2005 Environmental Sustainability Index

Benchmarking National Environmental Stewardship

Appendix G
An Ideal Set of ESI Indicators

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Appendix G – An Ideal Set of ESI Indicators

Ideally, a measure of environmental sustainability would encompass a range of issues broad enough to permit a complete appraisal of each country's environmental state. In this Appendix, we briefly review what we think a complete ESI would include, and discuss the constraints that prevent us from achieving such an ideal.

Systems

An ideal set of systems measures would span both natural and managed environmental systems, and cover the full range of terrestrial, atmospheric, and aquatic systems, In particular, such a set of indicators would include the following:

- Cultivated systems, including measures of soil fertility and soil moisture, pest management practices, genetic diversity, and crop yields. Only crop yields are actually available, and in the absence of measurements of the agricultural practices underlying them, they are not suitable as a sustainability measure.
- Managed forests, including measures of the quality of forests (genetic stock, tree circumference, resistance to pests and disease, and so on) and the nature of forestry practices. These measures are not available on a comparable basis across countries.
- Fisheries, including measures of the size, health, and age structure of the relevant population stocks as well as the management practices applied. This area has very little comparable information available.
- Water quantity, including measures of the availability of surface freshwater as well as groundwater. In many countries freshwater volumes can be estimated reasonably well, though there is unevenness in how this is carried out. Paradoxically, the number of stream gauges is declining even as human intervention in the hydrosphere is increasing. Groundwater availability is also very poorly measured.
- Water quality, including measures of eutrophication, turbidity, dissolved oxygen, and other critical indicators. There are two main deficiencies of the available measures in this regard. First, very few countries report water quality data to an international body. Second, it is difficult to make the available measures comparable because of natural variation in baseline levels of these measures. Some river basins are naturally turbid; others are not. A high turbidity level in the first kind of river is not a sign of low sustainability, while it is such a sign in the second.
- Air quality, including measures of pollutants such as sulfur dioxide, nitrogen oxides, particulates, volatile organic compounds (VOCs), and ozone. Few countries collect these measures in a comparable way, and those that do, report data for only a handful of urban areas. Tragically, one of the most serious and widespread forms of air pollution, concentration of indoor particulates from solid fuel combustion in the home, is not measured at all except in isolated, ad hoc efforts or through proxies.
- Landscape, including measures of urbanization, deforestation, agricultural conversion, and other anthropogenic alterations of the land. Of these, deforestation has received the most effort, and there are rough measures of the others.
- Biodiversity, including measures of both genetic and organismic diversity as well as of preservation of critical habitat and fragmentation of ecosystems. There are virtually no accepted measures of these phenomena that are comparable across nations.

- Sensitive ecosystems, including measures of coastal, mountain and dryland ecosystem health. These ecosystems are either under high stress or experience high vulnerability, and they would best be measured using indicators tailored to their special circumstances. However, no systematic, comparable measures have been collected.

Stresses

Within the Stresses component, we would like to be able to measure the full range of pressures on environmental systems including:

- Air pollution emissions, including emissions of the criteria air pollutants sulfur dioxide, nitrogen oxides, and volatile organic compounds (VOC). Many countries measure such emissions, and estimates are widely available.
- Water pollution, including measures of eutrophying and toxic chemicals released into watersheds, and untreated sewage. There are few comparable measures of such pollution, although there are proxies.
- Water consumption, including measures of surface and groundwater withdrawals in comparison to their recharge rates. There are reasonable estimates of surface water consumption, though groundwater use is unevenly measured, especially in comparison to recharge rates.
- Stresses on ecosystem functioning, including measures of anthropogenic disturbances to aquatic, terrestrial, and marine ecosystems. There are few comparable measures that fall into this category, though Europe has developed an effective system to measure the extent of acidification of land and aquatic ecosystems, and there are global efforts to quantify deforestation. There are no similar efforts to quantify disturbances to the hydrosphere or the coastal and marine environments
- Waste and consumption, including measures of solid waste generation, landfill volume, hazardous waste generation, unsafe disposal of waste, and natural resource consumption relative to carrying capacities broadly conceived. There are no adequate, comparable measures of these issues, although the work undertaken by those producing the Ecological Footprint Index (Wackernagel and colleagues) has made it possible to quantify natural resource consumption much more effectively than before.
- Releases of toxins, carcinogens, endocrine disruptors and other known or potentially hazardous chemicals. There are no international programs to collect such information on a comparable basis, with the exception of a few targets of international regulation such as persistent organic pollutants (POPs).
- Soil degradation, including measures of salinization, nutrient depletion, and desertification. There are no national comparable measures of this phenomenon that are considered reliable by soil experts.
- Population, including measures of fertility and total growth. This is well measured.

Human Vulnerability

Within the Human Vulnerability component, we would like to measure the following:

- Food security, including measures of caloric intake, malnutrition, and susceptibility to famine or other shortfalls in food availability. People who are malnourished are more susceptible to pollution harms as well as more vulnerable to resource mismanagement.
- Environmental health, including measures of morbidity and mortality stemming from waterborne vectors, such as intestinal infectious diseases; from poor air quality, such as respiratory diseases; and from exposure to toxins and mutagens, such as some cancers. In practice our ability to create such measures is severely limited. The World Health Organizations' path-breaking work on the environmental burden of disease was not able to quantify such outcomes at a national level, but only within large global regions.

- Susceptibility to environmentally-related natural disasters, such as floods, droughts, landslides and hurricanes. In the past it has been hard to create comparable metrics on this dimension, but the situation has improved due to intense international work in recent years.
- Economic security, including measures of environmentally-induced poverty traps and economic losses from broad environmental change. There are no comparable data on this dimension of human vulnerability, although recent breakthroughs in the methodologies associated with environmental accounting hold promise for improvements in the future.

Social and Institutional Capacity

Within the Social and Institutional Capacity component, the ideal indicators are as follows:

- Environmental governance, including measures of the effectiveness of the environmental regulatory apparatus, the flexibility and innovativeness of the regulatory regime, the strictness of enforcement of environmental laws as well as the extent of endemic problems such as corruption or deviation from rule of law, the use of best practices concerning monitoring, assessment, and implementation, the extent of public participation in environmental decision-making, and the availability of environmental information. In practice there are few good measures specific to the environment, though there are some more generic governance measures that are relevant.
- Science and Technology, including measures of the level of environmental knowledge among the public, the capacity of a society to respond to technical challenges, and the ability of a society to innovate and generate less-environmentally harmful products and production processes over time.
- Private Sector Responsiveness to Environmental Challenges, including measures of private sector compliance with laws, commitment to environmental stewardship, and capacity for environment-related innovation. The private sector is central to overcoming pollution control and natural resource management challenges, therefore measures of these would be of great value.
- Eco-Efficiency. While absolute levels of pollution and energy use matter, one key gauge of a society's environmental trajectory is its resource productivity as measured by energy use/GDP and other metrics of resources conserved per unit of economic output.

Global Stewardship

Within the Global Stewardship component, the ideal indicators are as follows:

- Greenhouse Gas Emissions. Because climate change is such an important global environmental issue, measuring the degree to which countries are contributing to the problem is vital within this category. Indeed, it is important to track emissions both as a function of economic scale (measuring efficiency) and population (measuring absolute impacts).
- Participation in international collaboration. There are hundreds of international environmental agreements, and ideally we would be able to construct a measure that fairly evaluates the participation of countries across a number of agreements. However, in practice this is difficult to accomplish as the number of agreements varies considerably across world regions and some countries have fewer opportunities to participate based solely on their location. In addition, the easiest things to measure (signature and ratification rates; compliance with reporting requirements; and so on) are seldom the most important. More meaningful measures would include adjustments of policies to achieve international goals; implementation of monitoring and research programs to further international efforts; and other substantive actions.

- Transboundary environmental pressures. Pollutants can flow across borders, and in some cases constitute a significant portion of total pollution within a receiving country. Such transboundary spillovers can be an important source of air pollution, water pollution, and hazardous chemicals. In addition, upstream countries are capable of withdrawing water in sufficient quantities to seriously deplete available water in downstream countries. A country can also significantly diminish the ability of migratory species to survive through alteration of habitat or other pressures. In practice, very few of these transboundary pressures are measured. Flows of air pollution in Europe are extremely well monitored. Acid rain spillovers in Asia have been modeled by the World Bank, but these data are an exception.
- Environmental impacts of trade, investment and consumption flows. In addition to generating direct environmental harm outside their borders, countries can potentially exert profound indirect effects through their international economic activities. These are some of the least understood or measured impacts. Although the economic flows are monitored quite closely, their environmental impacts are not. The task is made more complicated because most economic flows have both positive and negative effects, and because the effects are seldom uniform across different locations. Monitoring efforts that link specific environmental outcomes in one location to the economic flows originating in another could produce large improvements in this area. All of the available proxies are admittedly crude.

Conclusion

Conceptually, environmental sustainability involves a wide range of issues, many of which are hard to quantify accurately and appropriately using available data sources. In general, metrics tend to be closely linked to human activities or human impacts. The pollution measures, capacity measures, and human welfare measures, for example, tend to be more accurate and easily available than the others. The ecosystem measures tend to be the least covered, with entire broad categories remaining chiefly a blank slate almost twenty years after the Brundtland Report.