and Ratner had earlier recommended that consideration be given to expanding the role of the UN to allow for intervention into the domestic matters of nations that have "failed," e.g., Bosnia, or are on the brink of "failing," e.g., Georgia, by using a new organ that would be created and made responsible for short-term UN conservatorship.[158]

This proposal is fraught with legal and political questions involving state sovereignty. Many relatively new independent nations remain suspicious of any external central control. Understandably, they perceive such interventions as a threat to their recently acquired sovereignty and, thus, may be hostile to any form of external help, even if such humanitarian assistance or peace operations could help restore legitimacy and end internal conflict.

Nicholson has suggested that nation states fail along a spectrum, not collapsing at some preconceived point of failure.[159] He criticized the International Monetary Fund (IMF) for its overconfidence and failure to understand the complexities of the nations it serves, but used it to illustrate how an international organization has intervened with little consideration or objection in the internal economic affairs of a number of countries. Thus, he suggested an argument could more easily be made for some "political equivalent" of the IMF to help "rescue people from the ravages of ineffective government."[160] This proposal would entail relaxation of existing sovereignty norms by nation states, which he admitted was unlikely.

By virtue of the growth in the number of nation states alone, Wallensteen suggested that some form of new governance is required that is "above the state, below the state, and beyond the state."[161] More recently, the roles of the IMF, UN, NATO, and the EU have been strengthened, while interventions undertaken by these organizations have also often usurped those functions normally reserved for nation states.

The EU provides an interesting study in the regional integration of states desiring to gain both economic strength and increased security, even if at some loss in their political sovereignty. EU membership, however, will remain restrictive and beyond the reach of many of the European countries that are also currently members of the Council of Europe.

---

157 Gerald Helman and Steven R. Ratner, "Saving Failed States," Foreign Policy No. 89, Winter 1992-93, p. 7.

158 Helman and Ratner, "Saving Failed States," pp. 5 and 12-17.

159 Michael Nicholson, "Failing States, Failing Systems," Conference Proceedings: Failed States and International Security: Causes, Prospects, and Consequences, Purdue University, 25-27 February 1998. 16 March 2001 <http://www.ippu.purdue.edu/info/gsps/FSIS_CONF/mnpaper.html>, p. 13.

160 Nicholson, "Failing States, Failing Systems," p. 13.

161 Paul Wallensteen, "State Failure, Ethnocracy and Democracy: New Conceptions of Governance," Conference Proceedings: Failed States and International Security: Causes, Prospects, and Consequences, Purdue University, 25-27 February 1998. 16 March 2001 <http://www.ippu.purdue.edu/info/gsps/FSIS_CONF/mnpaper.html>, p. 8.

Alternatively, NATO enlargement has been proposed as a means of providing these non-EU countries a political organization capable of providing needed security and stability.

Norton and Miskel suggest that a distinction be made between states that are failing or faltering and those that may be equally poor and less developed, but whose stability is not currently threatened.[162] They propose that intervention be limited to humanitarian assistance as a form of "triage" for failing states. Alternatively, they recommend that U.S. foreign aid and military assistance would be better spent on poorer, but more stable, countries.

They also offer a "taxonomy" for identifying failing or faltering states comprising nine proposed measurements, grouped into three major categories: (1) social conditions (poverty, literacy, and mortality and morbidity); (2) private sector capacity to improve upon living conditions (like inflation, emigration, and infrastructure); and (3) government strength or weakness, as measured by a willingness to invest in national infrastructure (border control, law and order and government action).[163] These nine measurements were considered during the selection of the indicators for the Stability Pyramid developed in the previous chapter.

Homer-Dixon also offers policy makers four general comments on interventions to address the complex linkage between environmental scarcity, stability, and conflict:[164]

- Interventions must operate at many points – there is no single solution.
- Early intervention is preferable to avoid emotional and often intractable positions.
- Policy responses are not necessarily capital-intensive, e.g., support for NGOs.
- Effective policy interventions may not necessarily be unique or special.

The above discussion highlights the importance of early identification of instability and the need to structure appropriate interventions, whether economic, environmental, or institutional, before conditions worsen and the capacity of the government to respond is threatened or weakened. Such interventions generally involve regional, international, and interagency approaches. In many cases, non-government organizations may be better positioned in a country to provide the needed intervention.[165] Military intervention is often necessary if other interventions have failed, or were not employed. In such operations other than war, the military generally support other international organizations in humanitarian assistance, peacekeeping, and possibly non-combatant evacuations. However, not all failing states pose a threat to U.S. interests and, thus, American responses may not be warranted.

---

[162] Richard J. Norton and James Miskel, "Spotting Trouble: Identifying Faltering and Failing States," Naval War College Review, Spring 1997, pp. 80-81.

[163] Norton and Miskel, "Spotting Trouble: Identifying Faltering and Failing States," pp. 83-85.

[164] Thomas Homer-Dixon, Environment, Scarcity, and Violence (Princeton NJ: Princeton University Press, 1999), pp. 10-11.

[165] John D. Steinbruner, Principles of Global Security (Washington DC: Brookings Institution Press, 2000), p. 152.

D. Selective Engagement

Selective engagement is a key component of both the National Security Strategy (NSS) and National Military Strategy (NMS) in shaping the international environment by "encouraging democratization, open markets, free trade, and sustainable development [thereby] preventing conflict."[166] As the term suggests, selective engagement acknowledges the scarcity of resources and, thus, proactively discriminates as to their use and allocation.

The United States European Command's (EUCOM) *Strategy of Readiness and Engagement* synchronizes the guidance provided in both the NSS and NMS and explains how it will be applied within its theater of operations. This strategy acknowledges that both environmental degradation and scarcity are significant within its broad area of responsibility and may lead to confrontation and conflict. However, it suggests that "environmental cooperation can build democracy, trust, understanding, and may avoid costly military interventions,"[167] by the execution of focused environmental engagement activities.

The CINC of the European Command employs a Theater Security Planning System (TSPS) to translate the NSS and NMS into tailored theater strategic objectives and major performance measures. The TSPS comprises a hierarchal series of plans and processes that include the Theater Engagement Plan, Theater Campaign Plan, Regional Working Groups, Regional Campaign Plans, and 89 individualized Country Campaign Plans.

The Theater Engagement Plan (TEP) is the strategic planning document that links the engagement activities of the CINC with national objectives outlined in the NSS and NMS.[168] The TEP is based on planning guidance provided in the Joint Staff Capabilities Plan. The TEP is published annually, identifying and prioritizing engagement activities over an eight-year planning horizon. These engagement activities are characterized as follows: operational activities, combined exercises, security assistance, combined training, combined education, military contacts, humanitarian assistance, and other engagement activities. The completed TEP is integrated into the "Global Family of Engagement Plans" and forwarded to the Chairman of the Joint Chiefs of Staff for approval. These plans are then forwarded to Services and other Defense agencies for use in developing appropriate programs and budgets. They are also sent to the Under Secretary of Defense for Policy for approval and to obtain support and funding from non-DoD agencies, as appropriate, such as the Security Assistance Programs.[169]

Several recommendations have been proposed to improve the Theater Engagement Planning Process to ensure it does not evolve into a cumbersome and bureaucratic reporting undertaking. Specifically, Steinke and Tarbet suggested that the Secretary of Defense needs to provide clearer guidance to the CINCs as to the purpose of the TEPs and their relation with the NSS and NMS, and that the CINCs be given separate and adequate funding to execute their respective engagement programs.[170] Given the complexity of the international security environment, it was also recommended that the National Security

[166] White House, A National Security Strategy for a Global Age, p. 2.

[167] United States European Command, Strategy of Readiness and Engagement (Stuttgart, 1998), p. 10.

[168] Chairman of the Joint Chiefs of Staff, Theater Engagement Planning: CJCSM 3113.01A, 31 May 2000, p. A-1.

[169] Chairman of the Joint Chiefs of Staff, Theater Engagement Planning, p. A-3.

[170] Ralph R. Steinke and Brian L. Tarbet, "Theater Engagement Plans: A Strategic Tool or a Waste of Time?", Parameters, Spring 2000, pp. 69-81.

Council be given added responsibility for development of a "global TEP" that would articulate and integrate not only the CINCs' engagement activities, but also those of other key federal departments.

It is unlikely that action will be taken on this proposal very soon. This is unfortunate, since it would help to resolve the "mismatch" of roles and responsibilities that exists among different U.S. agencies, as well as addressing the "leadership void" that also exists in prioritizing U.S. resources to best address the environmental threats presented in Chapter 4.

As one example, the Department of State established a number of small regional environmental "hubs" at designated embassies worldwide in 1977. Their mission is "to engage with several countries of the region on a particular environmental issue, with the aim of promoting regional environmental cooperation, sharing of environmental data, and adoption of sound policies that will benefit all countries of the region."[171] These hubs were envisioned to work closely with other U.S. government agencies to support their efforts and to raise issues through diplomatic channels, as appropriate. Regional hubs within the EUCOM theater are located in Cote d'Ivoire for West and Central Africa; Botswana for Southern Africa; and Denmark for the Baltic and Nordic nations. These hubs, however, have generally been poorly staffed, and their activities infrequently coordinated with the CINCs.

Interestingly, in cooperation with Hungary and the European Commission, the U.S. helped establish a Regional Environmental Center (REC) for Central and Eastern Europe in 1990.[172] The REC has evolved as an independent and non-profit foundation, promoting cooperation among diverse groups and non-government organizations in solving regional problems. Consequently, the State Department did not establish a hub for this region.

E. <u>Prioritization of Engagement Activities</u>

The Regional Work Group (RWG) process is critical to the development of the TEP at EUCOM. The CINC's staff and country teams, representing the theater's five regions, meet annually to develop a *Regional Resource Apportionment Matrix* (RRAM). This final RWG product comprises a prioritized list of countries for use in allocating resources by each of the major TEP engagement activities discussed above. The RRAM is determined based on the results of a series of detailed country assessments that determine: performance against specific CINC objectives, (measures of effectiveness); the likely need, capacity, and impact of any planned engagement activities; a strategic factors analysis that strives to measure numerous political, legal, economic, and military factors; and the potential threat posed to the region, theater, and the United States.[173] The final RRAM also considers the relative importance, or weighting, that the CINC places on specific focus countries.

---

[171] Department of State, "Regional Environmental Hub Program" – Fact Sheet, 22 September 2000 <http://www.state.gov/www/global/oes/envir_hubs/index.html>.

[172] Regional Environmental Center, "About the Regional Environmental Center (REC)," 16 October 2000 <http://www.rec.org/ REC/Introduction/intro.html>.

[173] LtCol. Gary T. Rogers, "2001 Regional Working Group Packet and Materials for United States European Command announced in message DTG 251336Z JAN 01," 2 April 2001 [E-mail to Steve Hearne < mailto: hearnes@nwc.navy.mil >.

The RRAMs for each of the EUCOM regions are then integrated into a single prioritized list of engagement activities and submitted to a CINC steering group for approval. Once approved, the prioritized list is formally folded into the official EUCOM TEP.

The Stability Pyramid framework provides the CINC staff, country teams, and other policy makers a Core Set of socioeconomic, institutional, and environmental indicators that will help identify those conditions that could easily fuel national or regional instability. Once identified, appropriate interventions and engagement activities can be developed by the CINC's staff, or forwarded to the appropriate U.S., regional, or international agency, so that action can be taken to assist in diffusing the situation. It is envisioned that the Core Set of indicators would be provided to country teams in advance of, and during, the RWG meeting.

The utility of the Stability Pyramid framework and Core Set of stability indicators is demonstrated in the next section for the three "reference" countries of Germany, Hungary, and Georgia. Each nation is representative of a different region within the EUCOM theater—Western Europe, Central Europe, and the Newly Independent States, respectively.

F. Identifying Instability – The Reference Countries

Values for the Core Set of stability indicators for the three reference countries that have been considered throughout this paper are provided in Table 6-1 (next page). The source and date for the data are listed by each of the major dimensions that comprise the Stability Pyramid framework: environment, socioeconomic, and institutional. Data are provided for a fixed point in time. Time series data provide a valuable temporal capability in monitoring trends, but their collection was beyond the scope of this paper. Trend analysis would be relatively easy if the identified Core Set of indicators were accepted and tracked on an annual basis.

What is striking from a review of the environmental indicators in Table 6-1 is the high withdrawal of ground and surface water by Hungary. Regional reports have confirmed that competition for water is particularly serious along Hungary's left bank tributaries of the Danube, the major river flowing through this landlocked nation.[174] The diversion of the Danube by Slovakia along their shared border remains a hot spot of controversy and protest.

The lower values for nitrogen oxide air emission levels in urban areas will increase for both Hungary and Georgia with economic growth. Consumption patterns are likely to mirror those of Western Europe, to include an increased demand for private automobiles and the modernization and expansion of road networks to support this growth in transport.

Georgia is rich in natural ecosystems, but many of these are too small to support many mammal populations.[175] This is reflected in the notably low value for protected areas as a percent of total land. Georgia, however, has declared the intent to "designate up to 20 percent of the total area of the country territory as protected areas of different categories."[176]

---

[174] Environmental Programme for the Danube River Basin, Strategic Action Plan for the Danube River Basin, 1995-2005, (EPDRB Task Force, Vienna, 1995): 81.

[175] Georgia Ministry of Environment, State of the Environment: Country Overview – Georgia, (European Union's TACIS Programme, April 1998): 23.

[176] Georgia Ministry of Environment, State of the Environment: 20 and 23.

TABLE 6-1

CORE SET OF INDICATORS FOR REFERENCE COUNTRIES

Core Set of Stability Indicators		Countries		
Environment	Source	Germany	Hungary	Georgia
NO_x emissions in urban areas (kg per capita) [EEA 1996 for Germany; OECD 1994 for Hungary; EU 1995 for Georgia]	EEA, EU, OECD	23.0	18.4	16.0
Urban exposure to particulate matter (micrograms per M3)	IISD	37.7	40.7	na
CO_2 emissions (metric tons per capita)	IISD	2.77	1.56	0.31
Change in forest area (% of total land area) [avg.1990-1995]	HDR	0.0	-0.5	0.0
Arable and permanent crop land (% total land area)	IISD	34.7	54.6	15.4
Withdrawal ground + surface water (% total available) [1997]	HDR	43.2	104.3	6.0
Organic matter emissions in water bodies as kg BOD/capita	IISD	0.12	0.18	na
Wetland loss through drainage in hectares	UNCSD	na	na	na
Protected areas (% of total land - IUCN Categories) [1999]	WRI	26.9	7.0	2.8
Socio-Economic				
Population growth rate as %	IISD	0.12	-0.40	0.16
Life expectancy at birth (years) [1998]	HDR	77.3	71.1	72.9
Urban population (% of total population)	IISD	87.3	63.8	60.2
Access to safe drinking water (% of population)	IISD	na	99.0	na
Under-5 mortality (reported deaths to 1000 live births) [1998]	HDR	5	11	23
Daily per capita supply of calories [1997]	HDR	3,382	3,313	2,614
Energy intensity (GDP output per kg (US$)-oil equivalent)	IISD	7.16	1.87	1.62
Trade openness (imports + exports as % of GDP) [1998]	HDR	52.1	102.2	42.0
GDP per capita (for 1998 in 1995 US $)	HDR	31,141	4,920	703
Income inequality (Gini coefficient)	IISD	30.0	30.8	na
Institutional				
Level of Democracy (Polity IV Dataset: -10 to 10) [1999]	CIDCM	10	10	5
Civil liberties (Freedom House: range 1 to 7) [2000]	FH1	2	2	4
Corruption score (Freedom House: range 1 to 7) [1999]	FH2	na	2.50	5.00
Research and development (R&D) as % of GDP	IISD	2.41	0.68	na
R&D scientists and engineers per million population	UNCSD	na	na	na
Number of internet hosts per 10,000	IISD	161.0	83.0	1.3
Main telephone lines per 1000 population [1998]	HDR	567	336	115
Cellular mobile phone subscribers/1000 population [1998]	HDR	170	107	11
Defense expenditures (% of GDP) [1998]	HDR	1.5	1.0	1.3

na – not available or not monitored; date of data provided as available

EEA - European Environmental Agency - *Environmental Signals 2000*

OECD - Environmental Indicators: A Review of Selected Central and Eastern European Countries

EU - European Union - *State of the Environment: Country Overview - Georgia*

IISD - International Institute of Sustainable Development - *Dashboard of Sustainability Database* - Version 3.3 - Mar 01

WRI - World Resources Institute *Report 2000-2001*

UNCSD - United Nations Commission for Sustainable Development - proposed SD indicator

CIDCM - Center for International Development and Conflict Management, University of Maryland

FH1 - Freedom House - Annual Survey of Civil Liberties

FH2 - Freedom House - *Nations in Transit Report 1999-2000*

Of particular concern in reviewing the socioeconomic indicators, are the high child mortality rate and low per capita income for Georgia, and the high level of energy intensities for both Hungary and Georgia. The efficient use of energy is closely linked with economic development. Total energy consumed per unit of GDP for both of these nations is over three times that for Germany. This is characteristic of many of the Central and Eastern European nations and Newly Independent States. This high level of energy intensity is likely the result of an aging industrial base and inefficient electrical production and distribution systems.

At first glance, trade openness does not appear to be an issue for Georgia. This value, however, has fallen significantly since 1994 and, thus, merits closer observation.[177] Trade openness is an indicator of a country's economic and political independence and a measure of its integration into the global community and willingness to conform to international norms.[178] Institutional corruption has the potential to impede the import and export of goods, thus, a loosening of trade openness may be indicative of such corruptness.

This appears the case for Georgia, as reflected in its higher corruption score compared to either Hungary or Germany. Other indicators are also pessimistic of Georgia's institutional stability. As discussed in Chapters 4 and 5, the level of democracy rating for Georgia characterizes its polity as a "partial democracy." The poor state of the nation's infrastructure is reflected by Georgia's inability to provide land phone lines and supporting communication services. These indicators suggest that Georgia is in a particularly vulnerable position to institutional crisis and could be easily swayed to a return to a more autocratic rule.

The entire Core Set of indicators tells an interesting story. Germany, as expected, reflects the characteristics generally associated with an advanced and stable Western European nation. This does not suggest that this country is not without problems. In fact, it is working to reduce high levels of air emissions and a high proportion of its total population is currently living in primarily urban areas. However, Germany's socioeconomic, institutional, and environmental base is believed relatively stable for the foreseeable future.

Hungary is representative of a more transitional economy that is focused on increased economic liberalization and trade openness, increased democratization, and improvements to its infrastructure. Concerns exist regarding localized water scarcities. While this issue should be monitored, it is unlikely to escalate into any form of violent regional conflict.

Georgia has been shown to be a country beset with economic and institutional problems. Its economy has been largely dependent on agriculture, mining, and tourism. Pervasive corruption and tax evasion have undermined serious efforts to establish political legitimacy, created mistrust, led to serious budget deficits, and impeded recent economic development. Georgia has suffered energy shortages as a result of its inability to pay for critical imported energy that provides the bulk of its needs.

---

[177] Kathryn Bovill, "State Failure Project," 17 May 2001 [E-mail to Steve Hearne, <mailto:hearnes@nwc.navy.mil>.

[178] Daniel C. Esty, Jack A. Goldstone, Ted Robert Gurr, Barbara Harff, Marc Levy, Geoffrey D. Dabelko, Pamela T. Surko, and Alan N. Unger, "State Failure Task Force Report: Phase II Findings," Environmental Change and Security Project Report, Issue 5, Summer 1999, p. 5.

Georgia is hopeful that expansion of the Eurasian corridor, seaports, and oil pipelines will generate significant revenues in the future. The Georgian president warmly greeted the recent announcement of an agreement between Azerbaijan and Turkey that a new natural gas line would be built through his country.[179] This is strategically important to Georgia, as it will provide a short-term supply of natural gas as payment for transit, and later, hard currency.

The Core Set of indicators presented in Table 6-1 provides the CINCs and other U.S. policy makers a multi-dimensional tool to identify national and regional instability. As discussed in the previous chapter, indicators for socioeconomic and institutional factors may provide a better early warning than those listed for the environment. This is evident from Table 6-1, where several institutional and socioeconomic factors suggest that Georgia is at an important juncture on a challenging new path to establish a more stable, democratic, and secure state.

G. Applicability to Regional and International Actors

The Stability Pyramid framework was developed for the CINCs and other U.S. policy makers. However, non-U.S. regional or international actors may want to employ this or a similar framework in identifying instability and developing and prioritizing appropriate interventions. It is important to recognize that many of the conditions that underlie national and regional instability require the specialized involvement of a number of agencies and NGOs, such as the EU, EBRD, and IMF.

The EU, for example, has become increasingly active in addressing instability within the Caucasus region. It entered into a Partnership and Cooperation Agreement with Georgia in July 1999 covering "non-military" cooperation.[180] Emphasis has more recently shifted from humanitarian assistance to improving Georgia's underlying economic condition through "most favored nation" treatment, elimination of trade restrictions, encouraging investments, and continuing regularly scheduled dialogue at the ministerial and other senior policy maker levels. To date, Georgia has benefited from over 300 million euros in EU assistance alone.

[179] Paul M. Czaarzasty LTC, "Georgia in the News Sources" Excerpt from Oil and Gas Report for 23-29 (March 2001, Volume N 12 (477), 30 March 2001 [E-mail to Steve Hearne < mailto:hearnes@nwc.navy.mil >], p. 7.

[180] European Commission, "The EU's Relations with Georgia – An Overview," 16 March 2001 <http://europa.eu.int/ comm/external_relations/georgia/intro/index..htm>, p. 1.

CHAPTER 7

CONCLUSIONS

The objective of this paper was the development of a simple framework and associated Core Set of indicators whose use could assist as an early warning tool of national and regional stability. Such a framework and Core Set of indicators might also be employed to better identify, plan, and prioritize theater engagement activities and applicable interventions. This paper has argued that geographical CINCs and policy makers will benefit from a simplified framework—the Stability Pyramid—that can easily identify tendencies toward instability among different nation states, communicate the form of instability to others, and help design and prioritize proactive engagement activities and other responsive interventions that are tailored to the specific forms of instability.

A growing body of theoretical and applied research has been conducted over the last several years with respect to state instability and failure; the closely related and often complex relationships between wealth, governance, and environment; and the development of applicable indicators used in supportive models and frameworks. This extensive body of work spans several disparate disciplines and eclectic sources of information. Therefore, it was necessary to filter and integrate relevant portions of this research into a single volume in order to devise a suggested next evolutionary step: the Stability Pyramid. It is hoped that this synthesis will make an important and lasting contribution to the literature.

The paucity of environmental data that has plagued many research efforts to date is currently being addressed by several international organizations and does not diminish the utility of the Stability Pyramid framework. Ongoing regional and international efforts to develop a "harmonized" set of environmental, socioeconomic, and institutional indicators have been presented, as have efforts to further aggregate indicators into a single index of environmental sustainability and sustainable development. The multi-dimensional nature of the environment makes development of a single index difficult. Consequently, it was necessary to select for the simplified framework a limited and balanced number of indicators that are both representative of each of the three major components and minimize the implicit weighting concerns discussed in Section C of Chapter 3. The majority of indicators used in the Stability Pyramid framework were selected from the current UNCSD working list of national indicators. The Stability Pyramid also employs the proposed UNCSD-based "thematic" indicator framework, in contrast to the OECD "Pressure-State-Response" and related EU "Driving Forces—Pressure—State—Impact—Response" approaches.

Environmental stress has been shown to be an important factor leading to instability; however, mainly as an indirect cause. Such stressors tend to operate in a complex manner with other socioeconomic and institutional contextual factors to produce effects that can lead to instability. Environmental stressors worsen when exacerbated by accelerated population growth, urbanization, and economic development. Such conditions are found among poorer and less developed economies struggling for higher Western living standards.

Economic development does not necessarily have to come at the expense of the environment. Conversely, strengthening national regulations to improve environmental quality does not have to come at the expense of economic competitiveness. A controversial hypothesis was presented that suggests environmental quality, while negatively impacted during the early stages of economic development, will rapidly improve once economic conditions have stabilized and reached a point where a populace can better afford, and thus are more likely to demand, a cleaner environment. Improved economic condition was shown to have a positive effect on environmental sustainability and overall sustainable development.

Good governance has also been found to enhance environmental sustainability. The surge of democratization following the dissolution of the Soviet Union led to a number of studies into the potential linkage between polity type and the environment. In general, the research suggests some form of positive relationship between democracy and environmental quality. Although still under debate, the research also broadly suggests that democracies are better at developing cooperative solutions to international environmental problems than are more autocratic regimes. Further, improvement in the quality of institutions was also found to enhance national environmental performance, suggesting that future interventions should focus on this critical dimension, not solely on economic or environmental concerns. This is key, as partial democracies are generally more prone to institutional crisis and instability.

The positive linkages found between the environment, economic development, and institutional governance were important in the overall development of the Stability Pyramid framework. Several conceptual and analytical models of state instability and failure were also considered in constructing this simpler framework of stability and in selecting a Core Set of indicators that are representative of the key environmental, socioeconomic, and political dimensions.

The resulting framework and corresponding Core Set of indicators were then applied against three reference countries. Germany, Hungary, and Georgia were selected as being representative of different regions within the United States EUCOM. Georgia is viewed as a pivotal state within the Caucasus region because of its geopolitical importance in a revitalized East-West Eurasian transport corridor and to external actors, including the United States, the EU, and the Russian Federation.

The Stability Pyramid framework provides the CINC and other policy makers an important and relatively simple tool to quickly identify and respond to situations of national and regional instability. The temporal nature of many environmental stressors suggests that their effects may not be readily apparent in the short-term. Thus, it should not be surprising that the Core Set of socioeconomic and institutional indicators may provide an earlier warning of instability in those situations where environmental stress is not highly pronounced. In fact, this was the case for the reference countries, particularly Georgia.

The Stability Pyramid framework was shown as being relatively easy to integrate into the United States EUCOM Theater Engagement Planning process. A completed Core Set of indicators could be provided in advance of the annual RWG meetings to both CINC staff and country teams, where it would serve as an important reference in completing the detailed country assessments. Specifically, potential areas of instability would be identified by highlighting the applicable indicator for the region or sub-region of interest using the matrix format provided in the proceeding chapter, and by inclusion of a short narrative as to why this indicator suggests a problem likely exists. This information would then be attached to the read-ahead that is routinely forwarded to the RWG participants.

The Stability Pyramid framework would thus serve as a tool in development of the *Regional Resource Apportionment Matrix*, the final RWG product that prioritizes engagement activities by each major program. At other times, this framework would provide regional offices a standardized tool to quickly compare potential instability between different nations in a given region, and among pivotal states. Importantly, this framework could also be easily exported to other regions within United States EUCOM, e.g., Sub-Saharan Africa, and to other geographical CINCs and U.S. policy makers for similar testing and use.

Further simplification and refinement could be accomplished by the development of a color-coded valuation system for the Core Set of indicators in a manner similar to that used for the Dashboard of Sustainability that was presented in an earlier chapter. The development of a comparable visual and computerized tool, however, was beyond the scope of this paper.

BIBLIOGRAPHY

Books, Reports, and Papers

Baechler, Gunther. "Early Warning of Environmentally Caused Conflicts." Chapter 10, Preventive Measures: Building Risk Assessment and Crisis Early Warning System. Edited by J. L. Davies and T. R. Gurr Lanham, MD: Rowman & Littlefield, 1998.

Brauch, Hans Gunter, Antonio Marquina, Abdelwahab Biad, and Peter Liotta. Euro-Mediterranean Partnership for the 21st Century. St. Martin's Press, 2000.

Chen, Robert S., W. Christopher Lenhardt, and Kara F. Alkire, eds. Consequences of Environmental Change – Political, Economic, Social, Proceedings of the Environmental Flash Points Workshop, Reston, Virginia, November 12-14, 1997.

Dahl, Arthur. "Towards Indicators of Sustainability." Paper, Scope Scientific Workshop on Indicators of Sustainable Development, Wuppertal, 15-17 November 1995.

Ekbom, Anders and Jan Bojo. Poverty and Environment: Evidence of Links and Integration into Country Assistance Strategy Process. Discussion Paper No. 4, Environmental Group, Africa Region, The World Bank, 1999.

Environmental Programme for the Danube River Basin. Strategic Action Plan for the Danube River Basin, 1995-2005. EPDRB Task Force, Vienna, 1995.

Esty, Daniel C., Jack A. Goldstone, Ted Robert Gurr, Pamela T. Surko. Working Papers: State Failure Task Force Report. 1995.

Esty, Daniel C., Jack A. Goldstone, Ted Robert Gurr, Barbara Harff, Marc Levy, Geoffrey D. Dabelko, Pamela T. Surko, and Alan N. Unger. State Failure Task Force Report: Phase II Findings. 1998.

Esty, Daniel C. "Pivotal States and the Environment" in United States and the Pivotal States: Testing an Intellectual Hypothesis. Paul Kennedy, et al. (eds). New York: Norton, 1998.

Esty, Daniel C. "Economic Integration and the Environment" in The Global Environment: Institutions, Law, and Policy. Washington DC: CQ Press, 1999.

Esty, Daniel C., Jack A. Goldstone, Ted Robert Gurr, Barbara Harff, Marc Levy, Geoffrey D. Dabelko, Pamela T. Surko, and Alan N. Unger. "State Failure Task Force Report: Phase II Findings." Environmental Change and Security Project Report, Issue 5, Summer 1999.

European Bank for Reconstruction and Development. Transition Report 1999: Ten Years of Transition. London: EBRD, 1999.

European Bank for Reconstruction and Development. Transition Report 2000: Employment, Skills and Transition. London: EBRD, 2000.

European Commission. Towards Environmental Pressure Indicators for the EU. Belgium: European Communities Publication, 1999.

European Environment Agency. Environmental Signals. Copenhagen: EEA, 2000.

European Environment Agency. Environment in the European Union at the Turn of the Century. Copenhagen: EEA, 2000.

Fredriksson, Per. Trade, Global Policy, and the Environment. Discussion Paper, World Bank, Washington, D.C., 1999.

Georgia Ministry of Environment. State of the Environment: Country Overview – Georgia. European Union's TACIS Programme. April 1998.

Gleditsh, Nils Petter and Bjorn Otto Sverdrup. "Democracy and the Environment," Paper presented to the Fourth National Conference in Political Science, Geilo, Norway, January 1996.

Hamilton, Kirk and Ernst Lutz. Green National Accounts: Policy Uses and Empirical Experience. Paper No. 39, Environmental Economics Series, World Bank, 1996.

Hammond, Allen, Albert Adriannse, Eric Rodenburg, Dirk Byant, and Richard Woodward. Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development. World Resources Institute, 1995.

Homer-Dixon, Thomas. Environment, Scarcity, and Violence. Princeton NJ: Princeton University Press, 1999.

Huntington, Samuel P. The Clash of Civilizations and the Remaking of the World Order. New York: Simon and Schuster, 1996.

Keen, Robert and James D. Spain. Computer Simulation in Biology: A Basic Introduction. John Wiley and Sons, New York, 1992.

Kennedy, Paul. Preparing for the Twenty-First Century. New York: Random House, 1993.

National Intelligence Council. Global Trends 2015: A Dialogue About the Future with Nongovernment Experts. NIC Paper 2000-02, December 2000.

National Research Council. Our Common Journey: A Transition Toward Sustainability. National Academy Press, 2000.

Opposing Viewpoints, Population. San Diego: Greenhaven Press, 2000.

Organisation for Economic Co-Operation and Development. Environmental Indicators: A Review of Selected Central and Eastern European Countries. Paris: OECD, 1996.

Organisation for Economic Co-Operation and Development. Towards Sustainable Development – Environmental Indicators. Paris: OECD, 1998.

Organisation for Economic Co-Operation and Development. Environmental Trends in Transition Economies. Policy Brief. Paris: OECD, 1999.

Organisation for Economic Co-Operation and Development. OECD Environmental Outlook. Paris: OECD Environmental Directorate, 2001.

Panayotou, Theodore. "Economic Growth and the Environment." Center for International Development at Harvard - Working Papers No. 56, July 2000.

Phillips, John L. Jr. How to Think About Statistics. New York: W.H. Freeman and Company, 1992.

Pielou, E.C. The Interpretation of Ecological Data: A Primer on Classification and Ordination. New York: John Wiley & Sons, 1984.

Porter, Michael E., Jeffrey D. Sachs, Andrew M. Warner, Peter K. Cornelius, Macha Levinson, and Klaus Schwab, eds. The Global Competitiveness Report 2000. New York: Oxford University Press, 2000.

Segnestam, Lisa. Environmental Performance Indicators: A Second Edition Note. Paper No. 71. Washington DC: World Bank, October 1999.

Singer, Max. "Global Population Will Decrease After 2050." Population: Opposing Viewpoints. [excerpted from the Atlantic Monthly, August 1999]. San Diego: Greenhaven Press, 74-81.

Smeets, Edith, and Rob Weterings. Environmental Indicators: Typology and Overview. Technical Report No. 25. Copenhagen: European Environment Agency, 1999.

Steinbruner, John D. Principles of Global Security. Washington DC: Brookings Institution Press, 2000.

United Nations Development Programme. Human Development Report 2000. New York: Oxford University Press, 2000.

White House. A National Security Strategy for a Global Age. December, 2000.

World Bank, Environmental Department. Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development. Washington, DC, 1997.

World Resources Institute. World Resources 2000-2001: People and Ecosystems. Washington DC: WRI, 2000.

Periodical Articles

Carstens, David H. “Bringing Environmental and Economic Internationalism into US Strategy.” Parameters: US Army War College Quarterly (Spring 2001): 99-108.

Chang-Ching Yu, John T. Quinn, Christian M. Dufournaud, Joseph J. Harrington, Peter P. Rogers and Bindu N. Lohani. “Effective Dimensionality of Environmental Indicators: A Principal Component Analysis with Bootstrap Confidence Intervals.” Journal of Environmental Management (May 1998): 101-119.

Chase, Robert S., Emily B. Hill, and Paul Kennedy. "Pivotal States and U.S. Strategy," Foreign Affairs (January/February 1996): 33-51.

Crabtree, Bob, and Neil Bayfield. “Developing Sustainability Indicators for Mountain Ecosystems: A Study of the Cairngorms, Scotland.” Journal of Environmental Management (January 1998): 1-14.

Economist. "Green and Growing: Sustainable Growth." Economist (January 2001): 74-75.

Ehrlich, Paul R., Gretchen C. Daily, Scott C. Daily, Norman Myers, and James Salzman. “No Middle Way on the Environment”. The Atlantic Monthly (December 1997).

Fagin, Adam and Petr Jehlicka. “Sustainable Development in the Czech Republic: A Doomed Process? Environmental Politics (Spring 1998): 113-128.

Gleick, Peter H. “Environment and Security: The Clear Connections.” The Bulletin of the Atomic Scientists (April 1991): 123-127.

Hauge, Wenche, and Tanja Ellingsen. "Beyond Environmental Scarcity: Causal Pathways to Conflict." Journal of Peace Research No. 3 (May 1998): 299-317.

Helman, Gerald, and Steven R. Ratner. “Saving Failed States.” Foreign Policy No. 89 (Winter 1992-93): 3-20.

Homer-Dixon, Thomas F. "Environmental Scarcities and Violent Conflict." International Security (Summer 1994): 5-40.

Jaggers, Keith, and Ted Robert Gurr. "Tracking Democracy's Third Wave with the Polity III Data." Journal of Peace Research No. 4 (1995): 469-482.

Klare, Michael T. “The New Geography.” Foreign Affairs (May/June 2001): 49-61.

Michalos, Alex C. “Combining Social, Economic and Environmental Indicators to Measure Sustainable Human Well-Being.” Social Indicators Research No. 40 (1997): 221-258.

Midlarsky, Manus I. "Democracy and the Environment: An Empirical Assessment." Journal of Peace Research No. 3 (May 1998): 341-361.

Norton, Richard J., and James Miskel. “Spotting Trouble: Identifying Faltering and Failing States.” Naval War College Review (Spring 1997): 79-91.

Percival, Val and Thomas Homer-Dixon. “Environmental Scarcity and Violent Conflict: The Case of South Africa.” Journal of Peace Research No. 3 (May 1998): 279-98.

Steinke, Ralph R. and Brian L. Tarbet. “Theater Engagement Plans: A Strategic Tool or a Waste of Time?” Parameters (Spring 2000): 69-81.

Tir, Jaroslav, and Paul F. Diehl. "Demographic Pressure and Interstate Conflict: Linking Population Growth and Density to Militarized Disputes and Wars, 1930-89." Journal of Peace Research No. 3 (May 1998): 319-339.

Lectures, Interviews, and Electronic Mail

Bovill, Kathryn. “State Failure Project.” [E-mail to Steve Hearne <hearnes@nwc.navy.mil>,17 May 2001].

Czaarzasty, Paul M. LTC. “Georgia in the News Sources” Excerpt from Oil and Gas Report for 23-29 March 2001, Volume N 12 (477) [E-mail to Steve Hearne hearnes@nwc.navy.mil>, 30 March 2001].

Kaplan, Robert D. “2001 Jerome E. Levy Lecture in Economic Geography and World Order.” Lecture Notes, Naval War College, Newport, 9 April 2001.

International Institute for Sustainable Development. “Dashboard of Sustainability” Demonstration during Ninth Session, United Nations Commission on Sustainable Development (CSD 9) Meeting, 16-27 April 2001, United Nations Headquarters. [E-mail to Steve Hearne <hearnes@nwc.navy.mil>, 27 April 2001].

Rogers, Gary T. LtCol. “2001 Regional Working Group Packet and Materials for United States European Command announced in message DTG 251336Z JAN 01.” [E-mail to Steve Hearne <hearnes@nwc.navy.mil>, 2 April 2001].

Military Publications

Chairman of the Joint Chiefs of Staff. Theater Engagement Planning: CJCSM 3113.01A. 31 May 2000.

Moloff, Alan. "Environmental Security and Engagement in Central Command.” US Army War College Strategy Research Project, Carlisle, 7 April 2000.

National Military Strategy, Shape, Respond, Prepare Now – A Military Strategy for a New Era, 1997, <http://www.dtic.mil/jcs/core/strategi.html> [16 Oct 00].

North Atlantic Treaty Organization. Environment & Security in an International Context. Committee on the Challenges of a Modern Society Report No. 232. NATO, 1999.

United States European Command. Strategy of Readiness and Engagement. Stuttgart, 1998.

Internet

Bousquet, Alain, and Pascal Favard. "Does S. Kuznets' Belief Question the Environmental Kuznets Curves?." 6 November 2000. 15 March 2001 <http://idei.asso.fr/Commun/WorkingPapers/F2000/107-00.pdf>.

Bradford, David F., Rebecca Schlieckert, and Stephen H. Shore. "The Environmental Kuznet Curve: Exploring a Fresh Specification." National Bureau of Economic Research Working Paper, No. 8001. November 2000. 15 March 2001 <http://www.nber.org/papers/w8001>.

Consultative Group on Sustainable Development Indicators. 1999. "Aggregated Indices." 16 March 2001 <http://www.iisd.org/cgsdi/indices.htm>.

Consultative Group on Sustainable Development Indicators. "Visual Models: The Dashboard of Sustainability." 3 April 2001 <http://www.iisd.org/cgsdi/dashboard.htm>.

Department of State. "Regional Environmental Hub Program" – Fact Sheet. 22 September 2000 <http://www.state.gov/www/global/oes/envir_hubs/index.html>

Eberstadt, Nicholas. "The Population Explosion." Foreign Policy. March-April 2001. 19 March 2001 <http://www.foreignpolicy.com/issue_marapr_2001/eberstadt.html>: 1-8.

Esty, Daniel C., Jack Goldstone, Ted Robert Gurr, Barbara Harff, Pamela T. Surko, Alen N. Unger, and Robert Chen. "The State Failure Project: Early Warning Research for U.S. Foreign Policy Planning." Conference Proceedings: Failed States and International Security: Causes, Prospects, and Consequences. Purdue University, 25-27 February, 1998. 16 March 2001 <http://www.ippu.purdue.edu/info/gsps/FSIS_CONF/gurr_paper.html>.

European Commission. "The EU's Relations with Georgia – An Overview." 16 March 2001 <http://europa.eu.int/comm/external_relations/georgia/intro/index.htm>.

European Environment Agency. Sustainability Targets and Reverence Value (STAR) Database. 11 April 2001 <http://star.eea.eu.int/asp/default.asp>.

Freedom House. Nations in Transit: 1999-2000. 28 April 2001 <http://www.freedomhouse.org/esearch/nitransit/2000/pdf_docs.htm>.

Freedom House. The Annual Survey of Political Rights and Civil Liberties 1999-2000. 12 February 2001 <http://www.freedomhouse.org/survey/2000>.

Global Leaders for Tomorrow Environmental Task Force, World Economic Forum. 2001_ Environmental Sustainability Index, Report to Annual Meeting, Davos, 2001. <http://www.ciesin.columbia.edu/indicators/ESI/downloads.html>

Hardi, Peter and Alan AtKisson. "The Dashboard of Sustainability." Draft Design Specifications Document for the Consultative Group on Sustainable Development Indicators, October 1999. 3 April 2001 <http://www.iisd.org/cgsdi/dashboard.htm>.

Japaridze, Tedo. "Development and General Significance of the Eurasian Corridor." Conference Proceedings: Future Prospects for the Eurasian Corridor. John F. Kennedy School of Government, 23 April 1998. 19 March 2001 <https://wwwc.cc.columbia.edu/sec/dlc/ciao/conf/jfk05/jfk05b.html>.

Jesinghaus, Jochen. “A European System of Environmental Pressure Indices, First Volume of the Environmental Pressure Indices Handbook: The Indicators.” European Commission, Joint Research Centre, Draft 20 April 1999. 3 April 2001 <http://esl.jrc.it/envind/theory/handb_.htm>.

Jesinghaus, Jochen. “Indicators for Decision Making.” Draft of 12.12.99. 3 April 2001 <http://esl.jrc.it/envind/idm/idm_e_.htm.

Joint Research Centre. “The CGSDI Dashboard of Sustainability - Version 3.3”. 16 March 2001 <http://esl.jrc.it/envind/dashbrds.htm>.

Joint Research Centre. “The Methodology used for the Dashboard Software Tool.” 16 March 2001 <http://esl.jrc.it/envind/db_meths.htm>.

Kaplan, Robert D. “Where Europe Vanishes.” The Atlantic Monthly. November 2000. 9 April 2001 <http://www.theatlantic.com/issues/2000/11/kaplan.htm>, <http://www.theatlantic.com/issues/2000/11/kaplan2.htm>, and <http://www.theatlantic.com/issues/2000/11/kaplan3.htm>.

King, Gary and Langche Zeng. “Improving Forecasts of State Failure.” Unpublished Paper. 30 March 2001 <http://gking.harvard.edu/>.

Mason, John. “Failing Nations: What US Response?, William Patterson College of NJ. 19 April 2001 <http://www.wpunj.edu/wpcpages/sch-hmss/polisci/faculty/jmfailed.htm>.

Nicholson, Michael. “Failing States, Failing Systems.” Conference Proceedings: Failed States and International Security: Causes, Prospects, and Consequences. Purdue University, 25-27 February 1998. 16 March 2001 <http://www.ippu.purdue.edu/info/gsps/FSIS_CONF/mnpaper.html>.

Regional Environmental Center. “About the Regional Environmental Center (REC).” 16 October 2000 <http://www.rec.org/REC/Introduction/intro.html>.

United Nations Division for Sustainable Development. Report on the Aggregation of Indicators of Sustainable Development. Background Paper No. 2, for the Ninth Session of Commission on Sustainable Development, 16-27 April 2001, New York. 5 April 2001 <http://www.un.org/esa/sustdev/csd9/csd9_docs.htm>.

United Nations Division for Sustainable Development. Indicators of Sustainable Development: Framework and Methodologies. Background Paper No. 3, for the Ninth Session of Commission on Sustainable Development, 16-27 April 2001, New York. 15 April 2001 <http://www.un.org/esa/sustdev/csd9/csd9_docs.htm>.

University of Maryland, Center for International Development and Conflict Management. Polity IV Project: Dataset and User's Manual. 26 March 2001 <http://www.bsos.umd.edu/cidcm/polity/polreg.htm>.

Wallensteen, Paul. "State Failure, Ethnocracy and Democracy: New Conceptions of Governance." Conference Proceedings: Failed States and International Security: Causes, Prospects, and Consequences. Purdue University, 25-27 February 1998. 16 March 2001 <http://www.ippu.purdue.edu/info/gsps/FSIS_CONF/mnpaper.html>.

APPENDIX A

THE OECD CORE SET OF ENVIRONMENTAL INDICATORS

OECD Working Group on Environmental Information and Outlooks (WGEIO)

OVERVIEW OF CORE SET INDICATORS BY ENVIRONMENTAL ISSUE

Issue		Core indicators[181]	([182])
Climate change	Pressures	♦ **Index of greenhouse gas emissions**	M
		– CO_4 emissions	S
		– CH_4 emissions	S/M
		– N_2O emissions	S/M
		– CFC emissions (PFC, HFC, SF6)	S/M
	Conditions	♦ **Atmospheric concentrations of greenhouse gases**	S
		♦ **Global mean temperature**	
	Responses	♦ **Energy efficiency**	M/L
		– Energy intensity (i.e. total primary energy supply per unit of GDP or per capita)	S
		– Economic and fiscal instruments (e.g. energy prices and taxes, CO2 tax, expenditures)	S/M
Ozone layer depletion	Pressures	♦ **Index of apparent consumption of ozone depleting substances (ODP)**	M
		– Apparent consumption of CFCs/ and halons	S
	Conditions	♦ **Atmospheric concentrations of ODP**	S/M
		♦ **Ground level UV-B radiation**	
		– Stratospheric ozone levels	S/M
	Responses	♦ **CFC recovery rate**	M
Eutrophication	Pressures	♦ Emissions of N and P in water and soil ➔ **Nutrient balance**	L
		– N and P from fertilizer use and from livestock	S
	Conditions	♦ **BOD/DO, concentration of N & P in inland waters**	S/M
		♦ **BOD/DO, concentration of N & P in marine waters**	
	Responses	♦ **Population connected to biological and/or chemical sewage treatment plants**	M/L
		– User charges for waste water treatment	M
		– Market share of phosphate-free detergents	S/M
Acidification	Pressures	♦ **Index of acidifying substances**	M/L
		– Emissions of NO_x and SO_x	S
	Conditions	♦ **Exceedance of critical loads of pH in water & soil**	M/L
		– Concentrations in acid precipitation	S
	Responses	♦ **% of car fleet equipped with catalytic converters**	S/M
		♦ **Capacity of SO_x and NO_x abatement equipment of stationary sources**	M/L
Toxic contamination	Pressures	♦ **Emissions of heavy metals**	M/L
		♦ **Emissions of organic compounds**	L
		– Consumption of pesticides	S/M
	Conditions	♦ **Concentration of heavy metals & organic compounds in media & living species**	L
		– Concentration of heavy metals in rivers	S/M
	Responses	♦ **Changes of toxic contents in products and production processes**	L
		– Market share of unleaded petrol	S
Urban environmental quality	Pressures	♦ **Urban air emissions (SO_x, NO_x, VOC)**	M/L
		– Urban traffic density (or national)	M/S
		– Urban car ownership (or national)	S
		– Degree of urbanisation (urban population growth rates, urban land)	S/M
	Conditions	♦ **Population exposure to air pollution, to noise**	L/M
		– Concentrations of air pollutants	S
		♦ **Ambient water conditions in urban areas**	M/L
	Responses	♦ **Green space** (Areas protected from urban development)	M/L
		♦ **Economic, fiscal and regulatory instruments**	M
		– Water treatment and noise abatement expenditure	S/M

[181] Indicators of the Core Set proposed by the OECD Working Group on Environmental Information and Outlooks (former Working Group on the State of the Environment). It presents **main core** indicators (in bold), complementary indicators to accompany the message conveyed by "main" indicators, and proxy indicators when the "main" indicator is currently not measurable. Selected key indicators to be used for communication purposes are printed on a shaded background.

[182.] Each character specifies the indicator's measurability: S = short term, basic data currently available for a majority of OECD countries; M =medium term, basic data partially available, but calling for further efforts to improve their quality (consistency, comparability, timeliness) and their geographical coverage (number of countries covered); L = long term, basic data not available for a majority OECD of countries, calling for a sustained data collection and conceptual efforts.

APPENDIX A

THE OECD CORE SET OF ENVIRONMENTAL INDICATORS

OECD Working Group on Environmental Information and Outlooks (WGEIO)

Biodiversity	Pressures	♦ **Habitat alteration and land conversion from natural state** to be further developed, e.g. land use or cover change index; road network density	L
	Conditions	♦ **Threatened or extinct species as a share of assessed species**	S
		♦ **Area of key ecosystems**	M
	Responses	♦ **Protected areas as % of national territory, and by type of ecosystem** (focus on areas protected for biological reasons)	S/L
		– Protected species	S
Cultural landscapes		Indicators to be further developed e.g. Presence of artificial elements, Sites protected for historical, cultural or aesthetic reasons	
Waste	Pressures	♦ **Generation of waste (municipal, industrial, hazardous, nuclear)**	S
		– Movements of hazardous waste	S
	Responses	♦ **Waste minimisation** (to be further developed)	L
		– Recycling rates	S/M
		– Economic and fiscal instruments, expenditures	M
Water resources	Pressures	♦ **Intensity of use of water resources** (abstractions/available resources)	S
	Conditions	♦ **Frequency, duration and extent of water shortages**	M/L
	Responses	♦ **Water prices and user charges for sewage treatment**	S/M
Forest resources	Pressures	♦ **Intensity of forest resource use** (actual harvest/productive capacity)	M
	Conditions	♦ **Area, volume and structure of forests**	S/M
	Responses	♦ **Forest area management and protection** (e.g. % of protected forest area in total forest area; % of harvest area successfully regenerated of afforested)	M/L
Fish resources	Pressures	♦ **Fish catches** (intensity of use of fish resources)	S
	Conditions	♦ **Size of spawning stocks**	M
	Responses	♦ **Fishing quotas**	S/M
Soil degradation (desertification & erosion)	Pressures	♦ **Erosion risks: potential and actual use of land for agriculture**	L
		– Change in land use	S
	Conditions	♦ **Degree of top soil losses**	M/L
	Responses	♦ **Rehabilitated areas**	M/L
Material resources (new issue)		♦ **Intensity of use of material resources** (Indicators to be developed, link to Material Flow Accounting)	
Socio-economic, sectoral and general indicators *(not attributable to specific issues)*	Pressures	♦ **Population growth & density**	S
		♦ **Growth and structure of GDP**	S
		♦ **Private & government final consumption expenditure**	S
		♦ **Industrial production**	S
		♦ **Structure of energy supply**	S
		♦ **Road traffic volumes;**	S
		♦ **Stock of road vehicles**	S
		♦ **Agricultural production**	S
	Responses	♦ **Environmental expenditure**	M/L
		– Pollution abatement and control expenditure	S/M
		– Official Development Assistance (indicator added on the basis of experience with environmental performance reviews)	S
		♦ **Public opinion**	S

APPENDIX B
Terms and Abbreviations

BOD	Biochemical Oxygen Demand
CCMS	Committee on the Challenges of Modern Society
CGSDI	Consultative Group on Sustainable Development Indices
CIDCM	Center for International Development and Conflict Management
CINC	Commander-in-Chief
CO_2	Carbon Dioxide
CSD	Commission on Sustainable Development
DOD	Department of Defense
DPSIR	Driving Force-Pressure-State-Impact-Response
DSR	Driving Force-State-Response
EC	European Commission
EEA	European Environment Agency
EKC	Environmental Kuznets Curve
EPI	Environmental Performance Indicators; Environmental Pressure Index
ESI	Environmental Sustainability Index
EU	European Union
EUCOM	European Command
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Greenhouse Gases
GNP	Gross National Product
HDI	Human Development Index
IISD	International Institute for Sustainability
IMF	International Monetary Fund
ISO	International Standards Organization
IUCN	World Conservation Union (continue to use old acronym)
NATO	North Atlantic Treaty Organization
NGO	Non-Governmental Organization
NMS	National Military Strategy
NMVOC	Non-Methane Volatile Organic Compounds
NO_2	Nitrogen Dioxide
NO_x	Nitrogen Oxides
NSS	National Security Strategy
ODA	Official Developmental Assistance
OECD	Organization for Economic Co-Operation and Development
PCA	Principal Component Analysis
PPI	Policy Performance Index
PSR	Pressure-State-Response
R&D	Research and Development

APPENDIX B
Terms and Abbreviations (Continued)

REC	Regional Environmental Center
RRAM	Regional Resource Apportionment Matrix
RWG	Regional Working Group
SDI	Sustainable Development Index
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
TEP	Theater Engagement Plan
TSP	Total Suspended Particulates
TSPS	Theater Strategic Planning System
UN	United Nations
U.S.	United States
VOC	Volatile Organic Carbon