CHAPTER 5

INDICATORS AND INDEXES: THE SIGNS OF LIFE

We should not be sure that the effort to elaborate and publish all these indicators is truly necessary, unless there is a collective will to ensure that they are used: a) to show the truth and b) to take corrective action on the basis of that truth. (Schatan, 1990, p. 69)

NEW INDICATORS FOR THE ENVIRONMENTAL AGE

Traditionally, indicators have been used to guide decision making in a wide range of contexts. The right set of indicators can enable a decision maker to digest large quantities of otherwise inaccessible information, getting the whole picture at a glance. Some indicators, like Gross Domestic Product (GDP), population growth rate, literacy rate, or net trade balance are used and applied throughout the world as touchstones against which to judge national or regional success. Like a canary in a mine, indicators can also be used to warn of areas of concern, so that preventative or remedial actions can be taken in time; other indicators can help us to gauge the success or effectiveness of such actions.

In the absence of appropriate indicators, many decisions are made without adequate understanding or consideration of their effects on the environment. Similarly, many decisions are made without sufficient knowledge of the environmental factors that may aid or hinder the long-term sustainability of a particular activity or sector. Decision makers need better indicators to warn them of impending hazards and to monitor negative trends, allowing them to anticipate and prevent problems that might harm the viability of the ecosystems on which they depend. New approaches are also needed to measure the extent and effectiveness of management or policy actions taken to prevent or ameliorate environmental degradation. The impacts of environmental quality and resource limitations on our goals and well-being and, in turn, the effects of our actions on the environment are factors that cannot be ignored in the “environmental age.”

Increasingly, decision makers are being faced with accountability for these relationships and for the effects of their decisions across sectoral, regional, national, and even temporal boundaries. For long-term survival, decision makers in business and industry will need to become knowledgeable participants in planning sustainable use of environmental resources, in addition to becoming responsible managers of their own impacts. Degraded environments, legislated limits, lost markets, and impaired resource supplies all show up in the bottom line. Public sector managers and policy makers have the additional mandate to promote and ensure social well-being through effective, responsible, and informed decision making.

Unfortunately, “what societies carefully measure today are often trends that belong to an earlier era. They bear little relationship to the interaction of the environmental, demographic, and economic forces now shaping our lives and those of our children. They may be of only marginal value to the
most important decisions being made by individuals, governments, and businesses in the late twentieth and early twenty-first centuries" (Brown et al., 1992, p. 11). The indicators on which we traditionally have relied may be inadequate or outmoded; in some cases, they have been misapplied or they simply may not be giving us the whole picture. For example, U.S. newspapers routinely report new housing starts each month, but fail to report regularly on the clearcutting of forests that provided the wood for those houses — or on other environmental impacts, such as soil erosion, silting of rivers, and destruction of fisheries, associated with the cutting. Similarly, data on automobile sales are released every 10 days in the U.S., but bicycle sales are not regularly reported anywhere, even on an annual basis, although bicycles serve far more people globally than do automobiles.

We need to re-examine the indicators that are in common use today, with the goal of selecting or creating more realistic, more comprehensive, and more effective indicators of progress and well-being, and then incorporating them into the decision-making process. To a great extent, we are redefining the ways in which we measure our progress towards sustainability. The objective is to develop indicators that can aid decision makers in understanding:

- the links between different types of human activity and the natural and cultural environment;
- the functions of the environment and the natural resource base, with respect to the prosperity and sustainability of human activities;
- the impacts of economic activities and industrial processes on the environment; and
- the effectiveness of actions taken to limit the negative impacts of human activities, or to mitigate or ameliorate environmental damage.

Decision makers at all levels and in all contexts need information that is accessible, reliable, and easily understandable — information in the form of indicators that succinctly describe and quantify their connections with and impacts on the environment in which they operate. A key challenge will be to define individual packages of indicators that are appropriate for particular sectoral applications; the example of the World Tourism Organization is given later in this chapter and in Appendix 3.

FUNCTIONS AND SOURCES OF INDICATORS

Virtually any data set can provide potential indicators. Selecting certain indicators reduces the impossibly wide range of available information to a smaller set of usable and meaningful measures, emphasizing those factors most important in the decision-making process. In selecting appropriate indicators, two important questions are "Will the information be at the right scale to support better decisions?" and "What other information is needed to clarify the meaning of changes — whether regional or temporal, or across sectoral or socioeconomic boundaries — in a particular indicator?" Clearly, indicators that are useful in measuring global flows, stresses, and impacts may be ill-suited to most regional, local, or project-level planning. Similarly, measures and procedures suitable to support effective project-level planning and operations may be difficult to use on a broader scale or to aggregate into national- or international-level indicators.

The selection of, or emphasis on, particular indicators depends to a great extent
on the goals and priorities of the decision maker. If the objective is to preserve natural environments, key indicators may be those measuring areas protected or losses of critical attributes that are the focus of protection, such as species or ecosystem functions. If the objective is to reduce the risk of degrading environments used by humans, such as beaches or lakes, then the most important indicators may be levels of use or extent of impact on the biological values critical to continued use. If the main objective is to sustain a minimum level of productivity (of food, fiber, or water supply, for example), then critical indicators will include measures of those biophysical factors central to the production system, such as soil depth, rate of replanting, aquifer recharge rate, and accurate assessments of resource stocks and flows. These and many other types of indicators are likely to be useful to decision makers, in understanding the links between their actions and the continuing capability of the environment to sustain them.

A comprehensive set of indicators should therefore provide reliable measures of:

- environmental sensitivities and interrelationships, including biophysical and physical features as well as sociocultural and economic interconnections with the natural environment;
- the status of the environment and the natural resource base;
- the levels of human activities that are causing pressures or stresses on the environment;
- the actual measurable biophysical impacts of these activities;
- in turn, the social and economic consequences of the impacts;
- the level of response to existing or potentially troublesome situations, e.g., in terms of declared strategies, regulations, legal limits, financial incentives and disincentives, or defensive expenditures; and
- the effectiveness of the responsive actions.

Each of these measures represents a different type of indicator, serving different management needs. The information sources for these indicators are varied, encompassing biophysical, economic, and sociocultural data sets.

Although information needs and availability vary, many key indicators and indexes rely on information that is required by several different sectors, and much can be built from existing information sources. To a certain extent, indicators of sustainable development may include many of the same measures that are currently in use and commonly reported internationally as measures of sectoral industrial activity. Other indicators will be based on measured or collected information about the environment. One problem with the reporting of such information is that for many trends and indicators, no one is officially responsible for compiling the annual data and making them publicly available and accessible (Brown et al., 1992, p. 11). Sometimes the data are gathered routinely, but they are published in inaccessible forms, such as statistical yearbooks. In other cases, the data are simply lacking, and it seems that no one is explicitly responsible for monitoring some of the most important trends. “At present, coverage of economic trends dwarfs that of environmental ones, though the latter are arguably more important (in the long term). This is largely because governments and industries
regularly collect and release data on dozens of economic indicators, such as employment, industrial output, and interest rates, while details of global environmental trends, such as deforestation, are collected only once a decade" (Brown et al., 1992, p.12). In some cases, private groups and non-governmental organizations have attempted to fill the information gaps, at least partially. For example, the Stockholm International Peace Research Institute is widely considered to be the most reliable source for data about global military expenditures, while the World Resources Institute, Worldwatch Institute, World Conservation Union (IUCN), among others, are respected and trusted as sources of accurate environmental information.

CHOOSING AND USING APPROPRIATE INDICATORS

There are probably as many approaches to the construction, selection, and application of indicators as there are statisticians and data sets. In many cases, a single piece of information on its own can tell an important story, for example: the world is projected to add at least 960 million people in this decade (Brown, 1991, p. 16); worldwide, the main cause (35 percent) of human-induced soil degradation is overgrazing (WR, 1992, p. 114); in 1991, the external debt of all developing countries was $1,351 billion (U.S.) (Brown et al., 1992, p. 69); in 1973, world grain stocks dropped to a low of only 55 days' worth of consumption, causing grain prices to double (Brown et al., 1992, p. 32).

Sometimes a simple grouping of individual indicators can provide a more complete picture of a particular aspect of human well-being. For example, the United Nations Development Program (UNDP) offers an illustrative checklist of indicators of personal security, rule of law, freedom of expression, political participation, and equality of opportunity (UNDP, 1992, p. 31). As a group, these represent a comprehensive portrayal of political freedom. The same UNDP report groups tabulated information into vignette-like profiles of various aspects of human development (UNDP, 1992, pp. 121-126). For example, the indicators that collectively constitute a profile of communications in industrial countries include: radios; televisions; telephones; daily newspaper circulation; passenger cars; book titles published; library books; annual museum attendances; and annual cinema attendances. The indicators that collectively constitute a profile of human capital formation in developing countries include: adult literacy rate; mean years of schooling; scientists and technicians; R&D scientists and technicians; tertiary graduates; and science graduates. Individually, each of these indicators might be of relatively limited application, but in groups they can reveal a more complete and, perhaps, more realistic picture of certain aspects of human development and well-being.

From the basic economic, biophysical, or sociocultural measures, composite or derived indicators can be devised that, using existing information sources, will provide the type of issue-specific information that decision makers need. A few examples of composite indicators would include: military expenditure expressed as a percentage of health and education expenditure; persons per habitable room in a given area; agricultural production expressed as a function of the amount of fertilizer applied or irrigation carried out; and so on. In the tourism sector, for example, base measures of numbers of tourists or measures of length of accessible seashore are of some use, but the calculation of meters of seashore per tourist can be a far more meaningful management indicator for planners in this sector (one such calculation from Malta estimated less than 30 cm per tourist in peak season) (based on Role, 1992). Sometimes a
composite indicator will take the form of a coefficient of correlation, which is basically a statistical measure of the extent of closeness that exists between two different variables or indicators. An example of this type of application is the Gini coefficient, which is a measure of how closely the distribution of income in a given population approaches absolute equality or inequality: as the coefficient approaches zero, the distribution of income approaches absolute equality; as the coefficient approaches one, the distribution of income approaches absolute inequality.

Usually it is necessary to monitor changes in a particular indicator over time, in order to get the full picture. It can also be illuminating to compare indicators from one region to another, or from one group to another. Figure 5.1 uses a combination of approaches: specific indicators are applied to different regions — North (i.e., industrial countries) and South (i.e., developing countries). In the same table, changes in the disparities or "gaps" between regions are also represented over a 15- to 30-year time period. For example, in 1990, average life expectancy at birth in the North was 74.5 years, compared to 62.8 in the South; this represents a gap of 11.7 years, down from 22.8 years in 1960 (UNDP, 1992, pp. 39, 131). Using just 12 easily understandable and readily available indicators, the table paints a graphic picture of narrowing gaps between North and South in terms of basic human survival, contrasted with widening gaps in education and training, and in economic and technological development.

When changes are represented in chronological order, statisticians refer to it as a time series. Figures 5.2 to 5.5, for example, portray a rapidly industrializing country — Indonesia — through the use of four time series: Gross National Product Per Capita, Mortality of Children Under Age 5, Total Fertility Rate, and Energy Consumption Per Capita, for the period 1970 to 1990. In each case, the data for Indonesia are compared with trends in the developing countries as a group. This grouping of time series provides a broad overview of Indonesia during a time of fundamental changes.

Time series analysis is critical for informed decision making.

Administrators in all organizations make plans to cope with future changes. The planning function looks to the future; to plan is to make decisions in advance about a future course of action. Obviously, then, planning and decision making are based on forecasts or expectations of what the future holds...Every forecasting approach used today is based on several simple assumptions:

- future occurrences depend, at least partially, on presently observable events;
- future activities will follow patterns similar to those that have been traced in the past; and
- past relationships can be discovered by observation and study (Sanders, 1990, p. 481).

Time series analyses can enhance our understanding of past and current patterns of change, giving us greater insight into the dynamic forces affecting the patterns of change (Sanders, 1990, pp. 483-484). An obvious limitation, however, is the length of time over which accurate and reliable records have been kept for the particular indicator.

Another important function of time series analysis is to provide a basis for projecting trends into the future in order to aid in forecasting. To a certain extent, forecasting
Figure 5.1 — North-South Gaps in Human Development

NORTH-SOUTH GAPS IN HUMAN DEVELOPMENT

Change in absolute disparity

<table>
<thead>
<tr>
<th>Year</th>
<th>1980</th>
<th>1990</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean years of schooling</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Tertiary education Enrolment ratio</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>Scientists and technicians Per 1,000 people</td>
<td>45</td>
<td>42</td>
</tr>
<tr>
<td>Expenditure on R &amp; D US$ billions</td>
<td>183</td>
<td>411</td>
</tr>
<tr>
<td>Telephones Per 1,000 people</td>
<td>121</td>
<td>440</td>
</tr>
<tr>
<td>Radios Per 1,000 people</td>
<td>417</td>
<td>665</td>
</tr>
</tbody>
</table>

Figure 5.2 — Gross National Product Per Capita

Figure 5.4 — Mortality of Children

(US dollars)

(people per 1000 births)

Figure 5.3 — Total Fertility Rate

Figure 5.5 — Energy Consumption Per Capita

(total fertility rate)

(gigajoules per capita)

is based on the statistical analysis of established patterns. One of the most well-known applications of a time series projection is in estimating future population trends, as illustrated, for example, in Figure 5.6. This figure also raises some of the important limitations or precautions with respect to the calculation and use of projections. The ultimate accuracy of a projection depends on a number of different factors, including:

- the reliability of the input data;
- the accuracy of the model used to approximate the real situation; and
the validity of assumptions about the persistence and regularity of past trends and patterns revealed in the time series (Sanders, 1990, pp. 511-512).

For example, the population projections shown in Figure 5.6 are based on the assumption that population will continue to grow exponentially until something interferes with that growth — almost certainly a valid assumption. However, it is important to realize that the projection is also based on a model — an approximation of reality — in which a zero population growth rate worldwide is achieved (voluntarily, rather than forced by nature's limitations) within the next 50 years. Another well-known example in which established time series have been used as the basis for making projections is in the forecasting of the magnitude of global climatic change and associated effects, such as sea level rise. Expert opinions about the extent and effects of global warming vary quite substantially. Figure 5.7 shows several different projections of the extent of global warming over the next 50 years, and Figure 5.8 shows the expected rise in sea levels associated with these changes. In this case, the differences and uncertainties in the projections stem from a number of sources, including natural cyclical climatic variations that are not
particularly well understood, even by climatologists; relatively short time series of observed and collected data to input into the time series; uncertainties about the extent and nature of societal actions in response to the threat or reality of global climatic change; and uncertainties about the ultimate effectiveness of those actions.

GETTING A MORE COMPLETE PICTURE: COMPOSITE INDEXES

In some situations, it can be useful to aggregate several different indicators into a single measure of socioeconomic progress or well-being: an index. Although the terms “index” and “indicator” are often used interchangeably, in principle an index represents a selectively weighted combination of a number of different measurements or indicators. Indexes have the advantage of providing a more comprehensive picture of a given situation than can be obtained from a single indicator. However, a number of problems are inherent in the construction of any index, particularly indexes that endeavor to portray development, overall well-being, human progress, or sustainability. Not the least of these problems is the choice of component indicators, i.e., the items to be included as components of the index (and, by extension, the choice of components that
Figure 5.8 — Estimates of Sea Level Rise During the Next Century

THE CHALLENGE OF SUSTAINABILITY

will not be represented in the index). Once the individual components have been identified, the problem remains to assign an appropriate weight to each item in the index. Clearly, decisions having complex or poorly understood implications should not be based solely on an individual index.

Indexes have traditionally been employed by economists to represent changes that occur in prices, quantities, or other variables over time. The Consumer Price Index (CPI), for example, measures the average change in price of consumer goods and services by periodically calculating the cost of a “fixed market basket of goods and services” relative to its cost during a particular base period. The system of weighting, i.e., the importance assigned to individual items in the “basket,” can be varied in response to changes in consumer buying habits and preferences over time (Sanders, 1990, p. 463). The CPI is essentially an indicator of consumer buying power. It is enormously influential in economic policy making in the United States; for example, both union wage rates and social security benefits are commonly pegged to the CPI (Sanders, 1990, p. 463). The CPI also offers a relatively straightforward example of the complexities of assigning appropriate weighting schemes in the construction of an index: elderly people seldom purchase expensive items like homes, cars, or appliances, all important components of the CPI. However, the elderly can be very much affected by the rising prices of smaller everyday items. This means that the traditional weighting scheme used in calculating the CPI may not adequately represent the buying power nor, by extension, the economic well-being of the elderly in the United States (Sanders, 1990, p. 467). This is of particular concern in view of the influence of this index on social security benefits paid to the elderly.

Not all indexes are based on economic data. For example, the World Resources Institute has calculated a Greenhouse Index, which essentially quantifies the contribution of each country in the world to global warming (Hammond et al., 1990, p. 14ff). The index is based on the annual addition to the atmosphere of the three major gases contributing to global climatic warming (CO₂, CH₄, and CFCs), each appropriately weighted according to their relative heat-trapping potential. Only the net additions of each gas to the atmosphere from anthropogenic sources (i.e., resulting from human activity) are included in the calculation. The results of the initial calculation of the index, based on data for 1987, showed that:

...responsibility for greenhouse emissions is spread widely around the world. Three of the six countries that are the largest contributors to the atmosphere’s warming potential — the United States, the U.S.S.R., Brazil, China, India, and Japan — have heavily industrialized economies; three do not... Ranked by Greenhouse Index, every major region of the world and every continent are represented in the top 50 countries; all except Africa are represented in the top 20....Global warming is truly a global phenomenon, in both cause and potential effect (Hammond et al., 1990, p. 15).

In some cases, high rates of deforestation account for high rankings in the Greenhouse Index; in other cases, high rates of energy consumption are to blame.

QUANTIFYING SUSTAINABILITY: COMPREHENSIVE INDEXES OF DEVELOPMENT, PROGRESS, AND WELL-BEING

The search for more realistic and more inclusive measures of sustainable economic
and social welfare than the commonly used Gross Domestic Product (GDP), which measures production, not consumption or distribution, has led to a series of attempts to develop comprehensive indexes and indicators of overall well-being. In addition to the usual problems involved in the construction of aggregate indexes (such as data availability and weighting concerns), the choice of components is obviously complicated by the lack of a suitable definition of "sustainable development" or "human development." What are the most basic elements of human well-being?...the key indicators of progress?...the fundamental components of human development?...the essential factors for sustainability?

Some of these efforts have focused on measuring well-being by correcting existing economic indicators (like GDP) for their obvious shortcomings in terms of overall economic welfare, environmental health and the true costs of environmental degradation, and the sustainability of income. One example is the Net Economic Welfare (NEW) index (Nordhaus and Tobin, 1972; Samuelson,
1980), an early attempt to allow for non-market activities (such as household labor), environmental degradation, and the depletion of natural resources in the calculation of income flows. Another example of an “improved” income index is the Sustainable Social Net National Product (SSNNP) (Daly, 1989), which accounts for depreciation, defensive expenditures, and depletion of natural capital, thus coming closer to being a true measure of sustainable income. Recently, there has been substantial progress on a number of fronts, in the construction and application of comprehensive Natural Resource Accounting (NRA) systems, which explicitly incorporate the depletion of environmental capital into national accounting (Repetto and Magrath, 1988; Repetto et al., 1989; Solorzano et al., 1991).

The Physical Quality of Life Index (PQLI) (Morris, 1979) and the Human Development Index (HDI) (UNDP, 1990, 1991, and 1992) of the UNDP are two well-known examples of attempts to develop a comprehensive measure of the physical well-being of a population. An example of a particularly comprehensive index of overall human development and welfare is the Index of Sustainable Economic Welfare (ISEW) (Daly and Cobb, 1989), which is calculated as follows.

Calculations of the ISEW for the United States during the period 1950-1988 reveal a marked divergence between GDP per capita and ISEW (see Figure 5.9).

An alternative to constructing a single aggregated index is to define a comprehensive set of indicators. A set of indicators may collectively accomplish what an individual index may not, that is, to provide a more realistic assessment or representation of overall human well-being and the sustainability of human development activities. For example, the World Tourism Organization (WTO) indicators initiative has drawn on work underway in several nations to develop indicators of sustainable development and of environmental impact (see Appendix 3). Many of these efforts have generated long lists of sector-specific indicators, measures of biological integrity, and measures of system sustainability. In the long term, given unlimited financial resources and time, the ideal would be to define a comprehensive set of indicators, covering all factors important to tourism and the environment. Such a set would respond in all respects to the need to measure the state of the environment, tourism-environment links, and the effects of our actions. In the medium term, however, it will be important to identify a set of practical indicators towards which the tourism sector can reasonably build over the coming decade. And in the short term, it will be necessary to make use of data that have already been collected or can be easily adapted from existing information held by most nations.

A similar, but non-sectoral, approach has been taken by the Worldwatch Institute, which has identified a set of five key global indicators: grain harvest, soybean production, meat production, fish catch, and grain stocks (see Table 5.1). The Institute has argued that grain production and, by extension, per capita grain consumption may be the most

After adjusting the consumption component of the index for distributional inequality, the authors factor in several environmental costs associated with economic mismanagement, such as depletion of nonrenewable resources, loss of farmland from soil erosion and urbanization, loss of wetlands, and the cost of air and water pollution. They also incorporate what they call “long-term environmental damage,” a figure that attempts to take into account such large-scale changes as the effects of global warming and of damage to the ozone layer (Brown, 1991, p. 10).


### Table 5.1 — Worldwatch Institute

<table>
<thead>
<tr>
<th>key global indicators:</th>
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<tbody>
<tr>
<td>grain harvest</td>
<td>soybean production</td>
</tr>
<tr>
<td>meat production</td>
<td>fish catch</td>
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<td>grain stocks</td>
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<th>energy trends:</th>
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<tr>
<td>grain harvested area</td>
<td>oil production</td>
</tr>
<tr>
<td>irrigated area</td>
<td>natural gas production</td>
</tr>
<tr>
<td>fertilizer use</td>
<td>net installed electrical generating capacity of nuclear power plants; nuclear reactor construction starts</td>
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<table>
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<th>atmospheric trends:</th>
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<tr>
<td>global average temperature</td>
<td>wind energy generating capacity</td>
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<tr>
<td>atmospheric concentrations of carbon dioxide</td>
<td>photovoltaic (solar cell) shipments; average prices for photovoltaic modules</td>
</tr>
<tr>
<td>carbon emissions from burning fossil fuels</td>
<td>energy efficiency of the world economy</td>
</tr>
<tr>
<td>production of chlorofluorocarbons (CFCs)</td>
<td>wind energy generating capacity</td>
</tr>
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<table>
<thead>
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<th>selected features for which historical data are lacking or comparisons between other indicators and trends:</th>
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<tbody>
<tr>
<td>environmental features:</td>
<td>economic features:</td>
</tr>
<tr>
<td>population declines in migratory birds</td>
<td>arms trade compared to grain trade</td>
</tr>
<tr>
<td>lost of forest cover; share of energy use provided by wood; per capita paper and paper board use</td>
<td>wheat/oil exchange rate</td>
</tr>
<tr>
<td>soil loss</td>
<td></td>
</tr>
<tr>
<td>steel recycling; share of steel produced from scrap</td>
<td>social features:</td>
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<tr>
<td>cumulative generation of irradiated fuel from commercial nuclear plants (nuclear waste)</td>
<td>income distribution</td>
</tr>
<tr>
<td></td>
<td>maternal mortality</td>
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<tr>
<td></td>
<td>reproductive rights of women</td>
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powerful indicator of human well-being. Grain consumption can be used as a measure of the satisfaction of basic human needs, and as a sensitive barometer of environmental degradation. At the top end of the scale, in the form of meat consumption, it can be used as a measure of threats to health (Brown, 1991).

A similar approach to assessing overall well-being and sustainability — that is, the identification of a comprehensive set of indicators — has been taken by the World Conservation Union (IUCN), United Nations Environment Program (UNEP), and World Wide Fund for Nature (WWF) in the document *Caring for the Earth: A Strategy for Sustainable Living* (IUCN/UNEP/WWF, 1990). To a great extent, the choice of indicators in this set (see Appendix 3) is based on the operative definition of sustainable development in the document, viz.: “A sustainable society enables its members to achieve a high quality of life in ways that are ecologically sustainable. To measure progress toward a sustainable society, we need indicators of quality of life and of ecological sustainability” (IUCN/UNEP/WWF, 1990, p. 21). The authors identify the requirements of such indicators as follows.

The concepts of quality of life and of ecological sustainability are broader than their measurement. By definition, indicators can measure only components of either. The search for reliable and efficient indicators of sustainability is just beginning. The indicators should be quantitative and some at least should be convertible to a monetary value so that they can be related to the national accounts. They should not be too difficult or expensive to measure (IUCN/UNEP/WWF, 1991, p. 21).

The IUCN/UNEP/WWF define primary indicators as those measuring the condition of the ecosystem or species concerned; secondary indicators as those measuring human impacts; and tertiary indicators as measuring actions taken to reduce impacts. The authors of the list comment that it is not a comprehensive set, and that some of the indexes do not meet their own criteria for reliable and efficient indicators of sustainability. However, the set comprises a wide variety of indicators — biophysical, sociocultural, and economic — representing all of the functions of indicators discussed above.

INTEGRATING THE INDICATORS OF SUSTAINABILITY INTO THE DECISION-MAKING PROCESS

“Assuming responsibility for the mess we have made begins with measurement of physical changes in the planet’s life-support systems that we have set in motion. Such understanding is necessary, though by no means sufficient, for wise policy making. At the same time, we need to measure and chart our progress, or lack thereof, in reversing the degradation” (Brown et al., 1992, p. 15). Better use of indicators will permit decision makers to assess the risks and impacts, as well as the environmental sustainability of the activities they manage. In turn, making better use of indicators in the decision-making process implies (1) promoting more comprehensive data collection; (2) reporting all types of information relating to human-planet interactions better; (3) working towards the construction of simple yet effective indexes of human well-being and the sustainability of development activities; and (4) above all, understanding the limitations and caveats of reliance on particular indicators.
Questions for Review

1. Which indicators are the most effective in influencing current decisions regarding investment and development?

2. Why is it important in these changing times for managers to make full use of appropriate indicators? How do indicators serve to make information more accessible to managers and more applicable to the decision-making process?

3. What are some of the challenges inherent in choosing and applying a set of indicators for particular sectoral or regional applications? What are some of the important measures that should be provided by a comprehensive set of indicators?

4. What is "forecasting"? Why is time series analysis critical for forecasting and thus for planning and decision making?

5. What are some of the advantages in using a composite or aggregated index, as opposed to a single indicator or set of indicators? What are some of the disadvantages?

Questions for Discussion and Research

1. In what contexts might an index of overall human welfare be of use in planning and decision making?

2. Have there been any attempts, of which you are aware, to define or develop a set of indicators that would be applicable to decision makers in your particular sector or region?

3. Where might one begin to choose a comprehensive set of regional or sectoral indicators for planning and decision making? By what process should the selection be carried out? Who should pay for the process? The experience of the WTO in defining a set of indicators can be used as an example.

4. Are the monitoring and measurement systems in place to supply data in support of indicators in each important industrial sector in your nation or region? What are the key information gaps?


Daly, H., and J. Cobb. 1989. For the Common Good: Redirecting the Economy Toward Community, the Environment, and a Sustainable Future. Toronto, Canada: Oxford University Press.


