WORLD ECONOMIC FORUM

Pilot Environmental Sustainability Index

An Initiative of the
Global Leaders for Tomorrow Environment Task Force,
World Economic Forum

Annual Meeting 2000
Davos, Switzerland

In collaboration with

Yale Center for Environmental Law and Policy (YCELP)
Yale University

Center for International Earth Science Information Network (CIESIN)
Columbia University

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February, 2000

This report is the result of collaboration among the Global Leaders for Tomorrow (GLT) Environment Task Force, the Yale Center for Law and Environmental Policy (YCELP) and the Columbia University Center for International Earth Science Information Network (CIESIN).

The GLT team was led by Kim Samuel-Johnson. The Environment Task Force members (listed on the inside cover) benefited from the participation of a number of experts in environmental sustainability and indicators who attended a workshop in New Haven, Connecticut on September 30-October 1, 1999, including Alan AtKisson, Christian P. Avérous, Peter Cornelius, Kirk Hamilton, Allen Hammond, Theodore Heintz, Kai Lee, William Nordhaus, Gus Speth, Andreas Sturm, Phillip Toyne, and Claas van der Linde.

The YCELP team was led by Daniel C. Esty; other team members include Jennifer Daniels, Elizabeth Jenkins, Lisa Max, and Brian Fletcher.

The CIESIN team was led by Marc A. Levy; other team members include Deborah Balk, Bob Chen, Alex de Sherbinin, Francesca Pozzi and Antoinette Wannebo. Additional assistance is gratefully acknowledged from Janice Aitchison (Columbia Earth Institute Office of External Relations), Jen Mulvey, Ed Ortiz, Carrie Keneally, Francesco Fiondella and Melanie Brickman. Tom Parris provided very helpful advice.

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We seek here to create a Pilot Environmental Sustainability Index, as part of an exploratory effort to measure the ability of economies to achieve environmentally sustainable development. The Index is calculated utilizing a number of data sources that cover a range of fundamental components of environmental sustainability. These components, and the 64 individual variables that go into the index, were identified in consultation with a range of international experts.

We draw three primary conclusions from this pilot effort:

First, it is possible to construct a single index measuring environmental sustainability, generating results that appear to be both plausible and useful. Such an index can serve a helpful role in gauging the progress of the world's economies in achieving environmental sustainability. It makes use of a breadth of available information while generating a simple, easy-to-understand benchmark.

Second, by comparing the Prototype Environmental Sustainability Index with the Economic Competitiveness Index and other measures of economic performance, it is possible to shed light on debates over the degree to which economic and environmental objectives are in conflict. Our analysis suggests that decisions of how vigorously to pursue environmental sustainability and of how vigorously to pursue economic growth are in fact two separate choices. These results are consistent with the hypothesis that high levels of environmental protection are compatible with, or possibly even encourage, high levels of economic growth, though they do not prove it.

Third, there is considerable work to be done to move from the Pilot Index presented here to a more refined index in the future. A number of serious limitations in the available data relevant to environmental sustainability drastically limit the ability of the world community to monitor the most basic pollution and natural resource trends. We find this inexcusable and offer some suggestions for how to help correct the situation. We also recognize that there are significant methodological questions that remain to be addressed. We have not, most notably, "weighted" the factors that go into the Index. We hope over time to identify drivers of environmental sustainability and to use regression analysis and other more sophisticated methods to test more rigorously what policies promote sustainability.

Pilot Environmental Sustainability Index
(for illustrative purposes)

Top Quintile	Australia Austria Canada Denmark Finland France Iceland Ireland New Zealand Norway Sweden Switzerland
Second Quintile	Argentina Germany Israel Japan Netherlands Portugal Russia Slovak Republic Spain United Kingdom United States
Third Quintile	Belgium Bolivia Brazil Chile Costa Rica Czech Republic Ecuador Hungary Italy Korea Poland
Fourth Quintile	Bulgaria China Colombia Greece Indonesia Jordan Malaysia Mauritius Singapore South Africa Venezuela
Lowest Quintile	Egypt El Salvador India Mexico Peru Philippines Thailand Turkey Ukraine Vietnam Zimbabwe

(Economies listed in alphabetical order within each quintile.)

The Need for an Environmental Sustainability Index

Recent efforts to construct environmental indicators and sustainable development indicators have dramatically enhanced our ability to monitor conditions relevant to environmental sustainability. The pathbreaking work of the Organization for Economic Cooperation and Development, followed by a range of efforts by groups such as the United Nations Commission on Sustainable Development, the World Resources Institute, Worldwatch, the International Institute for Sustainable Development, the informal "Consultative Group on Sustainable Development Indicators", as well as a number of national-level initiatives, constitute major contributions.

Yet there remains a significant gap. There is still no index that serves an analogous role to that of the Gross Domestic Product (GDP) with respect to economic growth, providing in a single measure a benchmark for judging progress toward achieving environmental sustainability. There are efforts to construct wide-ranging collections of environmental indicators, to create customized sustainability indicators that suit the circumstances of particular locations, and to create indicators of sustainable development that encompass a range of environmental, social and political phenomena. While we applaud these efforts, because they meet important needs, we are convinced that there is a need for an Environmental Sustainability Index that is capable of being expressed in a single measure for each economy, and is focused strictly on environmental matters.

The purpose of this study has been to construct such an index on a pilot basis to learn how feasible the task is given the state of available data, to explore potential uses of such an index, and to learn lessons about how a more ambitious version of the Index could be developed.

The results presented here are intended to serve these objectives alone. The methods used are experimental and should not be construed as definitive statements about precise levels of environmental sustainability. Indeed, we recognize that there remain important methodological issues that still must be addressed. For instance, the Pilot Index presented here does not differentially "weight" the variables. Of course, any attempt to provide weights entails a significant exercise in judgment that will inescapably turn on values, perspectives, and potential costs and benefits that vary from person to person and country to country.

The Path Ahead

This Pilot Environmental Sustainability Index will be refined in the months and years ahead. This prototype unveiled here is meant to stimulate a debate and dialogue over what constitutes environmental sustainability, how to measure the concept, what data are needed and where they can be found (or developed), what should count as good performance, how to weight different components of environmental sustainability, what methodology should be pursued in constructing an index, and what policy choices drive sustainability.

We hope that future work will enable us to make the Index more sophisticated and reliable—and permit us to isolate the "drivers" of environmental sustainability. In this regard, we plan to evolve toward the model provided by the World Economic Forum’s Global Competitiveness Index and to employ advanced statistical techniques, including regression analysis, to help further our understanding of the individual roles of natural endowments, pollution and resource stresses, public health and social conditions, cultural norms and preferences, as well as policy choices in determining the environmental sustainability of particular economies. This exercise, requiring systematic unpacking and analysis of the concept of environmental sustainability, has just begun.

How the Pilot Index was Constructed

The Pilot builds on an extensive data base covering 56 economies. It was constructed in a hierarchical fashion, as summarized in the following diagram:

ENVIRONMENTAL SUSTAINABILITY INDEX

↑

COMPONENTS (5)

↑

FACTORS (21)

↑

VARIABLES (64)

The five components were derived from a careful analytic exercise aimed at systematically identifying the factors that comprise environmental sustainability consistent with recent scholarship. The components describe the current environmental systems; stresses to those systems; the vulnerability of human populations to environmental disturbances and disasters; the social and institutional capacity to respond to environmental problems (including governance systems); and global stewardship, or the degree to which an economy behaves responsibly with respect to other economies (through its consumption patterns and efforts to manage common environmental problems). This scheme has much in common with the widely used "pressure-state-response" framework, but seeks to be more comprehensive in scope by adding components on vulnerability and global stewardship; these are especially important when one moves from "environmental" indicators to "environmental sustainability" indicators. In the table that follows, we spell out the underlying logic for these components.

Table 1. Components of the Pilot Environmental Sustainability Index

COMPONENT	LOGIC
Environmental Systems	An economy is environmentally sustainable to the extent that its vital environmental systems are maintained at healthy levels, and to the extent to which levels are improving rather than deteriorating.
Environmental Stresses and Risks	An economy is environmentally sustainable if the levels of anthropogenic stress are low enough to engender no demonstrable harm to its environmental systems.
Human Vulnerability to Environmental Impacts	An economy is environmentally sustainable to the extent that people and social systems are not vulnerable (in the way of health impacts, economic losses, and so on) to environmental disturbances; becoming less vulnerable is a sign that an economy is on a track to greater sustainability.
Social and Institutional Capacity	An economy is environmentally sustainable to the extent that it has in place political institutions and underlying social patterns of skills, attitudes and networks that foster effective responses to environmental challenges.
Global Stewardship	An economy is environmentally sustainable if it cooperates with other countries to manage common environmental problems, and if it reduces negative environmental impacts on other countries to levels that cause no serious harm.

These components consist of a number of *factors* considered to constitute the most fundamental building blocks of each component. A total of 21 such factors were identified. For each factor, *variables* were identified to serve as measures. A detailed listing of the factors and variables—including the theoretical foundation for the inclusion of each variable—is included in Table 6.

Preliminary Analysis of Pilot Environmental Sustainability Index

The results of the prototype Index are summarized in Table 5. We stress that there is no foolproof way to validate such a measure, and that therefore these results should be used as intended only: to facilitate an exploration into the methods used and to foster debate about how to improve the Index.

The results for the Pilot Environmental Sustainability Index appear intuitively plausible, although there are some anomalies that are discussed below.

One of our motivations in creating the Index was to test whether it could shed light on the debate over the relationship between economic growth and environmental protection. To do so we plotted the Index against two measures of economic performance, economic growth rates between 1993-1998 and the 1999 Economic Competitiveness Index. The results appear in Figures 1-4.

Figure 1

Relationship between Environmental Sustainability and Economic Growth 1993-1998

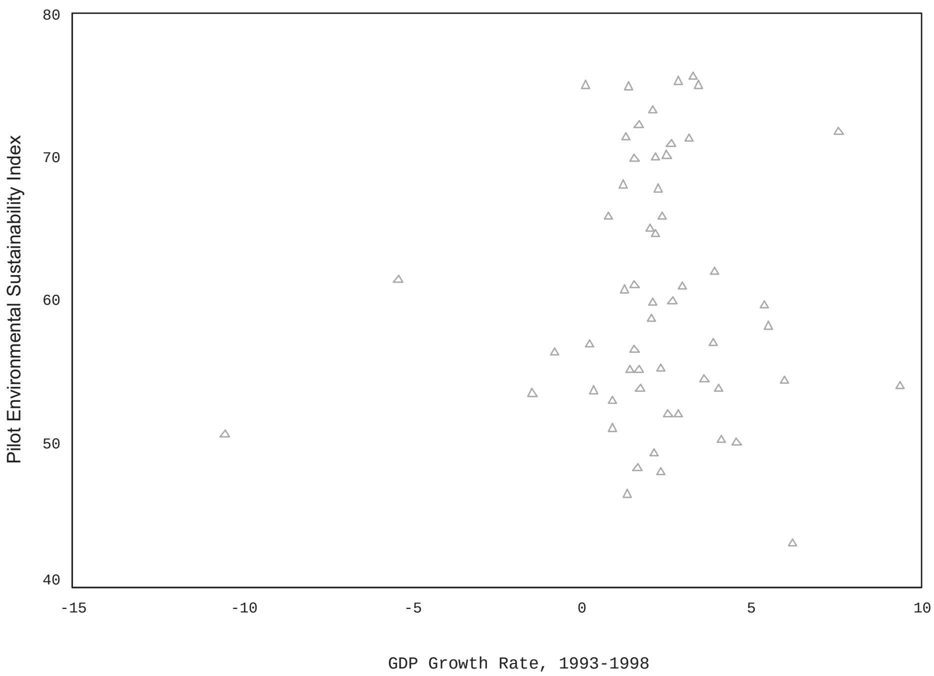


Figure 1 suggests that there is no clear relationship between a country's observed economic growth rate and its Pilot Environmental Sustainability Index. Some economies have grown fast and have low Environmental Sustainability measures; other fast growers have high Environmental Sustainability scores.

Figure 2

Relationship between Environmental Sustainability and Economic Competitiveness

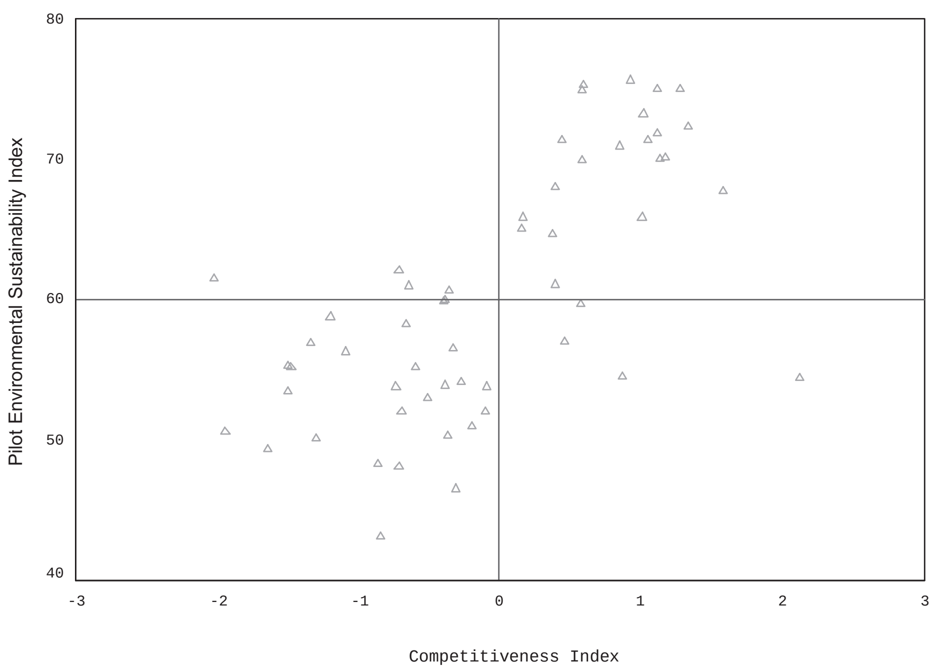


Figure 3

Environmental Sustainability and Economic Competitiveness:
(for illustrative purposes only)

The upper right quadrant

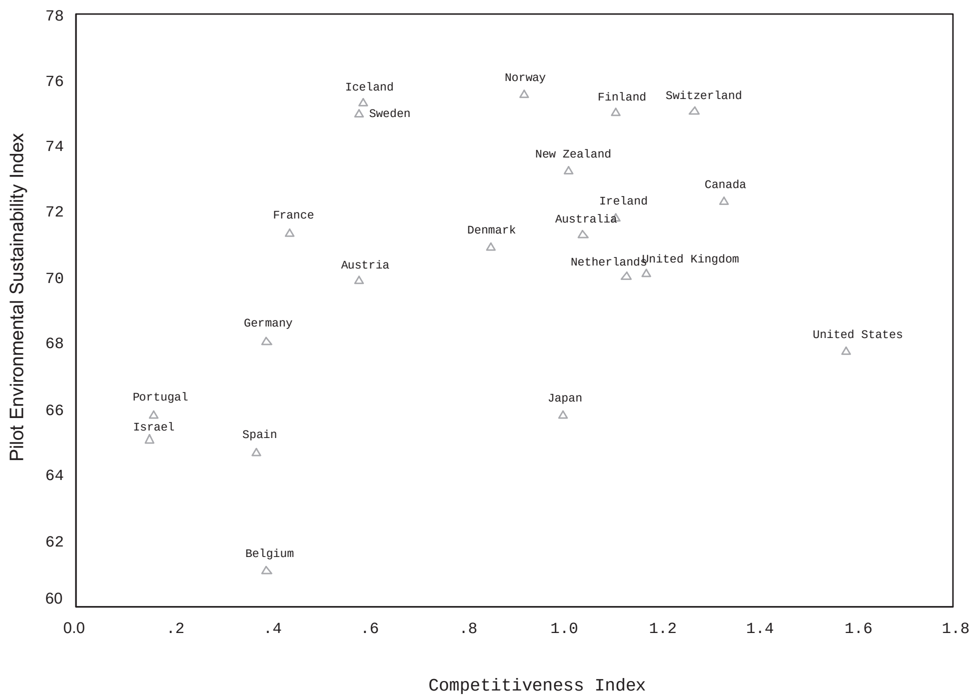
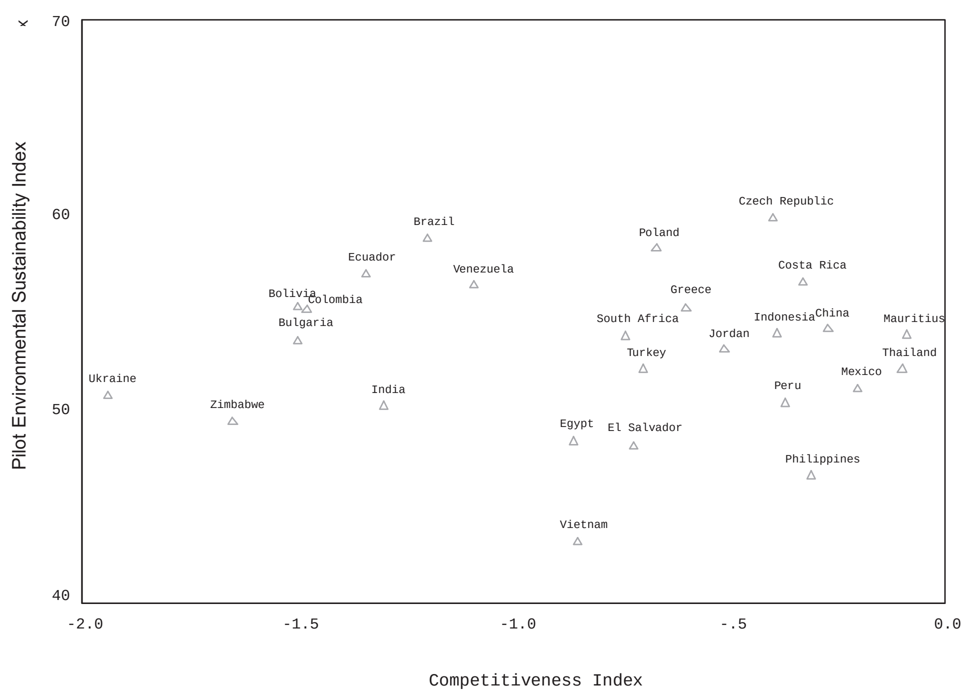


Figure 4

Environmental Sustainability and Economic Competitiveness:
(for illustrative purposes only)

The lower left quadrant



Figures 2-4 reveal a somewhat more nuanced picture concerning the relationship between the Pilot Environmental Sustainability Index and the Economic Competitiveness Index. Figure 2 suggests a correlation between the Competitiveness Index and the Pilot Environmental Sustainability Index and thus, possibly, a connection between good economic performance and good environmental performance. Numerically, this correlation is 0.79, compared to 0.03 between GDP growth rate and the Index.

However, this correlation dwindles considerably when one looks separately at the two dominant clusters of economies. The upper right quadrant of Figure 2 consists exclusively of advanced industrial economies. Within this group of economies, as seen in Figure 3, there is no strong relationship between the Pilot Environmental Sustainability Index and the Economic Competitiveness Index. If one follows a trajectory from Belgium up through Spain, Germany, France and Sweden, for example, one sees that within a narrow band on the Competitiveness Index scale there is room for considerable variation on the Pilot Environmental Sustainability Index. Similarly, moving across from France to Austria to Denmark to Australia to the United Kingdom and Canada, one sees that within a narrow range on the Pilot Environmental Sustainability Index there is widespread variation on competitiveness.

Figure 4 shows that the same observation can be made for economies in the lower left quadrant of Figure 2.

Taken together, these figures could be read to suggest that when it comes to making fundamental policy choices having to do with environmental sustainability and economic competitiveness, there is no significant trade-off. The choices appear to be distinct and separable. This is consistent with the well-known "Porter Hypothesis" which suggests that high levels of environmental protection are compatible with high levels of economic growth, and may even encourage the innovation that supports growth. Of course, correlation does not prove causation. But these preliminary results are interesting and merit further exploration.

To test whether the five components are measuring different aspects of environmental sustainability, we computed the degree to which they correlate with each other. The results appear in Table 2.

Table 2. Correlation among the Components of the Pilot Environmental Sustainability Index

	Environmental Systems	Stresses and Risks	Human Vulnerability	Social and Institutional Capacity	Global Stewardship
Environmental Systems	1.000				
Environmental Stresses and Risks	0.188	1.000			
Human Vulnerability	0.262	0.071	1.000		
Social and Institutional Capacity	**0.529	-0.009	**0.576	1.000	
Global Stewardship	**0.407	*0.269	*0.297	**0.529	1.000

*** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).*

The highest correlation (between the Social and Institutional Capacity Component and the Human Vulnerability Component) is 0.576. Overall the correlations are moderate, which suggests that in fact these five components have been framed in a way such that they constitute related but fundamentally distinct building blocks of environmental sustainability consistent with the underlying theoretical model.

We also measured the correlation of each factor with the Pilot Environmental Sustainability Index. The results are summarized here:

Table 3. Correlation with Pilot Environmental Sustainability Index (absolute value)

FACTOR	CORRELATION
Science and Technical Capacity	0.814
Avoiding Public Choice Failures	0.760
Water Quality	0.703
Public Health	0.682
Tracking Environmental Conditions	0.634
Environmental Regulations and Management	0.632
Capacity for Rigorous Policy Debate	0.620
Air quality	0.583
Contribution to International Efforts	0.568
Environmental Disasters Exposure	0.543
Basic Sustenance	0.524
Ecosystem Stress	0.506
Land	0.451
Eco-efficiency	0.415
Water Quantity	0.397
Population	0.396
Air Pollution	0.288
Water Pollution and Consumption	0.170
Biodiversity	0.149
Impact on Global Commons	0.149
Waste Production and Consumption	0.009

Note that five of the highest seven correlations are with social and institutional capacity factors. This suggests either that capacity is a fundamentally important driver behind environmental sustainability, or that we have inadvertently failed to distinguish the factors comprising social and institutional capacity effectively, thereby creating a degree of double-counting. We suspect the former is the case (partly because these factors correlate less well with each other than they do with the overall Index), but we cannot be definitive at this point. An important aspect of the follow-up to this pilot study will be to explore this issue in greater depth.

Finally, we measured the correlation of each variable with the overall Pilot Environmental Sustainability Index. This gives us a first-order estimate of the sensitivity of the Pilot Index to each variable. The variables with correlations greater than 0.5 are reported here:

Table 4. Variables That Have Correlations (absolute value) Greater Than 0.5 with Pilot Environmental Sustainability Index.

VARIABLE	CORRELATION
Scientific and Technical Articles per million population	0.85
Corruption Perceptions Index, 1999	0.83
Civil Liberties, 1998-1999	0.79
Lead Concentration in Water	0.73
Expenditure for R&D as a Percentage of GNP	0.72
Dissolved Oxygen Concentration	0.72
Infant Mortality Rate (per 1000 births)	0.70
Percentage Households with garbage collection)	0.69
R&D Scientists and Engineers per million population	0.69
1997 total environmental IO memberships	0.64
Consumption pressure (units per person)	0.62
Average of Normalized Mean Annual TSP	0.60
Energy efficiency	0.58
Urban SO2 concentration	0.57
Retail Prices for Premium Gasoline	0.55
Death loss from environmental disasters	0.54
Deforestation (% change 1990-1995)	0.51

We now turn to some observations on the results of the rankings of the individual components, shown in Figures 6-10.

Overall the rankings in the **Environmental Systems component** appear reasonable. In general, economies that rank high in this component have one of the following qualities: low population densities, high wealth, or a bounty of natural resources such as water or biodiversity. This component, while not yet fully developed, appears to capture the extent to which environmental systems are maintained at healthy levels.

The **Environmental Stress component** has two anomalies worthy of discussion. The overall variance is lower than expected – the curve appears too flat given what we know about variation in environmental stress globally, and the rank order has some inconsistencies with conventional wisdom about variation in environmental stress. Two specific anomalies are worthy of mention—Russia scored far higher than we expected, and Singapore scored far lower. The impact can be seen in Figure 2, in which these two economies are clear outliers.

The Singapore anomaly is probably a function of the fact that, as a city-state, it possesses a qualitatively different environmental context than the other economies, all of which possess more conventional mixes of urban and rural areas and a greater diversity of ecosystems. Future versions of the Index will need to find effective ways to capture the idiosyncrasies of environmental circumstances that diverge markedly from the norm.

The Russia anomaly deserves greater scrutiny than has been possible in this pilot, but is apparently driven by a combination of factors including the following:

- rapid deindustrialization as result of the postcommunist transition
- rapid decline in population growth rates as result of emigration, increases in mortality, and falling birth rates
- poor environmental data
- an abundance of critical natural resources, especially water

As far as the Stress Component overall is concerned, the apparently imperfect nature of the rank order might also be driven by limitations in the available data. Stresses are hard to measure, because conceptually they require knowledge of interaction effects—i.e., what byproducts human activities are generating, but also the sensitivity to those byproducts of ecosystems and human health. A given level of sulfur dioxide, for example, will generate significantly varying levels of stress depending on the type of ecosystem present where it falls, the population in the area, and the nature of basic infrastructure in the area. There are few data sets that integrate sensitivity and exposure in this way, and none were included here because the processing costs were prohibitive for this preliminary exercise; they could be included in subsequent updates to this Index.

The **Human Vulnerability component** generates a reasonably plausible distribution of the world's economies. Future versions of the index would seek to make greater use of public health data that reflect environmental conditions, such as respiratory tract infections in children. Although there are few extant global data sets of such variables, we think they could be created by compiling data from national-level sources.

The **Social and Institutional Capacity component** also generates a plausible distribution of the world's countries. As far as we have been able to determine this is the first case of a consistent measure of nations' social and institutional capacity to promote environmental sustainability, and therefore represents an especially important contribution of this prototype. Insofar as the Index seeks to serve as an indicator of the degree to which nations are equipped to achieve sustainability over the medium to long run, this capacity measure is critical.

The **Global Stewardship component,** while crude and in need of more data and better measures, appears to be broadly effective at distinguishing among nations that take seriously their commitment to global environmental sustainability and those that do not.

The preliminary nature of this pilot effort must be stressed. As an especially thoughtful discussion of sustainability indicators concluded (NRC, 1999, p. 265):

> *Indicators used to report on a transition toward sustainability are likely to be biased, incorrect, inadequate, and indispensable. Getting the indicators right is likely to be impossible in the short term. But not trying to get the indicators right will surely compound the difficulty of enabling people to navigate through a transition to sustainability.*

We agree entirely with this sentiment, and hope that the results of this Pilot Environmental Sustainability Index will contribute to the long-term goal of environmental sustainability. Indeed, we see this effort as just a beginning—and, more importantly, as part of an ongoing dialogue.

In that spirit, we think that the effort to create this Pilot Environmental Sustainable Index has taught us a number of valuable lessons:

1) In spite of the challenges, it is possible to create a single index of environmental sustainability. While acknowledging the challenges of getting a single index "right," and acknowledging the assumptions and values that inescapably will be embedded in such an index, the benefits of having a tool to measure environmental performance justify the effort.

2) A more refined Index would help us to better understand the relationship between economic and environmental performance, something that has been very difficult to do in the absence of good data. We observe that when it comes to setting important social goals having to do with economic growth and environmental sustainability, these goals need not be seen as deeply or inherently in conflict. Rather the choices appear to be separable.

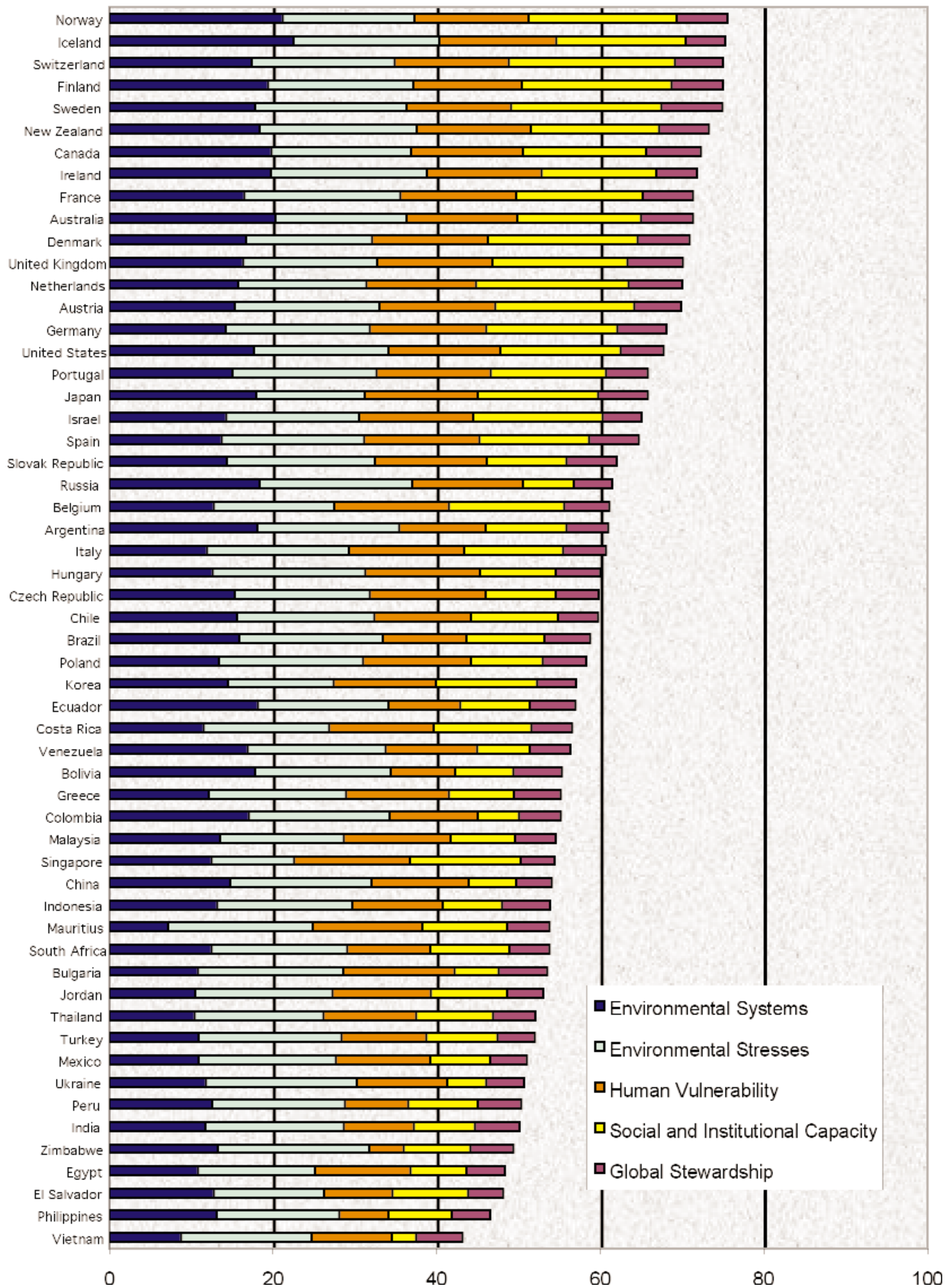
3) The available data are not adequate to generate an index that would have the same level of credibility and utility as economic measures such as GDP or the World Economic Forum's Economic Competitiveness Index. This is disappointing, but interventions are possible that would improve the situation. Significant opportunities exist, moreover, to improve the sophistication of the index-construction methodology and to expand the value of the exercise as a policy evaluation tool.

4) These results demand further refinement and justify additional work. The following improvements might be considered:

- A major investment in data gathering and creation could pay substantial dividends. To make up for the dearth of global, comparable data on such basic issues as water quality, air pollution, and soil erosion, we propose creating such data sets by making use of information currently fragmented in a variety of governmental, private institute, university and other holdings. With serious, but realistic, levels of effort we can create significant additions to the supply of global data on critical environmental trends. Some of the variables in this Pilot Index made use of this strategy, and we were encouraged by the results of those efforts. We would also like to expand coverage beyond the 56 countries in this pilot effort.
- Whereas the prototype Index seeks wherever possible to avoid imposing differential weights on the inputs into the Index, in reality it is not possible to combine various sources of data into a single number without applying some weighting scheme. Our decision not to do any weighting and thus implicitly to weight the factors equally could be refined. It would be better to investigate more thoroughly the scientific merits behind alternative weighting schemes, to debate such schemes publicly, and implement one that is theoretically defensible and that can claim a significant degree of legitimacy.
- It would be helpful to permit users to engage in alternative calculations of the Environmental Sustainability Index by creating a more interactive and flexible information system. Information technologies permit the creation of on-line systems that would let users add or remove variables, aggregate them into factors differently, and select alternative weighting schemes. Environmental policies need to be more data-driven. The world community should invest in data collection and analysis to facilitate improved pollution control and natural resource management over time.
- The Index would be more useful if it were linked more directly to efforts to understand the underlying drivers of environmental sustainability. Ecological quality and environment-related public health and capacity to maintain them over time depend on a number of factors including natural resource endowments, exposure to environmental stresses, the vitality of the systems under threat, and the speed and effectiveness of societal and policy response. It would be valuable to build a model that sorts out these factors and that identifies the critical points of possible policy leverage.

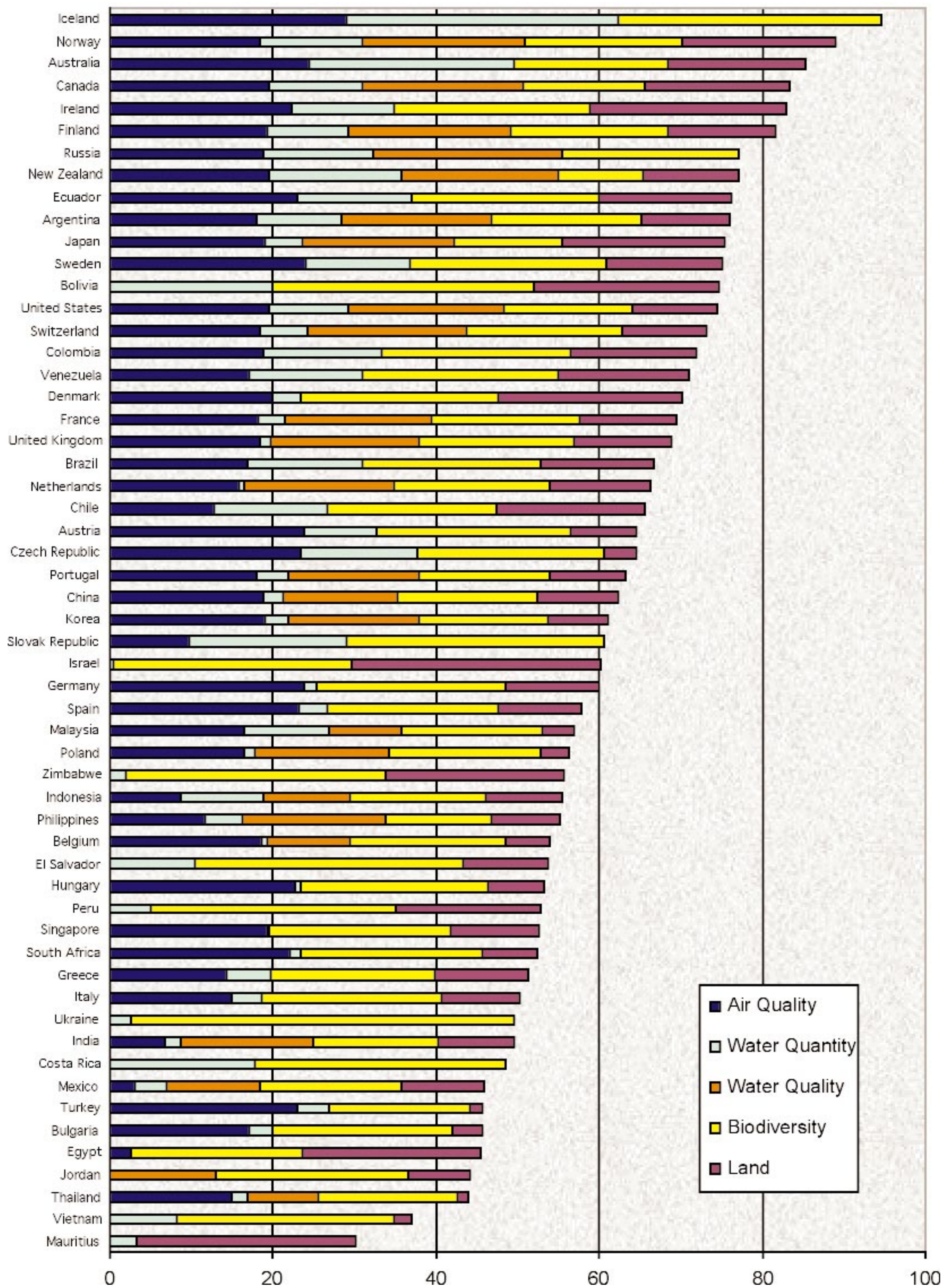
Figure 5. Pilot Environmental Sustainability Index

(for illustrative purposes)



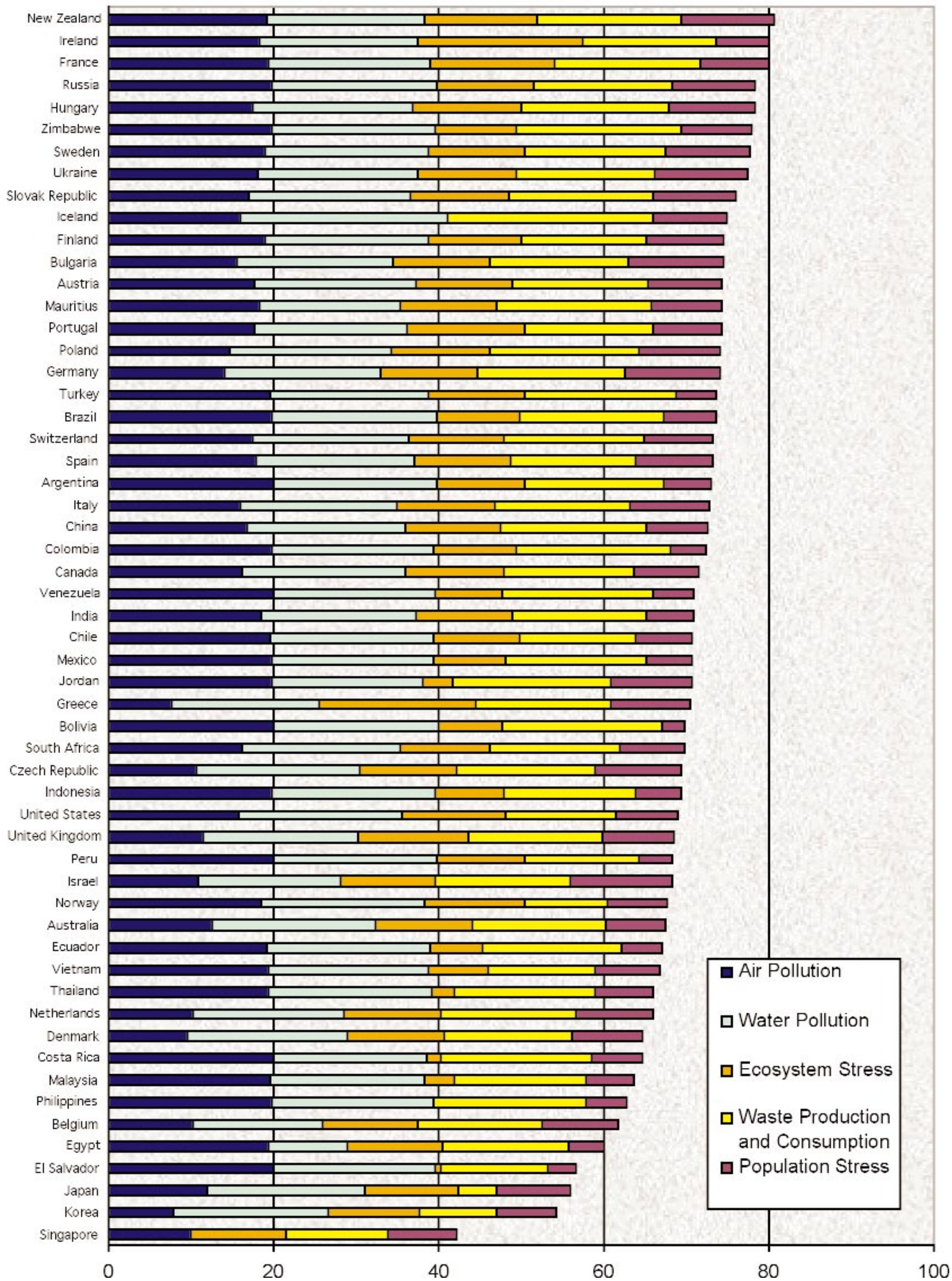
Longer bars denote greater levels of environmental sustainability.

Figure 6. Environmental Systems Component



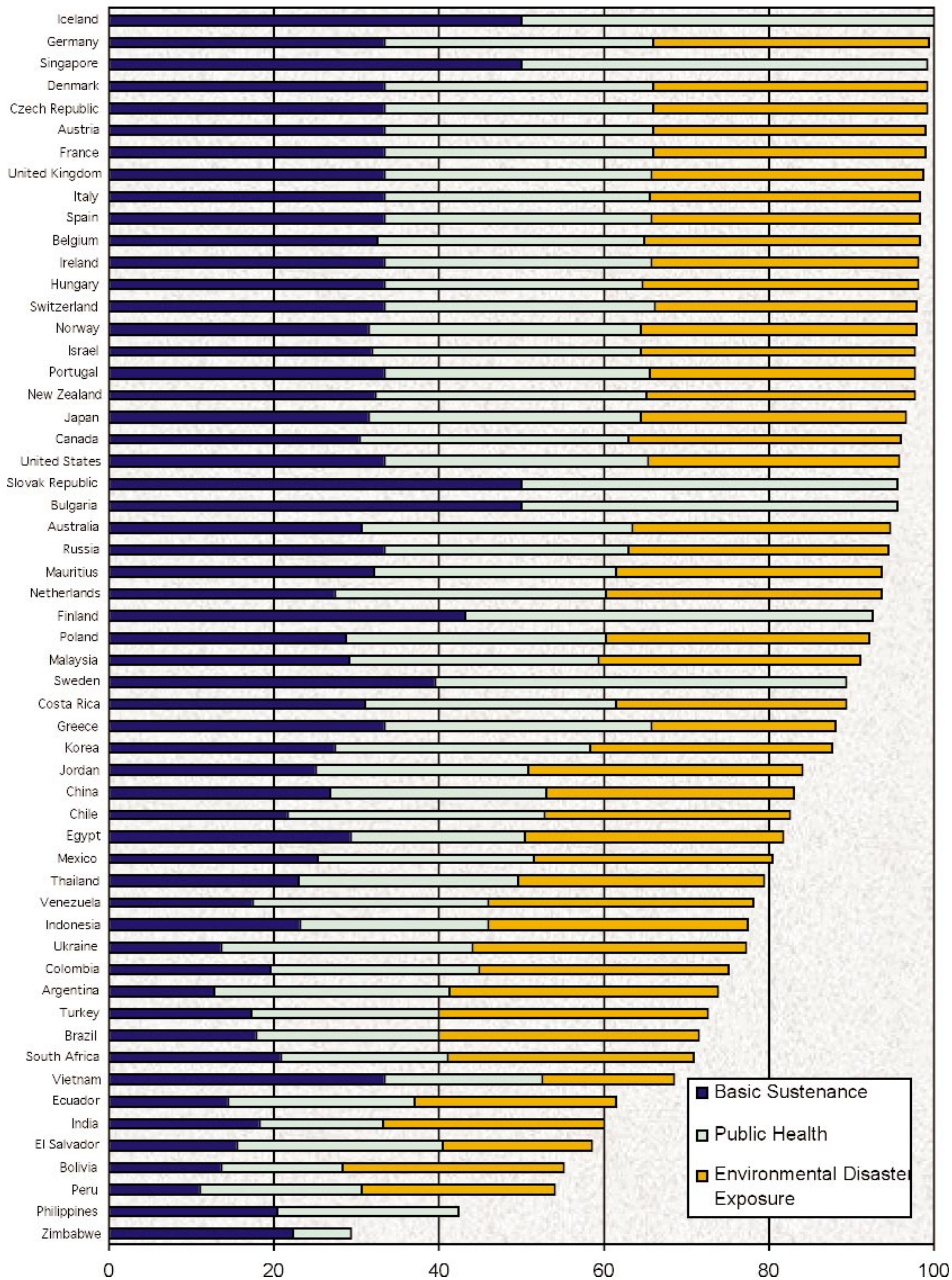
Longer bars denote more sustainable environmental systems.

Figure 7. Environmental Stresses Component



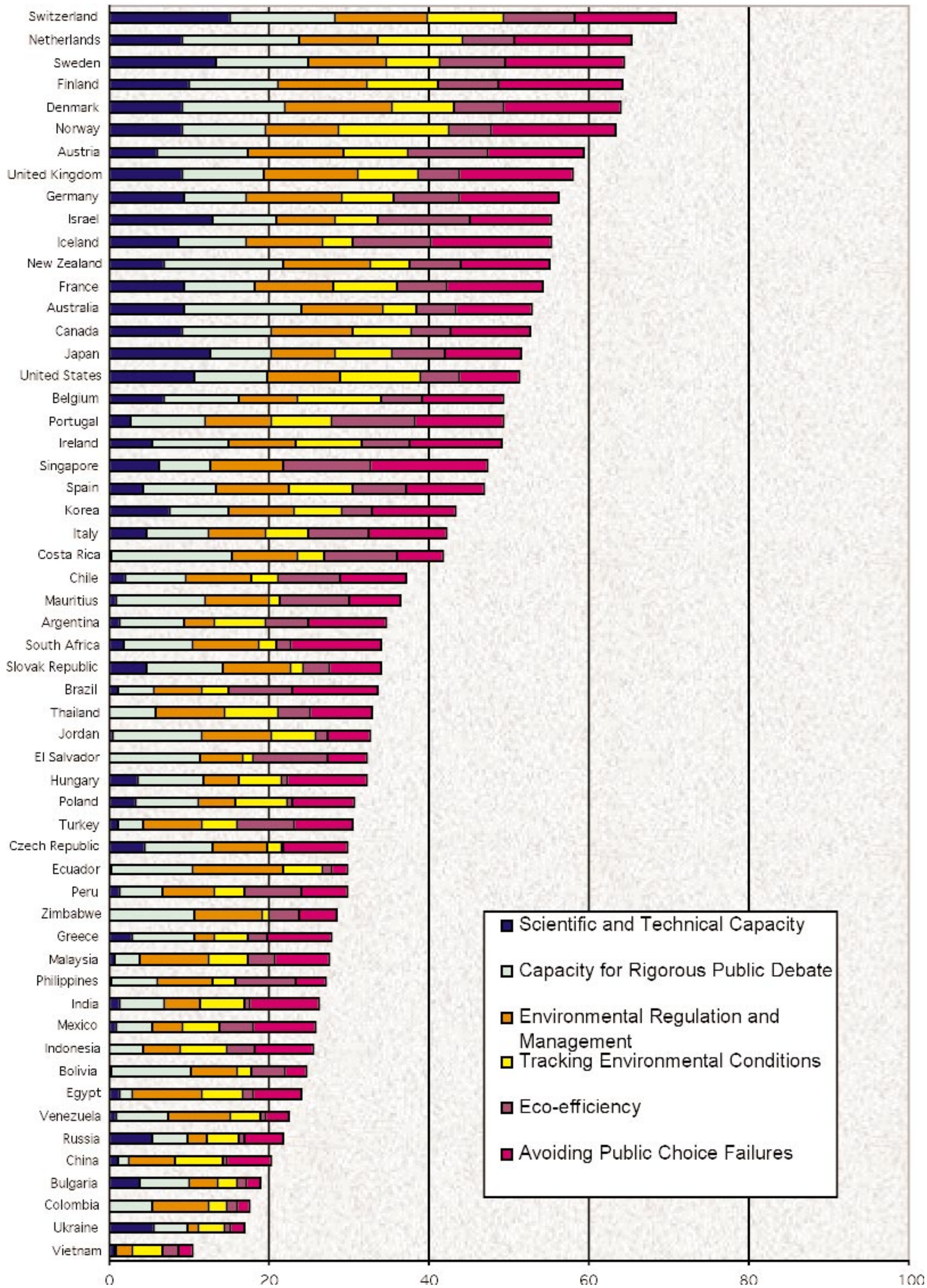
Longer bars denote lower levels of environmental stress.

Figure 8. Human Vulnerability Component



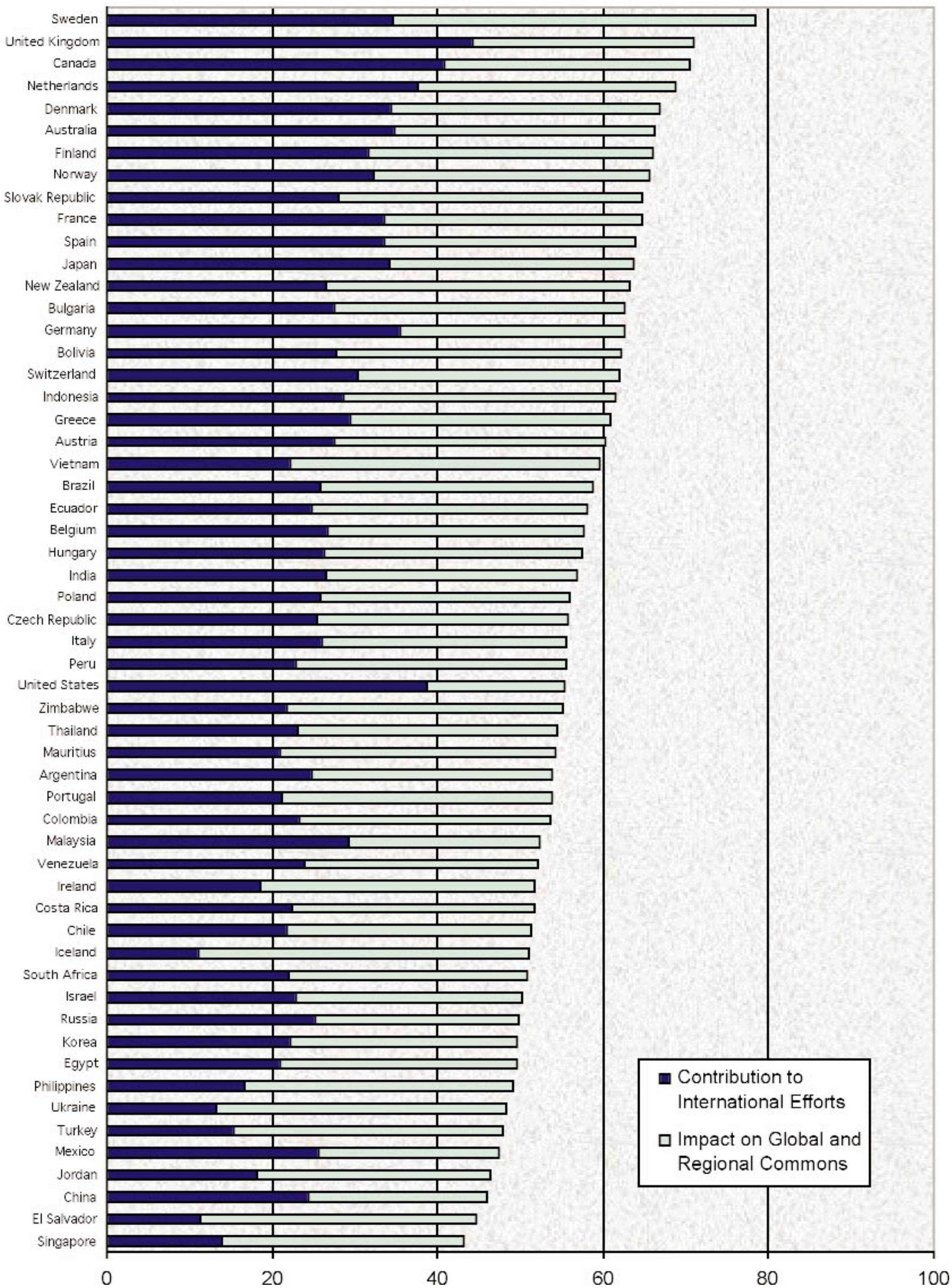
Longer bars denote lower levels of vulnerability.

Figure 9. Social and Institutional Capacity Component



Longer bars denote higher levels of capacity.

Figure 10. Global Stewardship Component



Longer bars denote greater levels of stewardship.

Table 5. Pilot Environmental Sustainability Index Component Values

	Environmental Sustainability Index	Environmental Systems	Environmental Stresses and Risks	Human Vulnerability	Social and Institutional Capacity	Global Stewardship
Argentina	61	76	73	74	35	54
Australia	71	85	67	95	53	66
Austria	70	65	74	99	59	60
Belgium	61	54	62	98	49	58
Bolivia	55	75	70	55	25	62
Brazil	59	67	74	71	33	59
Bulgaria	54	46	75	95	19	63
Canada	72	83	71	96	53	71
Chile	60	66	71	83	37	51
China	54	62	73	83	20	46
Colombia	55	72	72	75	18	54
Costa Rica	57	48	65	89	42	52
Czech Republic	60	64	69	99	30	56
Denmark	71	70	65	99	64	67
Ecuador	57	76	67	62	30	58
Egypt	48	46	60	82	24	50
El Salvador	48	54	57	59	32	45
Finland	75	82	75	93	64	66
France	71	69	80	99	54	65
Germany	68	60	74	99	56	63
Greece	55	51	70	88	28	61
Hungary	60	53	78	98	32	57
Iceland	75	95	75	100	55	51
India	50	50	71	60	26	57
Indonesia	54	55	69	77	26	61
Ireland	72	83	80	98	49	52
Israel	65	60	68	98	55	50
Italy	61	50	73	98	42	56
Japan	66	75	56	97	51	64
Jordan	53	44	71	84	33	46
Korea	57	61	54	88	43	50
Malaysia	55	57	64	91	27	52
Mauritius	54	30	74	94	36	54
Mexico	51	46	71	80	26	47
Netherlands	70	66	66	94	65	69
New Zealand	73	77	81	98	55	63
Norway	76	89	68	98	63	66
Peru	50	53	68	54	30	56
Philippines	47	55	63	42	27	49
Poland	58	56	74	92	31	56
Portugal	66	63	74	98	49	54
Russia	62	77	78	95	22	50
Singapore	54	53	42	99	47	43
Slovak Republic	62	61	76	96	34	65
South Africa	54	52	70	71	34	51
Spain	65	58	73	98	47	64
Sweden	75	75	78	89	64	78
Switzerland	75	73	73	98	71	62
Thailand	52	44	66	79	33	54
Turkey	52	46	74	73	30	48
Ukraine	51	50	77	77	17	48
United Kingdom	70	69	69	99	58	71
United States	68	74	69	96	51	55
Venezuela	56	71	71	78	23	52
Vietnam	43	37	67	69	10	60
Zimbabwe	49	56	78	29	29	55

For every variable in our data set we created a normalized range and scaled values from 0 (low sustainability) to 100 (high sustainability). We have not tried to define a true or definitive "sustainability" threshold. Each country was assigned a score from 0 to 100 depending on where it fell along the continuum for that particular variable. In a few instances a scientifically defensible cap was applied to the original values beyond which all economies received 0 or 100.

Once the variables were scaled they were assembled into composite scores for the factor in which they were located, assigning equal weights to each variable. For the purposes of illustration, we calculated component scores for each economy by combining the factor scores, again assigning equal weight.

The Environmental Sustainability Index value for each economy is simply the average value for the 21 factors. (We average the factors instead of the components because the components vary in their number of factors, and we wished to avoid weighting some factors more than others).

A number of variables are not available for each economy. The distribution of missing variables is summarized in the appendix. Because the Index is calculated by averaging variables, all measured in the same 0-100 scale, the simplest way to handle missing values was simply to average the variables for which we did have measures. Filling the data gaps is an important future task. Some combination of new data development, extrapolation, and defining proxies will be necessary.

Three economies (Hong Kong, Luxembourg, Taiwan) were excluded from the prototype because they were missing more than half the variables. A subsequent version of this Index could reintroduce these jurisdictions by making use of data available from alternative sources. It would also be valuable, as the data coverage permits, to include additional countries, eventually covering all nations in the world.

Examples of Variables for Which No Usable Data Could Be Found

A number of variables were identified as of high importance in the initial analytical work leading to the creation of this index, but had to be omitted because of difficulty finding usable data comparable across all economies in the study. Among the most disappointing omissions are the following:

- Percent of fisheries harvested at sustainable levels
- Number of “dangerous” nuclear power plants
- Financial contributions to international environmental programs
- Accumulation of toxic waste products in soil
- Loss of arable land
- Loss of wetlands
- Individual memberships in environmental organizations
- Proportion of governmental budget devoted to environmental protection
- Extent of use of environmental impact assessments
- Compliance with domestic environmental regulations
- Compliance with international environmental agreements
- Recycling rates for major materials
- Extent of subsidies to agricultural production, water use, fishing

Table 6. Structure of the Pilot Environmental Sustainability Index

COMPONENT	FACTOR	VARIABLE	YEAR	NUMBER OF COUNTRIES WITH DATA
Environmental Systems	Urban Air Quality	Urban NO2 concentration	MRYA* 1990-95	39
		Urban SO2 concentration	MRYA 1990-95	44
		Urban particulates concentration	MRYA 1990-95	38
	Water Quantity	Surface water resources per capita	1998	56
		Groundwater resources per capita	1998	50
	Water Quality	Nitrogen, nitrate and nitrite concentration	MRYA 1991-96	14
		Dissolved oxygen concentration	MRYA 1991-96	23
		Suspended solids	MRYA 1991-96	21
		Phosphorus concentration	MRYA 1991-96	16
		Fecal coliform concentration	MRYA 1991-96	17
		Lead concentration	MRYA 1991-96	18
	Biodiversity	Percentage of known plant species threatened	1994	49
		Percentage of known breeding bird species threatened	1996	54
		Percentage of known mammal species threatened	1996	53
	Land	Severity of human induced soil degradation	1990	52
Environmental Stresses	Air Pollution	SO2 emissions per land area	1995-97	27
		NO emissions per land area	1995-97	26
		VOC emissions per land area	1995-97	22
		Coal Consumption per land area	1997	52
		Number of vehicles per land area	1997	54
	Water pollution and consumption	Fertilizer used per arable land area	1995-97	55
		Industrial organic pollutants per land area	1996	44
		Freshwater withdrawals as percent of renewable water resources	MRYA 1985-94	41
		Groundwater withdrawals as a percent of annual recharge	MRYA 1985-94	37
	Ecosystem Stress	Deforestation	1990-95	55
	Waste Production and Consumption Pressure	Percentage of households with garbage collection	1993	28
		Consumption pressure per capita	1995	55
		Spent Nuclear Fuel Waste per capita	1991	43
	Population	Growth Rate 1995-00	1999	56
		Change in population growth rate, 1990-1995 and 1995-2000	1990-2000	56
Human Vulnerability to Environmental Impacts	Basic Sustenance	Percentage of urban population with access to safe drinking water	MRYA 1990-96	29
		Percentage of rural population with access to safe drinking water	MRYA 1990-96	28
		Percentage of households with electricity	1993	48
		Daily per capita calories supply as a percentage of total requirements	1988-90	49
	Public Health	Prevalence of infectious diseases	MRYA, 1985-95	55
		Infant mortality	1999	56
	Disasters Exposure	Deaths from natural disasters over the period 1978-98	Total 1978-98	49
Social and Institutional Capacity	Science and Technical Capacity	Research & Development scientists and engineers per million population	1985-95	49
		Expenditure for Research & Development as a percentage of GNP	1986-95	50
		Scientific and technical articles per million population	1995	56
	Capacity for Rigorous Policy Debate	IUCN member organizations per million population	1999	56
		Civil liberties	1998-1999	56
	Environmental Regulation and Management	Transparency and stability of environmental regulations	1999	56
		Percentage of urban population with access to adequate sanitation	MRYA 1990-98	45
		Percent land area under protected status (IUCN Categories I-V)	1997	56
	Tracking Environmental Conditions	Percentage of ESI variables in publicly available data sets	1999	56
		Availability of sustainable development information at the national level	1997	39
		Number of GEMS water quality monitoring stations per million population	1994-96	56
	Eco-efficiency	Energy efficiency (total energy consumption per unit GDP)	1997	43
		Hydroelectric plus renewable energy supply as a percentage of total energy produced	1997	55
		Percentage increase in the supply of hydroelectric and renewable energy bet. 1990 & 1997	1990-97	50
	Public Choice Failures	Retail prices for premium gasoline	1996-98	42
		Fossil fuel subsidies as a percentage of GDP	1995-96	16
		Corruption Perceptions Index	1999	56
Global Stewardship	Contribution to international cooperation	Number of memberships in environmental intergovernmental organizations	1998	55
		Percentage of total memberships in intergovernmental orgs that are environmental	1998	55
		Percentage of CITES reporting requirements met	1998	53
		Status of National Biodiversity Strategies & Action Plans under the CBD	1998	55
		Levels of ratification under the Vienna Convention for the Protection of the Ozone Layer	1999	56
		Number of members of Forest Stewardship Council and of Marine Stewardship Council	1999	56
	Impact on global commons	Forest area certified by Forest Stewardship Council	1999	56
		Ecological footprint "deficit"	1995	47
		Carbon-dioxide emissions	1997	56
		CFC consumption	1997	56
		SO2 exports	1990-96	35

** MRYA = Most Recent Year Available during the stated range*

Discussion of Variables

Environmental Systems

Urban Air

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Urban NO_2 concentration	Average of Normalized Mean Annual NO_2 ($\mu g/m^3$), 1990-95	An indicator of urban air quality
Urban SO_2 concentration	Average of Normalized Mean Annual SO_2 ($\mu g/m^3$), 1990-95	"
Urban particulates concentration	Average of Normalized Mean Annual Total Suspended Particulates, 1990-95	"

Source: World Resources Institute, ***World Resources 1998-99****, Data Table 8.5*

These data were originally obtained as values for cities within each country. Within each country, the values for each variable were normalized by city population. The number of data points provided by each country varied. Additional data points within each county may give a more comprehensive impression of the overall urban air quality.

Water Quantity

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Freshwater resources per capita	Annual Internal Renewable Surface Water Resources Per Capita (m^3), 1998	An approximate measure of the ability of surface resources to support the population
Groundwater resources per capita	Average Annual Groundwater Recharge (m3) per capita, 1998	An approximate measure of the ability of groundwater resources to support the population

Source: World Resources Institute, ***World Resources 1998-99****, Data Table 12.1 and 12.2*

Water Quality

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Nitrogen, nitrate and nitrite concentration	NO_3, NO_2 and NH_3 concentration (mg/l), 1991-96	A measure of eutrophication
Dissolved oxygen concentration	Dissolved oxygen concentration (mg/l), 1991-96	A measure of eutrophication
Suspended solids	Suspended solids (mg/l), 1991-96	A measure of water quality
Phosphorus concentration	Phosphorus concentration (mg/l), 1991-96	A measure of eutrophication
Fecal coliform concentration	Fecal coliform concentration (no./100 ml), 1991-96	A measure of water quality
Lead concentration	Dissolved Lead (mg/l), 1991-96	A measure of water quality

Source: UNEP, GEMS/Water Quality Monitoring Stations

This particular category deserves more attention. Assessing a nation's overall water quality is a challenge. Among the issues that need to be addressed are representativeness of Global Environmental Monitoring System (GEMS) data, standardization of GEMS data, selection of variables, and thresholds. Since each nation is represented by only a few stations, geographic proximity to urban areas maybe worth considering. It is possible that the only remote stations are represented in one nation, while another has only urban stations. This would not necessarily make for a fair comparison. There is also a need to standardize some variables and consider the context of the riverine system in which they are located. An example of this is normalizing dissolved oxygen by temperature. Only the station statistics are publicly available from the GEMS database, making it impossible to account for such factors as seasonal and interannual variability.

A compromise was made between more optimal indicators of water quality and commonly reported indicators. We used the mean value for a handful of commonly reported indicators.

One final point on desirable additional analysis is that water quality is usually assessed in relation to its use. For example, water quality requirements for boating and recreation are different than those for drinking water quality. Drinking water quality thresholds may be worth considering, as they are fairly standard. It would be difficult indeed to have an aquatic life standard without knowing something about the system itself or considering a time series of data.

We applied a threshold of 1000 milligrams per liter for the suspended solids variable. This was considered a reasonable threshold, but further research is needed.

Biodiversity

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Percentage of known plant species threatened	Percentage of known plant species threatened, 1994	An imperfect measure of the threatened diversity of plants
Percentage of bird species threatened	Percentage of bird species threatened, 1996	An imperfect measure of the threatened diversity of birds
Percentage of mammal species threatened	Percentage of mammal species threatened. 1996	An imperfect measure of the threatened diversity of mammals

*Source: World Resources Institute, **World Resources 1998-99** Data Table 14.2*

We elected not to use similar data available for reptiles and amphibians as we had greater confidence in the number of known species values for higher plants, birds and mammals.

Land

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Severity of human induced soil degradation	Composite measure of severity of soil degradation, 1995	An indicator of the strength of soil degradation processes within a nation.

Source: UNEP, Global Assessment of Human Induced Soil Degradation (GLASOD) database, 1990

The value for the Russian Federation needs to be calculated from the original dataset. Only the values for the former USSR were available.

Environmental Stresses

Air Pollution

VARIABLE NAME	FULL DESCRIPTION	LOGIC
SO_2 emissions per land area (1)	SO_2 emissions (metric tons) per sq. mile, 1995	Emissions contribute to declines in air quality
NO emissions per land area (1)	NO emissions (metric tons) per sq. mile, 1995	"
VOC emissions per land area (1)	Volatile Organic Compound emissions (metric tons) per sq. mile, 1995	"
Coal Consumption per land area (2)	Coal consumption (Billion Btu) per sq. mile, 1997	Use of coal fuels means an increase in toxic emissions and contributes to declines in air quality
Number of vehicles per land area (3)	Total number of vehicles per sq. mile, 1997	Proxy for air pollution and degradation induced by cars

Source: (1) World Resource Institute, World Resources 1998-99, Data Table 16.5, (2), US Energy Information Administration, (3) World Bank, World Development Indicators, 1999, Data Table 3.12

The air pollution variables are usually related to densely populated area and in some cases these are not homogeneously located within each country. For instance, for big countries like Russia or Canada with few densely populated areas and large uninhabited areas, the stress calculated by the total would not take into account these differences and would assign an incorrect rank. Thus, using the Gridded Population of the World data set available from CIESIN, we calculated the proportion of land area inhabited at 5 persons per sq. Km or higher and then adjusted the land area values based on these proportions, as reported in Table 7.

Table 7. Factor used to calculate populated land area measure

ECONOMY	Proportion of land area populated at 5 persons per sq km or higher	ECONOMY	Proportion of land area populated at 5 persons per sq km or higher
Argentina	0.497	Jordan	0.582
Australia	0.029	Korea	0.991
Austria	1.000	Malaysia	0.966
Belgium	1.000	Mauritius	0.679
Bolivia	0.417	Mexico	0.644
Brazil	0.372	Netherlands	0.984
Bulgaria	1.000	New Zealand	0.281
Canada	0.050	Norway	0.326
Chile	0.416	Peru	0.570
China	0.611	Philippines	0.982
Colombia	0.517	Poland	1.000
Costa Rica	0.991	Portugal	0.962
Czech Republic	1.000	Russia (Total)	0.236
Denmark	0.987	Russia (European)	0.683
Ecuador	0.568	Singapore	1.000
Egypt	0.111	Slovakia	1.000
El Salvador	0.999	South Africa	0.496
Finland	0.444	Spain	0.998
France	0.999	Sweden	0.489
Germany	0.999	Switzerland	1.000
Greece	0.984	Taiwan	0.877
Hungary	1.000	Turkey	0.997
Iceland	0.015	Ukraine	0.996
India	0.987	United Kingdom	0.984
Indonesia	0.699	United States	0.465
Ireland	0.995	Venezuela	0.412
Israel	0.974	Vietnam	0.992
Italy	0.998	Zimbabwe	0.913
Japan	0.982		

Water Pollution and Consumption

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Fertilizer used per arable land (1)	Fertilizer used (hundreds of grams) per hectare of arable land, 1995-97 avg.	Excessive use of fertilizers from agricultural activities has a negative impact on soil and water, altering chemistry and levels of nutrients and leading to eutrophication problems
Industrial organic pollutants per land area (2)	Organic pollutants emissions (kg/day) from industries per million sq. miles, 1996	Emissions of organic pollutants from industrial activities cause water quality degradation
Freshwater withdrawals as percent of renewable water resources (3)	Freshwater withdrawals as a a percent of renewable water resources, 1985-94	A ratio of freshwater withdrawals to recharge beyond a certain threshold results in unsustainable use
Groundwater withdrawals as a percent of annual recharge (3)	Groundwater withdrawals as a percent of annual recharge, 1985-1994	A ratio of groundwater withdrawals to recharge beyond a certain threshold results in unsustainable use

Sources: (1) and (2) World Bank, ***World Development Indicators, 1999****, Data table 3.2 and 3.6; (3) World Resource Institute,* ***World Resources 1998-99****, Data Table 12.1 and 12.2*

One important variable that we would have included in this category, having an important impact on soil and water, is the use of pesticides per land area. Data on pesticides is largely available, if the interest is in specific chemical substances, but availability of global data sets for generic use of pesticides is scarce.

Ecosystem Stress

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Deforestation	Percent change in forest cover, 1990-1995	Next to wetlands, forests are the richest ecosystem in terms of biodiversity, so continued loss in the long term is unsustainable

*Source: World Resource Institute, **World Resources 1998-99**, Data Table 11.1*

Waste Production and Consumption Pressure

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Percent of households with garbage collection (1)	Percent of households with garbage collection, 1993	This represents a proxy for waste disposal
Consumption pressure per capita (2)	Consumption Pressure Index (units per person), 1995	High level of consumption pressure means high stress to the environment, in terms of resources depletion and emissions
Spent nuclear fuel waste per capita (3)	Spent nuclear fuel arisings per capita (kg HM/ 1000 inhabitants), 1991	Nuclear waste requires, processing, transport, and storage, all of which pose a threat to humans and ecosystems

*Sources: (1) World Resource Institute, **World Resources 1998-99**, Data Table 9.3, (2) WWF, **Living Planet Report 1998**, (3) OECD **Energy-Environment Indicators, ENV Monograph No.79**, p. 32*

Data on waste production is usually very limited, but the significance of the threat posed to humans and ecosystems is such that we decided to combine the two variables (both proxy for waste production and disposal) with a consumption pressure index in order to have more complete values for this category.

The WWF Consumption Pressure Index is calculated as an aggregate index of grain, fish, wood and cement consumption; freshwater withdrawals; and CO2 emissions.

The amount of spent fuels, even though it does not distinguish between various types of radioactive waste and includes only part of the total amount of waste generated by the radioactive fuel cycle, could be considered a good proxy for the radioactive waste disposal situation (OECD).

Population Stress

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Growth rate 1995-2000	Population growth rate for the period 1995-2000	A high population growth rate represents a stress on the environment
Change in population growth rate, 1990-1995 and 1995-2000	Change in Population Growth Rate, 1990-1995 and 1995-2000	The change in growth rate is a measure of the trend in population growth, which has an impact on the environment

*Source: United Nations Population Division, **World Population Prospects 1998***

The change in population growth rate is simply the difference between the growth rate for the period 1995-2000 and the growth rate for the period 1990-1995 and expresses the trend of an economy towards an increase or a decrease in growth rate.

Basic Sustenance

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Percentage of urban population with access to safe drinking water (1)	Percentage of urban population with access to safe drinking water, 1990-96	The percentage of population with access to safe drinking water is directly related to the capacity of an economy to provide a healthy environment, reducing the risks associated with water-related diseases and exposure to pollutants
Percentage of rural population with access to safe drinking water (2)	Percentage of rural population with access to safe drinking water,1990-96	The percentage of population with access to safe drinking water is directly related to the capacity of an economy to provide a healthy environment, reducing the risks associated with water-related diseases and exposure to pollutants
Percentage of population with access to electricity (3)	Percentage with population with access to electricity, 1999	This represents the capacity of an economy to provide alternatives to fuel wood consumption and indoor burning
Daily per capita calories supply as a percentage of total requirements (4)	Daily per capita calories supply as a percentage of total requirements, 1988-90	This represents a measure of the vulnerability to malnutrition, famine or diseases, in addition to showing the incapacity of an economy to supply an adequate amount of food and to manage food resources

*Source: (1) and (2) World Resources Institute, **World Resources 1998-99**, Data Table 7.4, (3) World Resources Institute, **World Resources 1998-99**, Data Table 9.3, (4) World Resources Institute, **World Resources 1998-99**, Data Table 8.1*

Public Health

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Prevalence of infectious diseases (1)	Reported cases of infectious diseases per 100,000 population, 1985-95	A high number of people suffering from infectious diseases expresses the vulnerability of an economy to such diseases and a poorly equipped health system
Infant Mortality (2)	Infant mortality rate (deaths per 1,000 live births), 1999	The infant mortality rate is a measure of the vulnerability of the most vulnerable population group

*Source: (1) World Resources Institute, **World Resources 1998-99**, Data Table 8.1; (2) Population Reference Bureau, **World Population Datasheet, 1999***

This category would be more complete with variables that relate strictly to pollution, such as bloodstream lead levels in children, DDT concentration in breast milk or reported cases of asthma. Unfortunately availability of such data is very limited at a global scale, but these variables are more likely to be found at a national level. We are tracking down asthma sources and, as for the other variables, we are thinking of building a global data set by aggregating the different national-level data.

Disasters Exposure

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Deaths from natural disasters over the period 1978-98	Deaths per 100,000 population resulting from natural disasters over the period 1978-98	This is an approximate measure of the vulnerability of a population to floods, droughts, hurricanes, and other environmentally-related natural disasters

Source: EM-DAT: The OFDA/CRED International Disaster Database

The OFDA / CRED disaster database includes several types of disasters and several categories of damage. We excluded disasters such as earthquakes and volcanoes. We calculated the number of people killed by disasters, because this variable appeared to be more meaningful than the estimates of damage in US dollars (possible problems in reporting damage estimates) or the number of people affected (possible inconsistencies in the definition of "affected").

Social and Institutional Capacity

Scientific and Technical Capacity

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Research & Development scientists and engineers per million population (1)	Research & Development scientists and engineers per million population, 1985-95	The greater the proportion of an economy's population that is dedicated to research and development in a variety of scientific fields, the more capacity it has to respond effectively to environmental threats
Expenditure for Research & Development as a percentage of GNP (2)	Expenditure for Research & Development as a percentage of GNP, 1986-95	The greater the proportion of an economy's annual GNP that is dedicated to research and development in a variety of scientific fields, the more capacity it has to respond effectively to environmental threats
Scientific and technical articles per million population (3)	Scientific and technical articles per million population, 1995	The rate at which an economy's scientific establishment publishes articles in the natural and earth sciences is correlated with its capacity to respond to environmental problems

*Source: (1) and (2) UNESCO, **Statistical Yearbook 1998**, Table 5.1; (3) National Science Board, **Science and Engineering Indicators 1998**, Appendix Table 5-49.*

The data on research and development (R&D) are not strictly comparable, though they still represent a good approximation of the level of effort in each country. For both the R&D personnel and expenditure data, most countries (but not all) include those working in the military and defense sector, which does not necessarily contribute to environmental sustainability. For the personnel data, some countries do not include part-time workers in these data, and a few countries do not include researchers in the higher education sector. On the other hand, many countries count auxiliary personnel and technicians together. A full description of the specific R&D-related measures for each country can be found in UNESCO's *Statistical Yearbook 1998*, notes sections for Tables 5.2-5.4.

In order to calculate the "scientific and technical articles" variable, we included all articles relating to biology, chemistry, physics, earth and space sciences, engineering and technical, and mathematics. We did not include articles relating to clinical medicine or biomedical research.

Capacity for Rigorous Policy Debate

VARIABLE NAME	FULL DESCRIPTION	LOGIC
IUCN member organizations per million population (1)	Number of environmental organizations in the country that are members of IUCN -The World Conservation Union per million population 1999	IUCN is the oldest international environmental membership organization, currently with over 900 members (governmental and NGO) worldwide, so it includes the most significant environmental NGOs in each country
Civil liberties (2)	Civil Liberties (including right to organize and freedom of expression), 1998-99	In economies that guarantee freedom of expression, rights to organize, rule of law and economic rights, there is more likely to be a vigorous public debate about values and issues relevant to environmental quality, and legal safeguards that encourage innovation

Source: (1) IUCN-The World Conservation Union membership database, December 1999 (unpublished); (2) Freedom House, 1999 report

This factor would have benefited from a variable measuring the number of *all* environmental NGOs in a country (not just IUCN members). However, we were unable to locate such a data set. The measure of civil liberties is admittedly somewhat subjective, but the Freedom House survey is among the few that measure this critical aspect of sustainability in a comparable manner.

Environmental Regulation and Management

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Transparency and stability of environmental regulations (1)	Transparency and stability of environmental regulations, 1999	If companies perceive that environmental regulations are transparent and stable, they are more likely to comply with them
Percentage of urban population with access to adequate sanitation (2)	Percentage of urban population with access to adequate sanitation, 1990-98	This is a proxy for sewerage treatment facilities, which represents an investment on the part of governments in environmental quality
Percent land area under protected status (IUCN Categories I-V) (3)	Percent land area under protected status (IUCN Categories I-V), 1997	The percentage of land area dedicated to protected areas represents an investment by the country in biodiversity conservation

Source: (1) World Economic Forum, 1999 Competitiveness Survey, WEF Indicator 2.12; (2) UNICEF, State of the World's Children 2000, Table 3; (3) World Resources Institute, World Resources 1998-99, Table 14.1

It was very difficult to find direct measures of environmental regulation and management. Measures such as proportion of government budgets going to environmental regulation (e.g. ministries or agencies with environmental mandates) simply weren't available. Nor were there any comparable measures of the strength of the regulatory system, the existence of mandated environmental impact assessments (EIAs) or how well they are carried out, or the level of enforcement or compliance with environmental laws. As a result, we were left with one survey of corporate decision makers and two proxy measures. It is hoped that in future years improved data sets might be compiled.

Tracking Environmental Conditions

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Percentage of ESI variables in publicly available data sets (1)	Percentage of Environmental Sustainability Index variables in publicly available data sets, 1999	The degree to which data on environmental trends are collected and made publicly available affects the level of awareness and ability to respond to environmental problems
Availability of sustainable development information at the national level (2)	The quality of information addressing key chapters of Agenda 21 as assessed in government reports to Rio+5, 1997	Agenda 21 represents the biggest effort to date to frame what sustainable development actually looks like, and therefore the quality of information related to Agenda 21 chapters has a direct bearing on decision-makers' abilities to pursue sustainability
Number of GEMS water quality monitoring stations per million population (3)	Number of GEMS water quality monitoring stations per million population, 1994-96	Water quality is critical to human health, and therefore a concerted effort to monitor pollutants is important to assessing how an economy is safeguarding both health and the environment

Source: (1) CIESIN's own measure based on data sets compiled for the Environmental Sustainability Index; (2) United Nations, Agenda 21 – Institutional Issues, a compilation of national reports to the Rio+5 meeting, June 1997; (3) UNEP, Global Environmental Monitoring System for Water (GEMS/Water)

In order to make effective policies, decision makers need information on the status and trends of environmental systems and stresses. As the ESI exercise revealed, much of this information is not readily available. One current effort by the UN Statistics Division (UNSD) seeks to collect published and unpublished data on a wide range of environmental variables into one standard directory (equivalent to the UN's *Demographic Yearbook*). In early 1999 the UNSD sent a Questionnaire on Environmental Statistics and Indicators to 170 national statistical services of UN member states. Unfortunately, they only received 66 responses, of which a meager 42 contained data. None of the returned questionnaires were fully completed. This effort deserves support and recognition in order to make a truly useful international environmental data set.

Eco-efficiency

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Energy efficiency (total energy consumption per unit GDP)	Energy efficiency (Billion KWh/GDP), 1997	The more efficient an economy is, the less energy it needs to produce and consume goods
Hydroelectric plus renewable energy supply as a percentage of total energy produced	Hydroelectric plus renewable energy supply as a percentage of total energy produced, 1997	The higher the proportion of hydroelectric and renewable energy sources, the less reliance on more environmentally damaging sources such as fossil fuel and nuclear
Percentage increase in the supply of hydroelectric and renewable energy between 1990 and 1997	Percentage increase in the supply of hydroelectric and renewable energy between 1990 and 1997	Countries should be given credit not only for the proportion of hydroelectric and renewables, but also the increase in that proportion over time

Source: U.S. Department of Energy, Energy Information Administration

An ideal measure of eco-efficiency would measure not just the efficiency of energy use and the degree to which an economy uses renewable energy sources, but also the efficient use of other economic inputs (e.g., materials). Recycling rates of important materials (e.g., paper, glass, metals) would also be important to include.

Public Choice Failures

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Retail prices for premium gasoline (1)	Retail prices for premium gasoline, 1996-98	Unsubsidized gasoline prices are an indicator that appropriate price signals are being sent and that environmental "externalities" have been internalized
Fossil fuel subsidies as a percentage of GDP (2)	Fossil fuel subsidies as a percentage of GDP, 1995-96	Subsidies lead to inefficient use of resources
Corruption Perceptions Index (3)	Corruption Perceptions Index, 1999	Corruption contributes to lax enforcement of environmental regulations and an ability on the part of producers and consumers to evade responsibility for the environmental harms they cause

Sources: (1) Energy Information Administration, ***International Energy Annual 1997****, Table 7.2; (2) World Bank,* ***Expanding the Measure of Wealth, 1997****, Table 4.3; (3) Transparency International,* ***1999 Corruption Perceptions Index***

To be comprehensive, this category should include data on subsidies in the water, agricultural, transportation and fisheries sectors. Unfortunately, the coverage of such data sets, where they were located at all, was extremely limited. Because subsidies take so many forms (e.g., producer subsidies, price subsidies, incentives, tax breaks, etc.), comparable cross-national data are very difficult to collect. Subsidies affect how efficiently resources are used, and may also affect the degree to which harmful "externalities“ are produced.

Contribution to International Cooperation

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Number of memberships in environmental intergovernmental organizations (1)	Number of memberships in environmental intergovernmental organizations, 1998	Environmental sustainability requires a degree of participation in intergovernmental environmental organizations
Percentage of total memberships in intergovernmental organizations that are environmental (2)	Percentage of total memberships in intergovernmental organizations that are environmental, 1998	This is a measure of how an economy allocates its intergovernmental organization "budget," which reflects the degree to which it considers environmental issues an international priority
Percentage of CITES reporting requirements met (3)	Percentage of CITES reporting requirements met, 1998	Preparing and submitting national reports is a fundamental responsibility under CITES; the degree to which an economy fulfills this responsibility is an indication of how seriously it takes its commitment to protection of endangered species
Status of National Biodiversity Strategies & Action Plans under the CBD (4)	Status of National Biodiversity Strategies & Action Plans under the Convention on Biological Diversity, 1998	Preparing and submitting national action plans under the responsibility under the Convention on Biological Diversity; the degree to which an economy fulfills this responsibility is an indication of how seriously it takes its commitment to biodiversity protection
Levels of ratification under the Vienna Convention for the Protection of the Ozone Layer (5)	Levels of ratification under the Vienna Convention for the Protection of the Ozone Layer, 1999	The number of protocols and amendments that an economy has ratified under the Vienna Convention is an indication of its commitment to fight ozone depletion
Number of members of the Forest Stewardship Council and of the Marine Stewardship Council (6)	Individual and organizational members of the Forest Stewardship Council (FSC) and the Marine Stewardship Council (MSC), 1999	This is an indirect measure of the degree to which firms and associations within an economy are committed to reducing the negative impacts of their consumption; the FSC certifies timber according to the sustainability of the methods by which it was harvested, and the MSC certified seafood products and practices according to their sustainability

Sources: (1) and (2) Organizational memberships from Yearbook of International Organizations, provided in digital form by Monty Marshall, University of Maryland (organizations coded as "environmental" by CIESIN); (3) World Resources Institute, ***World Resources 1998-99****, Table 14.5; (4) UNEP, Annex II to Document UNEP/CBD/COP/4/11/Rev.1; (5) UNEP, The Ozone Secretariat web site; (6) Forest Stewardship Council and Marine Stewardship Council web pages (http://www.fscoax.org/index.html, http://www.msc.org/), and personal communication with Marine Stewardship Council.*

Impact on global commons

VARIABLE NAME	FULL DESCRIPTION	LOGIC
Forest area certified by Forest Stewardship Council (1)	Forest area certified by Forest Stewardship Council, 1999	This measures the extent to which an economy seeks sustainable forestry practices
Ecological Footprint "deficit" (2)	Ecological Footprint "deficit", 1995	The ecological footprint is a measure of the extent to which an economy's impact on global environmental resources exceed a share of the planet's absorptive capacity; a deficit means a country requires more land area than it actually has in order to support its economy
Carbon-dioxide emissions (3)	Total carbon-dioxide emissions times per capita emissions, 1997	Emissions of carbon-dioxide are not immediately harmful to any given country, but contribute to a global problem, we combine total and per capita emissions because we wish to be neutral with respect to debates over which measure best captures global responsibility
CFC consumption (4)	Total CFC consumption times per capita consumption, 1997	Consumption of CFCs is not immediately harmful to any given country, but contributes to a global problem; we combine total and per capita emissions because we wish to be neutral with respect to debates over which measure best captures global responsibility
Sulfur exports (5)	Total SO_2 emissions that travel beyond the boundaries of the emitting economy, 1990-96	The transport of sulfur emissions across national boundaries contributes to poor air quality and acid rain in receiving countries

Sources: (1) Forest Stewardship Council, Document 5.3.3; (2) Redefining Progress, Footprint of Nations Ranking List, 1997; (3) Carbon Dioxide Information Analysis Center, 1999; (4) UNEP, Production and Consumption of Ozone Depleting Substances, 1986-1998, Table 8, October 1999; (5) International Institute for Applied Systems Analysis, RAINS-ASIA and EMEP.

Table 7. Data Availability by Component and Factor

	Environmental Systems							Environmental Stresses							Human Vulnerability					Social and Institutional Capacity								Global Stewardship				Summary	
Variables/ Factors:	15 variables/5 factors							15 variables/5 factors							7 variables/3 factors					16 variables/6 factors								11 variables/ 2 factors					
Factor Name (Total No. of Variables)	Urban Air Quality (3)	Water Quantity (2)	Water Quality (6)	Biodiversity (3)	Land (1)	# missing variables	# of missing factors	Air Pollution (5)	Water Poll. & Cons. (4)	Ecosystem Stress (1)	Waste Prod. & Cons. (3)	Population (2)	# missing variables	# of missing factors	Basic Sustenance (4)	Public Health (2)	Disasters Exposure (1)	# missing variables	# of missing factors	Science & Tech Capacity (3)	Capacity for Policy Debate (2)	Env'tal Mgt. & Reg (3)	Tracking Env'tal. Change (2)	Eco-efficiency (3)	Public Choice Failure (3)	# missing variables	# of missing factors	Contribution. to Int'l Coop. (6)	Impact on Commons (5)	# missing variables	# of missing factors	% of variables missing	% of factors missing
Argentina	3	2	6	3	1	0	0	2	3	1	1	2	6	0	3	2	1	1	0	3	2	3	1	3	3	1	0	6	4	1	0	14.1	0.0
Australia	3	1	0	3	1	7	1	3	2	1	3	2	4	0	2	2	1	2	0	3	2	3	1	3	2	2	0	6	4	1	0	25.0	4.8
Austria	3	2	0	3	1	6	1	5	4	1	2	2	1	0	2	2	1	2	0	3	2	3	2	3	2	1	0	6	5	0	0	15.6	4.8
Belgium	3	2	6	3	1	0	0	5	2	1	2	2	3	0	4	2	1	0	0	3	2	3	1	3	2	2	0	6	5	0	0	7.8	0.0
Bolivia	0	2	0	2	1	10	2	1	3	1	3	2	5	0	4	2	1	0	0	2	2	3	2	3	2	2	0	6	3	2	0	29.7	9.5
Brazil	3	2	0	3	1	6	1	2	2	1	2	2	6	0	4	2	1	0	0	3	2	3	2	3	3	0	0	6	4	1	0	20.3	4.8
Bulgaria	3	2	0	3	1	6	1	4	4	1	2	2	2	0	2	2	0	3	1	2	2	2	1	2	2	5	0	6	4	1	0	26.6	9.5
Canada	3	2	4	3	1	2	0	5	4	1	3	2	0	0	2	2	1	2	0	3	2	3	2	3	2	1	0	6	4	1	0	9.4	0.0
Chile	2	2	0	3	1	7	1	2	2	1	3	2	5	0	4	2	1	0	0	2	2	3	1	3	2	3	0	6	4	1	0	25.0	4.8
China	3	2	6	3	1	0	0	2	3	1	1	2	6	0	2	2	1	2	0	3	2	3	1	3	3	1	0	6	5	0	0	14.1	0.0
Colombia	1	2	0	3	1	8	1	2	3	1	3	2	4	0	4	2	1	0	0	1	2	3	2	2	2	4	0	6	4	1	0	26.6	4.8
Costa Rica	0	2	0	3	1	9	2	1	1	1	2	2	8	0	3	2	1	1	0	2	2	3	2	3	2	2	0	6	4	1	0	32.8	9.5
Czech Rep.	3	1	0	1	1	9	1	2	2	1	2	2	6	0	1	2	1	3	0	3	2	2	2	1	3	3	0	6	5	0	0	32.8	4.8
Denmark	3	2	0	3	1	6	1	5	4	1	3	2	0	0	2	2	1	2	0	3	2	3	2	3	2	1	0	6	5	0	0	14.1	4.8
Ecuador	2	2	0	3	1	7	1	4	3	1	3	2	2	0	4	2	1	0	0	3	2	3	2	2	2	2	0	6	3	2	0	20.3	4.8
Egypt	1	2	0	3	1	8	1	2	4	1	3	2	3	0	4	2	1	0	0	3	2	3	2	3	2	1	0	6	4	1	0	20.3	4.8
El Salvador	0	1	0	3	1	10	2	2	2	1	3	2	5	0	4	2	1	0	0	2	2	3	1	3	2	3	0	6	3	2	0	31.3	9.5
Finland	3	2	4	3	1	2	0	2	4	1	2	2	4	0	4	2	0	1	1	3	2	3	2	3	2	1	0	6	5	0	0	12.5	4.8
France	3	2	4	3	1	2	0	5	4	1	3	2	0	0	2	2	1	2	0	3	2	3	2	3	2	1	0	6	5	0	0	7.8	0.0
Germany	3	2	0	2	1	7	1	5	4	1	3	2	0	0	1	2	1	3	0	3	2	3	2	2	2	2	0	6	5	0	0	18.8	4.8
Greece	3	2	0	3	1	6	1	5	3	1	3	2	1	0	2	2	1	2	0	3	2	2	2	2	2	3	0	6	5	0	0	18.8	4.8
Hungary	3	2	0	3	1	6	1	5	3	1	2	2	2	0	2	2	1	2	0	3	2	2	2	2	3	2	0	6	5	0	0	18.8	4.8
Iceland	3	2	0	3	0	7	2	4	2	0	1	2	6	1	3	2	0	2	1	3	2	3	2	3	1	2	0	3	5	3	0	31.3	19.0
India	3	2	4	3	1	2	0	2	3	1	2	2	5	0	3	2	1	1	0	3	2	3	1	2	3	2	0	6	5	0	0	15.6	0.0
Indonesia	1	2	5	3	1	3	0	2	3	1	3	2	4	0	4	2	1	0	0	2	2	3	1	3	2	3	0	6	5	0	0	15.6	0.0
Ireland	1	2	0	3	1	8	1	5	3	1	2	2	2	0	2	2	1	2	0	3	2	3	2	3	2	1	0	5	5	1	0	21.9	4.8
Israel	0	2	0	2	1	10	2	2	4	1	2	2	4	0	4	2	1	0	0	2	2	2	2	3	1	4	0	6	4	1	0	29.7	9.5
Italy	3	2	0	3	1	6	1	4	4	1	2	2	2	0	2	2	1	2	0	3	2	3	1	3	2	2	0	6	5	0	0	18.8	4.8
Japan	3	2	6	2	1	1	0	2	4	1	2	2	4	0	2	2	1	2	0	3	2	3	2	3	2	1	0	6	5	0	0	12.5	0.0
Jordan	0	2	5	3	1	4	1	1	4	1	3	2	4	0	2	2	1	2	0	3	2	3	1	3	1	3	0	6	4	1	0	21.9	4.8
Korea	3	1	4	3	1	3	0	4	2	1	1	2	5	0	4	2	1	0	0	3	2	3	1	3	3	1	0	6	5	0	0	14.1	0.0
Malaysia	2	2	3	3	1	4	0	2	2	1	2	2	6	0	3	2	1	1	0	3	2	3	2	3	1	2	0	6	5	0	0	20.3	0.0
Mauritius	0	2	0	3	1	9	2	2	2	1	2	2	6	0	3	2	1	1	0	3	2	3	2	2	1	3	0	6	3	2	0	32.8	9.5
Mexico	3	2	4	3	1	2	0	2	4	1	1	2	5	0	3	2	1	1	0	3	2	2	2	3	3	1	0	6	4	1	0	15.6	0.0
Netherlands	3	2	6	3	1	0	0	5	4	1	3	2	0	0	2	2	1	2	0	3	2	3	2	3	2	1	0	6	5	0	0	4.7	0.0
New Zealand	3	2	5	3	1	1	0	2	2	1	2	2	6	0	2	2	1	2	0	3	2	3	2	3	2	1	0	6	4	1	0	17.2	0.0
Norway	3	2	2	3	1	4	0	5	4	1	2	2	1	0	4	2	1	0	0	3	2	3	2	3	2	1	0	6	5	0	0	9.4	0.0
Peru	0	2	0	3	1	9	2	2	3	1	3	2	4	0	4	2	1	0	0	3	2	3	1	3	2	2	0	6	4	1	0	25.0	9.5
Philippines	2	2	3	3	1	4	0	2	2	1	2	2	6	0	3	2	1	1	0	3	2	3	2	3	1	2	0	6	5	0	0	20.3	0.0
Poland	2	2	6	3	1	1	0	5	4	1	3	2	0	0	3	2	1	1	0	3	2	2	2	2	3	2	0	6	5	0	0	6.3	0.0
Portugal	3	2	5	3	1	1	0	5	4	1	2	2	1	0	2	2	1	2	0	3	2	3	2	3	2	1	0	6	5	0	0	7.8	0.0
Russia	3	2	3	2	0	5	1	4	4	1	2	2	2	0	1	2	1	3	0	3	2	2	2	1	3	3	0	6	5	0	0	20.3	4.8
Singapore	2	1	0	3	1	8	1	2	2	1	2	2	6	0	2	2	0	3	1	3	2	2	1	1	1	6	0	6	5	0	0	35.9	9.5
Slovak Rep.	3	1	0	1	0	10	2	5	3	1	2	2	2	0	1	1	0	5	1	3	2	2	2	1	2	4	0	6	4	1	0	34.4	14.3
South Africa	2	2	0	3	1	7	1	2	4	1	1	2	5	0	3	2	1	1	0	2	2	3	2	3	2	2	0	6	4	1	0	25.0	4.8
Spain	3	2	0	2	1	7	1	5	4	1	2	2	1	0	2	2	1	2	0	3	2	3	2	3	2	1	0	6	5	0	0	17.2	4.8
Sweden	3	2	0	3	1	6	1	5	4	1	3	2	0	0	2	2	0	3	1	3	2	3	1	3	2	2	0	6	5	0	0	17.2	9.5
Switzerland	3	2	4	3	1	2	0	5	4	1	2	2	1	0	4	2	1	0	0	2	2	3	2	3	2	2	0	6	5	0	0	7.8	0.0
Thailand	3	2	4	3	1	2	0	2	3	1	2	2	5	0	3	2	1	1	0	3	2	3	2	3	3	0	0	6	5	0	0	12.5	0.0
Turkey	3	2	0	3	1	6	1	3	4	1	2	2	3	0	3	2	1	1	0	3	2	3	2	3	2	1	0	6	5	0	0	17.2	4.8
Ukraine	0	2	0	2	0	11	3	4	4	1	1	2	3	0	3	2	1	1	0	3	2	2	2	1	1	5	0	5	4	2	0	34.4	14.3
U.K.	2	2	5	3	1	2	0	5	4	1	3	2	0	0	2	2	1	2	0	3	2	3	1	3	2	2	0	6	5	0	0	9.4	0.0
U.S.	2	2	5	3	1	2	0	5	4	1	2	2	1	0	2	2	1	2	0	3	2	3	2	3	2	1	0	5	4	2	0	12.5	0.0
Venezuela	3	2	0	3	1	6	1	2	2	1	2	2	6	0	4	2	1	0	0	3	2	3	1	3	3	1	0	6	4	1	0	21.9	4.8
Vietnam	0	2	0	2	1	10	2	1	2	1	3	2	6	0	1	2	1	3	0	3	2	3	2	2	1	3	0	6	4	1	0	35.9	9.5
Zimbabwe	0	2	0	3	1	9	2	2	3	1	3	2	4	0	4	2	0	1	1	1	2	3	2	3	1	4	0	6	3	2	0	31.3	14.3

Table 8. Environmental Systems – Original Data

	Air Quality			Water Quantity		Water Quality						Biodiversity			Land
	Urban NO_2 concentration	Urban SO_2 concentration	Urban TSP concentration	Freshwater resources per capita	Groundwater resources per capita	Nitrogen (Nitrate and Nitrite) concentration	Dissolved oxygen concentration	Suspended solids	Phosphorus concentration	Fecal coliform	Lead concentration	Percent of plant species threatened	Percent of bird species threatened	Percent of mammal species threatened	Severity of soil degradation
Argentina	28.39	1.02	50.01	19212	3543	0.75	8.22	120.0	0.04	505	0	0.02	0.05	0.08	1.65
Australia	5.49	3.29	8.64	18596								0.11	0.07	0.23	1.22
Austria	13.25	4.40	15.23	6857	2716							0.01	0.02	0.08	2.37
Belgium	15.60	7.01	25.97	822	84	2.97	6.03	38.63	1.61	394695	0.01	0.00	0.02	0.10	2.57
Bolivia				37703	16338							0.00		0.08	1.19
Brazil	51.37	37.89	53.10	31424	11347							0.01	0.07	0.18	1.62
Bulgaria	55.57	26.23	99.62	2146	1598							0.03	0.05	0.16	2.94
Canada	8.25	3.22	7.82	94373	12241		10.84	17.33		37	0	0.22	0.01	0.04	0.52
Chile	81.00	29.00		31570	9444							0.06	0.06	0.18	1.05
China	6.52	8.09	28.26	2231	693	1.49	8.6	2891.7	0.29	11454	0.01	0.01	0.08	0.19	1.83
Colombia			120.00	28393	13533							0.01	0.04	0.10	1.43
Costa Rica				26027	5753							0.04	0.02	0.07	3.42
Czech Republic	9.53	9.11	19.46	5694									0.03		2.92
Denmark	54.00	7.00	61.00	2092	5706							0.01	0.01	0.07	0.47
Ecuador		4.30	62.87	25791	11006							0.02	0.04	0.09	1.30
Egypt		69.00		43	20							0.04	0.07	0.15	0.58
El Salvador				3128								0.01	0.00	0.01	2.39
Finland	15.34	1.46	16.63	21334	369		11.2	3.33	0.01		0	0.01	0.02	0.07	1.26
France	28.30	6.95	7.08	3065	1703		10.33	25.58	0.17		0.01	0.03	0.03	0.14	1.47
Germany	13.36	4.27	14.42	1165	555								0.02	0.11	1.92
Greece	64.00	34.00	178.00	4279	237							0.11	0.04	0.14	1.94
Hungary	15.04	12.44	21.25	604	685							0.01	0.05	0.11	2.51
Iceland	42.00	5.00	24.00	606498	86643							0.00	0.00	0.09	
India	50.60	46.97	473.00	1896	359	3.61	6.46	0.47		10181		0.08	0.08	0.24	1.92
Indonesia			271.00	12251	1094	0.74	3.32	216.0	0.57		0.05	0.01	0.07	0.29	1.90
Ireland		9.45		13187	971							0.01	0.01	0.08	0.28
Israel				289	187								0.04	0.14	0.44
Italy	124.38	15.55	28.97	2785	524							0.05	0.03	0.11	2.17
Japan	12.40	4.87	10.91	4344	1469	1.43	9.91	27.93	0.05	473	0.01	0.15		0.22	0.16
Jordan				114	97	21.1	2.63	90.0		466	0.02	0.00	0.03	0.10	2.43
Korea	8.81	7.49	11.97	1434			10.3	5.0		260	0.04	0.02	0.17	0.12	2.23
Malaysia		20.49	45.79	21259	3310		4.53	298.0		236667		0.03	0.07	0.15	2.76
Mauritius				1915	589							0.32	0.37	1.00	0.79
Mexico	130.00	74.00	279.00	3729	1450	1.28	5.33	176.07		315250		0.04	0.05	0.14	1.76
Netherlands	58.00	10.00	40.00	635	286	3.15	9.78	26.25	0.27	1874	0	0.00	0.02	0.11	1.40
New Zealand	9.75	1.75	13.66	88859	53804	0.15	9.9	10.5	0.05	222		0.11	0.29	0.30	1.51
Norway	24.82	5.47	10.25	87691	21923				0.01		0	0.01	0.01	0.07	0.34
Peru				1613	12219							0.02	0.04	0.13	1.67
Philippines		33.00	200.00	4476	2494		8.25	37.5		659		0.05	0.22	0.32	2.04
Poland	19.38	18.24		1278	931	3.35	9.31	25.5	0.33	50500	0.02	0.01	0.03	0.12	2.86
Portugal	24.78	4.61	50.40	3878	521		7.7	7.0	0.13	633	0.03	0.10	0.03	0.21	1.91
Russia	3.44	48.77	50.00	29115	5320	0.4	9.73	25.53					0.06	0.12	
Singapore	30.00	20.00		172								0.01	0.08	0.13	1.99
Slovak Republic	86.67	76.67	218.20	5745									0.02		
South Africa	22.02	7.46		1011	108							0.04	0.03	0.13	2.54
Spain	16.18	5.50	36.34	2775	521								0.04	0.23	2.09
Sweden	14.84	2.61	4.50	19858	2257							0.00	0.02	0.08	1.57
Switzerland	21.10	5.67	15.33	5802	369		11.02	53.67	0.07		0	0.01	0.02	0.08	1.73
Thailand	23.00	11.00	223.00	1845	721		2.97		0.31	52889	0.06	0.03	0.07	0.13	3.22
Turkey	4.72	17.40	11.35	3074	314							0.22	0.05	0.13	3.21
Ukraine				1029	388							0.01	0.04		
United Kingdom	16.12	5.49		1219	168	3.34	9.53	9.58	0.09		0	0.02	0.01	0.08	1.48
United States	6.73	2.20		8983	5531	0.55	9.59		0.07	150	0	0.11	0.08	0.08	1.72
Venezuela	57.00	33.00	53.00	36830	9767							0.01	0.02	0.08	1.32
Vietnam				4827	1078								0.09	0.18	3.20
Zimbabwe				1182	419							0.02	0.02	0.03	1.29

Note: See data tables on pages 22 thru 32 for full description of variables.

Table 8. Environmental Stresses and Risks – Original Data (continued)

	Air Pollution					Water Pollution and Consumption				Ecosystem Stress	Waste Production and Consumption Pressure			Population	
	SO_2 emissions per populated land area	NO emisisons per populated land area	VOCs emissions per populated land area	Coal consumption per populated land area	Total vehicles per populated land area	Fertilizer used per hectare of arable land	Industrial organic pollutants per land area	Freshwater withdrawals as percent of renewable resources	Groundwater withdrawals as a percent annual recharge	Deforestation	Percentage urban households with garbage collection	Consumption pressure per capita	Spent nuclear fuel arisings per capita	Change in growth rate, 1990-95 and 1995-00	Growth rate 1995-00
Argentina				0.0	10	254	0.4		3.7	0.30		1		-0.07	1.26
Australia			0.020	21.8	127	376		4.3		0.00	100	2	0.0	-0.19	1.02
Austria	0.002	0.005	0.013	4.0	127	1704	2.5	4.2	5.0	0.00		2	0.0	-0.23	0.52
Belgium	0.021	0.030	0.028	27.8	49	4245			90.7	0.00		2	12.0	-0.13	0.14
Bolivia					2	41	0.1	0.4		1.20	94	0	0.0	-0.08	2.33
Brazil				0.3	11	898		0.7		0.50	93	1		-0.18	1.31
Bulgaria	0.035	0.008		7.1	46	459	2.2	77.2	37.3	0.00	95	1		-0.15	-0.66
Canada	0.014	0.010	0.014	7.0	89	545	1.5	1.6	0.3	-0.10	100	2	51.2	-0.27	1.01
Chile				1.2	13	1131	0.6			0.40	95	3	0.0	-0.27	1.36
China				11.5	4	2732	3.9		8.6	0.10		1		-0.18	0.91
Colombia				0.5	14	2853	0.5	0.5		0.50	94	1	0.0	-0.07	1.87
Costa Rica					7	3636				3.10		1	0.0	-0.58	2.48
Czech Republic				33.8	6	1122		4.7		0.00	100	2		-0.20	-0.16
Denmark	0.066	0.025	0.017	22.3	120	1914	5.4	10.9	3.7	0.00	100	3	0.0	-0.07	0.26
Ecuador	0.002	0.004	0.003		74	752	0.5	1.8		1.60	80	1	0.0	-0.23	1.97
Egypt				1.1	62	3750	5.0	1967.9	261.5	0.00	65	1	0.0	-0.11	1.89
El Salvador				0.0	22	1261	1.3			3.40	46	1	0.0	-0.04	2.04
Finland				3.4	5	1397	1.1	2.0	12.4	0.10		2	12.5	-0.22	0.26
France	0.000	0.001	0.001	2.4	119	2679	2.8	21.0	6.2	-1.10	100	2	21.0	-0.09	0.36
Germany	0.007	0.011	0.016	24.1	316	2410	5.9	48.2	16.9	0.00	100	2	6.4	-0.43	0.14
Greece	0.060	0.044	0.043	6.4	16	1895	1.2		74.8	-2.30	90	2	0.0	-0.23	0.29
Hungary	0.020	0.005	0.004	5.6	9	836	3.8		15.1	-0.50	100	1		-0.11	-0.38
Iceland	0.013	0.039	0.012	3.7				0.1	0.4				0.0	-0.13	0.92
India				5.0	5	856	1.4		42.9	0.00	80	0		-0.22	1.64
Indonesia				0.7	9	1468	1.4	0.7		1.00	71	1	0.0	-0.11	1.43
Ireland	0.006	0.004	0.007	2.9	42	5514	1.3		4.9	-2.60		2	0.0	0.06	0.66
Israel				29.6	194	2963	7.0	108.8	109.1	0.00		2	0.0	-1.34	2.21
Italy	0.013	0.018		3.3	288	2280	3.1	35.3	40.0	-0.10		2	0.0	-0.12	-0.01
Japan				21.1	482	4168	10.3	16.6	7.0	0.10		2	524.0	-0.11	0.20
Jordan					15	544	0.8	144.1	70.7	2.50	100	1	0.0	-1.30	3.02
Korea	0.040	0.030		36.2	274	5291		41.7		0.20		2		-0.12	0.83
Malaysia				0.7	32	6375	1.3			2.50		2	0.0	-0.37	2.02
Mauritius				3.4	173	3174	33.2			0.00		1	0.0	-0.27	0.78
Mexico				0.4	27	538	0.3	21.7	16.9	0.90		1		-0.19	1.63
Netherlands	0.010	0.035	0.023	29.5	414	5923	8.2	78.1	25.3	0.00	100	2	0.3	-0.25	0.42
New Zealand				1.7	72	4247		0.6		-0.60		1	0.0	-0.76	1.01
Norway	0.001	0.005	0.009	1.0	53	2138	1.2	0.5	0.1	-0.20		4	0.0	0.02	0.53
Peru				0.0	11	453		15.3	0.7	0.30	57	1	0.0	-0.01	1.73
Philippines				0.5	19	1193			2.2	3.60		1	0.0	-0.27	2.11
Poland	0.021	0.009	0.006	24.6	81	1074	3.0	24.9	6.7	-0.10	97	1	0.0	-0.18	0.08
Portugal	0.008	0.007	0.007	3.7	111	1198	4.3	19.2	60.1	-0.80		2	0.0	0.06	0.04
Russia	0.001	0.000		1.0	5	129	0.4	1.8	0.0	0.00	100	2		-0.13	-0.16
Singapore				0.1	2176	50940	143.4			0.00		3	0.0	-0.49	1.43
Slovak Republic	0.013	0.009	0.006	8.1	69	660	3.4	5.8		-0.10	100	1		-0.25	0.12
South Africa				13.7	25	511	1.0	29.7	37.3	0.20		1		-0.44	1.49
Spain	0.011	0.006	0.006	2.8	95	1285	1.7	27.9	26.6	0.00		2	37.5	-0.10	0.03
Sweden	0.001	0.004	0.005	1.2	47	1121	1.1	1.7	3.0	0.00	100	2	23.6	-0.31	0.25
Switzerland	0.002	0.009	0.013	0.1	226	3058	8.2	2.8	35.1	0.00		2	2.2	-0.22	0.67
Thailand				1.9	32	873		29.0	1.6	2.70		2	0.0	-0.13	0.93
Turkey	0.001			2.2	16	678	0.6	16.1	31.5	0.00		1	0.0	-0.10	1.66
Ukraine	0.007	0.002		8.4	20	277	2.4	48.9	21.1	-0.10		1		-0.21	-0.38
United Kingdom	0.025	0.025	0.024	18.5	263	3700	7.5	16.6	27.6	-0.50	100	1	150.5	-0.08	0.18
United States	0.010	0.011	0.012	12.4	120	1134	1.5	19.0	7.3	-0.30		3	8.3	-0.16	0.83
Venezuela				0.1	14	1024	0.7			1.10		1	0.0	-0.25	2.02
Vietnam				1.2		2593		7.7		1.40	45	1	0.0	-0.49	1.55
Zimbabwe				1.0	3	554	0.2	8.7		0.60	100	0	0.0	-0.53	1.42

Note: See data tables on pages 22 thru 32 for full description of variables.

Table 8. Human Vulnerability to Environmental Impacts – Original Data (continued)

	Basic Sustenance				Public Health		Environmental Disasters Exposure
	Percent of urban population with access to safe drinking water	Percent of rural population with access to safe drinking water	Percent of population with access to electricity	Daily per capita calories supply as a percentage of total requirements	Prevalence of infectious disease	Infant mortality	Deaths from natural disasters
Argentina	71	24		131	45	21.8	0.90
Australia			99	124	17	5.3	2.11
Austria			100	133	18	4.8	0.40
Belgium	100	91	100	149	14	6.0	0.07
Bolivia	88	43	89	84	642	67.0	6.76
Brazil	80	28	99	114	424	40.5	1.84
Bulgaria			100	148	39	14.4	
Canada			100	122	16	5.6	0.47
Chile	99	47	94	102	29	11.7	3.59
China			100	112	37	31.4	3.49
Colombia	90	32	99	106	396	28.0	3.26
Costa Rica	100	99		121	12	14.2	5.84
Czech Republic			100		18	5.1	0.28
Denmark			100	135	9	5.2	0.21
Ecuador	81	10	98	105	363	40.0	9.17
Egypt	95	74	99	132	40	52.3	2.24
El Salvador	82	24	98	102	145	35.0	15.83
Finland	100	85	100	113	13	4.2	
France			100	143	15	5.0	0.43
Germany			100		15	4.9	0.06
Greece			100	151	1	6.3	11.57
Hungary			100	137	43	9.7	0.04
Iceland	100	100	100		4	2.6	
India		82	81	101	378	72.3	6.62
Indonesia	87	57	96	121	27	45.7	2.13
Ireland			100	157	7	6.2	1.08
Israel	100	95	100	125	7	5.8	0.24
Italy			100	139	76	5.5	0.58
Japan			100	125	34	3.7	1.20
Jordan			98	110	15	34.0	0.30
Korea	93	77	100	120	74	11.0	4.13
Malaysia	100	86		120	373	8.3	1.56
Mauritius	100	95		128	18	19.7	1.14
Mexico	90	66		131	44	31.5	4.61
Netherlands			100	114	13	5.1	0.01
New Zealand			98	131	9	5.3	0.83
Norway	100	100	100	120	5	4.1	0.02
Peru	91	31	76	87	816	43.0	10.30
Philippines	94		86	104	700	35.3	34.65
Poland	89		99	131	44	9.6	1.57
Portugal			100	136	59	6.4	1.24
Russia			100		62	16.6	1.87
Singapore			100	136	80	3.3	
Slovak Republic			100			8.8	
South Africa	90	33		128	238	52.1	3.64
Spain			100	141	44	5.5	0.81
Sweden			100	111	6	3.6	
Switzerland	100	100	100	130	12	4.8	1.58
Thailand	94	88		103	273	25.0	3.67
Turkey	72	63		127	200	42.7	0.86
Ukraine	77	12	100		47	14.0	0.04
United Kingdom			100	130	9	5.9	0.38
United States			100	138	53	7.0	3.07
Venezuela	79	79	90	99	90	21.0	1.27
Vietnam			100		1252	34.8	18.12
Zimbabwe	99	64	64	94	3288	52.8	

Note: See data tables on pages 22 thru 32 for full description of variables.

Table 8. Social and Institutional Capacity – Original Data (continued)

	Scientific and Technical Capacity			Capacity For Rigorous Policy Debate		Environmental Regulations and Management			Tracking Environmental Conditions			Ecoefficiency			Public Choices Failures and Distortions		
	R&D scientists and engineers per million population	Expenditure for R&D as a percentage of GNP	Scientific and technical articles per million population	IUCN member organizations per million population	Civil liberties	Transparency and stability of enviornmental regulations	Percent of urban population with access to adequate sanitation	Percent land area under protected status (IUCN categories I-V)	Fraction of ESI variables in publicly available data sets	Availability of sustainable development information at the national level	Number of GEMS water quality monitoring stations per million population	Total energy consumption per unit GDP	Hydroelectric plus renewable energy supply as % of total energy produced	Percentage increase in supply of hydroelectric and renewable energy	Retail prices for premium gasoline	Fossil fuel subsidies as a percentage of GDP	Corruption perceptions index
Argentina	671	0.4	26	0.49	3	3.1	73	1.7	0.86		0.33	0.63	0.245	-0.15	2.79	0.1	3.0
Australia	3166	1.7	266	1.32	1	4.6	100	7.0	0.75		0.58	0.67	0.061	-0.09	1.74		8.7
Austria	1631	1.5	149	0.62	1	4.1	100	28.3	0.84	3.6	0.00	0.38	2.186	0.08	3.40		7.6
Belgium	1814	1.7	182	0.49	2	3.3	100	2.6	0.92		1.37	0.64	0.019	0.14	3.61		5.3
Bolivia	250		0	0.87	3	2.7	82	14.4	0.70	2.0	0.25	1.07	0.189	-0.12	1.40		2.5
Brazil	168	0.6	10	0.06	4	3.9	80	4.2	0.80	2.0	0.07	0.72	1.621	0.00	2.94	0.0	4.1
Bulgaria	1742		75	0.12	3	3.4		4.4	0.73		0.00		0.165	0.45		7.1	3.3
Canada	2656	1.6	305	0.56	1	4.5	100	10.0	0.91	2.5	0.56	1.01	0.584	-0.09	1.55		9.2
Chile		0.7	21	0.13	2	3.3	90	18.9	0.75		0.20	0.90	1.648	0.47	1.89		6.9
China	350	0.5	4	0.00	6	4.0	74	6.4	0.86		0.00	2.44	0.142	0.13	0.93	2.4	3.4
Colombia			0	0.23	4	2.9	97	9.0	0.73	2.0	0.08		0.332	-0.20	0.70		2.9
Costa Rica		0.2	0	1.67	2	3.3	95	13.7	0.67	2.9	0.00	0.84	2.506	-0.11	1.59		5.1
Czech Republic	1159	1.2	111	0.29	2	4.0		15.8	0.67	2.3	0.00		0.033		2.56	3.0	4.6
Denmark	2647	1.9	266	0.94	1	4.5	100	32.2	0.86	3.0	0.75	0.33	0.067	0.38	3.57		10.0
Ecuador	169	0.1	0	0.97	3	2.8	95	43.1	0.80	2.6	0.24		0.226	0.07	1.08		2.4
Egypt	458	0.5	13	0.03	6	4.4	98	0.8	0.80	2.7	0.15	2.17	0.132	0.08		3.4	3.3
El Salvador	19		0	1.19	3	2.3	98	0.3	0.69		0.00	0.76	2.386	0.01	1.76		3.9
Finland	2812	2.5	240	0.58	1	5.4	100	6.0	0.88	3.1	0.97	0.44	1.084	0.04	3.91		9.8
France	2584	2.4	221	0.41	2	4.1	100	11.7	0.92	2.8	0.29	0.40	0.371	0.01	3.82		6.6
Germany	2843	2.4	212	0.17	2	4.1	100	27.0	0.81	3.1	0.13	0.41	0.121		3.33		8.0
Greece	774	0.6	97	0.47	3	3.2		2.2	0.81	2.3	0.00		0.325	1.36	2.68		4.9
Hungary	1033	0.8	97	0.30	2	3.6		6.8	0.81	2.4	0.40		0.012	0.42	2.82	1.5	5.2
Iceland	4000	1.6	191	0.00	1	4.0	100	9.7	0.69	3.0	0.00	0.76	2.640	0.00			9.2
India	149	0.8	6	0.01	3	3.6	70	4.8	0.84		0.04		0.205	-0.35	2.65	1.1	2.9
Indonesia		0.1	0	0.00	4	3.3	71	9.7	0.84		0.10	1.09	0.050	-0.21		0.9	1.7
Ireland	1871	1.4	103	0.27	1	4.1	100	0.9	0.78	3.4	1.07	0.37	0.235	0.04	3.12		7.7
Israel		2.2	359	0.49	3	4.2		14.9	0.70	3.3	0.33	0.49	0.574	9.21			6.8
Italy	1325	1.1	123	0.17	2	2.8	100	7.3	0.81		0.28	0.35	0.920	0.13	3.77		4.7
Japan	6309	2.9	173	0.13	2	4.4	85	6.8	0.88	2.9	0.21	0.34	0.609	-0.25	2.94		6.0
Jordan	106	0.3	0	1.69	5	4.0	100	3.4	0.78		0.85	1.94	0.066	-0.28			4.4
Korea	2636	2.8	51	0.09	2	3.4	100	6.9	0.86		0.02	1.21	0.316	-0.21	2.85	0.0	3.8
Malaysia	87	0.4	0	0.09	5	4.4	94	4.5	0.80	2.4	0.35	1.19	0.043	-0.25			5.1
Mauritius	361	0.4	0	0.85	2	3.4	100	6.0	0.67	2.1	0.00		2.809	0.00			4.9
Mexico	213	0.4	9	0.07	4	3.8		2.4	0.84	2.1	0.16	0.97	0.101	-0.05	1.54	0.7	3.4
Netherlands	2656	2.1	249	1.27	1	4.4	100	6.7	0.95	3.6	0.38	0.62	0.007	2.88	3.94		9.0
New Zealand	1778	1.1	261	1.31	1	3.8	100	23.6	0.83	1.9	1.05	0.81	1.040	-0.14	2.06		9.4
Norway	3678	1.8	213	0.45	1	4.0	100	6.8	0.91	3.1	3.81	0.63	0.333	-0.44	4.44		8.9
Peru	625	0.6	0	0.23	4	3.6	89	2.7	0.75		0.38	0.55	0.907	0.21	1.87		4.5
Philippines	157	0.2	0	0.03	3	3.2	95	4.9	0.80	1.8	0.05	0.96	1.680	0.07			3.6
Poland	1299	0.7	83	0.16	2	3.6		9.6	0.94	2.2	0.21		0.028	0.12	1.98	2.0	4.2
Portugal	1185	0.6	50	0.20	1	3.5	100	6.5	0.92	2.7	0.20	0.61	2.807	0.04	3.32		6.7
Russia	3520	0.7	95	0.03	4	3.1		3.1	0.80	2.1	0.29		0.108		0.53	1.5	2.4
Singapore	2728	1.1	149	0.75	5	5.8		4.4	0.64		0.00	1.05					9.1
Slovak Republic	1821	1	107	0.56	2	4.1		21.8	0.66	2.3	0.00		0.583		2.52		3.7
South Africa	938		24	0.38	2	4.1	92	5.4	0.75	2.0	0.00	1.98	0.012	0.62		0.3	5.0
Spain	1210	0.9	132	0.43	2	3.9	100	8.4	0.83	3.6	0.15	0.43	0.620	0.20	2.75		6.6
Sweden	3714	3.4	316	0.68	1	4.2	100	9.0	0.83		0.79	0.48	1.444	-0.04	3.83		9.4
Switzerland		2.8	392	0.98	1	4.6	100	18.0	0.92	3.0	0.98	0.28	1.628	0.03	3.03		8.9
Thailand	118	0.1	0	0.02	3	3.5	97	13.1	0.88	2.7	0.11	1.00	0.197	-0.29	1.38	0.4	3.2
Turkey	261	0.6	11	0.03	5	3.7	95	1.4	0.83	2.3	0.06	0.73	1.107	0.40	3.02		3.6
Ukraine	3173	1.3	46	0.04	4	2.8		1.6	0.66	3.0	0.00		0.104				2.6
United Kingdom	2417	2.2	246	0.66	2	4.5	100	20.5	0.91		0.24	0.49	0.012	-0.30	3.90		8.6
United States	3732	2.5	236	0.17	1	3.5	100	13.4	0.88	4.0	0.09	0.75	0.179	0.23	1.27		7.5
Venezuela	208	0.5	0	0.21	3	3.5	64	36.3	0.78		0.00	2.40	0.173	0.02	0.45	4.0	2.6
Vietnam	308	0.4	0	0.03	7	3.4	55	3.1	0.64	3.3	0.00		0.516	-0.04			2.6
Zimbabwe			0	1.61	5	3.8	96	7.9	0.69	1.9	0.00	1.33	0.385	-0.31			4.1

Note: See data tables on pages 22 thru 32 for full description of variables.

Table 8. Global Stewardship – Original Data (continued)

	Contribution to International Efforts						Impact on Global Commons				
	Environmental international organizations memberships as fraction of total IO memberships	Total environmental IO memberships	Percentage of CITES reporting requirements met	Status of National Biodiversity Strategies & Action Plans under the CBD (0=no info, 1= planned, 2= complete)	Levels of ratification under the Vienna Convention (1=low, 4=high)	Total FSC and MSC members	FSC-certified Forest area (ha)	Ecological Footprint "deficit", 1995 data (negative = deficit)	CO_2 emissions (total times per capita)	CFC consumption (total times per capita)	Exports of SO_2 (100 tonnes S)
Argentina	0.27	55	100	1	3	0	0	0.7	3579440	680459	
Australia	0.31	61	95.2	2	4	10	0	5.0	38747544	1887	
Austria	0.31	64	100	1	3	1	0	-1.0	32370	46508	145
Belgium	0.33	78	100	0	3	8	4342	-3.7	8247615	36885	804
Bolivia	0.28	53	66.7	2	3	13	660113		993	285	
Brazil	0.33	61	50	1	3	21	1335224	3.6	3432060	604931	
Bulgaria	0.23	47	83	2	4	0	0		2685130	0	2507
Canada	0.29	62	100	2	4	69	211013	1.9	42007848	624	
Chile	0.19	52	72.7	1	4	4	0	0.7	1224796	31968	
China	0.25	48	100	2	2	1	0	-0.4	69767772	2137421	12300
Colombia	0.27	59	75	1	3	3	0	2.1	873376	121727	
Costa Rica	0.27	45	81.8	1	3	7	31747	0	47286	2539	
Czech Republic	0.24	50	100	1	4	0	10441	-0.5	11653460	12	3394
Denmark	0.27	96	100	2	3	7	36	-0.7	4553915	71218	650
Ecuador	0.32	53	77.3	1	3	1	0		380931	8935	
Egypt	0.27	78	11	1	3	10	0	-1.0	1121904	42764	
El Salvador	0.25	40	40	1	1	0	0		20976	13634	
Finland	0.27	94	76	2	3	4	0	2.6	5087250	72849	235
France	0.38	91	95	1	3	1	0	0.1	16688750	6413	2426
Germany	0.39	88	100	0	4	30	80171	-3.4	67459350	4557	4687
Greece	0.35	65	100	1	3	1	0	-2.6	462042	35475	1002
Hungary	0.28	54	83	1	4	0	0	-1	2629422	2	1887
Iceland				0	3	0	0	14.3	132379	0	44
India	0.37	63	95.2	1	2	0	0	-0.3	7894148	48122	3400
Indonesia	0.27	56	94.4	2	3	3	62278	1.2	2207106	176883	1320
Ireland	0.35	55		0	3	1	0	0.6	2553236	103099	414
Israel	0.28	43	41.2	2	3	0	0	-3.1	3599064	0	
Italy	0.34	76	100	0	3	1	11000	-2.9	21129984	6490	2820
Japan	0.38	63	94.1	2	3	1	0	-3.4	80946244	102	1420
Jordan	0.22	49	22.2	1	4	0	0	-1.8	251116	128092	
Korea	0.30	54	75	0	4	0	0	-2.9	27397020	3822552	3380
Malaysia	0.30	53	84.2	2	3	6	55083	0.4	5134526	27547565	401
Mauritius	0.26	39	86	1	3	0	0		19992	36	
Mexico	0.27	56	100	1	3	9	143004	-1.2	9690714	14774684	
Netherlands	0.37	82	92	2	3	20	69064	-3.6	11518656	4082	466
New Zealand	0.28	43	100	1	4	2	45025	12.8	1827000	0	
Norway	0.27	96	95	1	4	4	0	0.1	768180	2	87
Peru	0.26	57	72.7	1	3	5	0	6.1	21432	15424	
Philippines	0.29	48	87.5	0	2	0	0	-0.6	431500	320674	723
Poland	0.29	56	71	1	4	0	2218006	-2.1	24538500	1388	5329
Portugal	0.31	68	69	0	3	1	0	-0.9	1739906	9637	317
Russia	0.37	59	80	1	2	1	0	-2.3	125447190	12245363	1834
Singapore	0.24	33	100	0	2	0	0	-7.1	9541008	216	642
Slovak Republic	0.26	46	75	2	4	0	0		2185640	0	659
South Africa	0.31	42	96	1	2	4	708621	-1.9	15020824	1794	
Spain	0.35	77	100	1	4	1	0	-1.6	1015216	9931	2908
Sweden	0.28	98	100	1	4	18	9026683	1.1	2482368	9404	247
Switzerland	0.36	67	96	1	3	7	2112	-3.2	2003620	191	67
Thailand	0.31	51	64.3	1	3	1	0	-1.6	5324560	337564	1340
Turkey	0.25	57	0	1	3	0	0	-0.8	3845246	244419	460
Ukraine	0.29	28		1	2	0	0		2277051	38382	2345
United Kingdom	0.38	73	100	2	3	77	55029	-3.5	39371885	6382	5467
United States	0.35	66	90.9		3	73	1564822	-3.6	776919249	3149	
Venezuela	0.27	59	84.2	1	3	2	0	-1.1	6980526	628059	
Vietnam	0.24	33	66.7	2	3	0	0		143836	3385	201
Zimbabwe	0.28	40	81	1	3	3	72504		221100	17406	

Note: See data tables on pages 22 thru 32 for full description of variables.

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