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METHODS AND TOOLS FOR SUSTAINABITILY MEASUREMENT

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Abstract

The complexities involved in measuring changes in social, environmental and economical capital are enormous and there is no unique standardized method for measuring sustainability. Various measurement methods have been proposed. However, it is possible to detect some common features, which all have their origin in the UN conference on Environment and Development which took place in Rio de Janeiro in 1992. In the present article the authors outline methods and tools used for measuring sustainability.

Key words

sustainability, measurement methods, measuring tools

Introduction

Perspectives of sustainability differ in regard to the relationship between human development and nature. To measure sustainability, it is necessary to integrate spheres that have traditionally been measured separately. The main objective of measuring sustainability is frequently to monitor the evolution of indicators over time. Indicators help us to choose targets for the future and to determine how far we are from where we want to arrive.

Sustainable indicators

Indicators represent a specific phenomenon that cannot be measured directly. They are obtained by the combination of different variables (e.g. energy intensity as energy consumption per capita, etc.). They should generally give enough information for a subjective

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evaluation of the problem. This evaluation is usually made by comparing the value of the indicator to a threshold value.

Sustainability indicators are tools that communicate information of a complex phenomenon such as gross domestic product (GDP), emissions of carbon dioxide per person, etc. They can be calculated per period and/or per area and allow one to evaluate the progress of a region/city/country towards a specific goal.

To allow policy assessments, it must be clear which value of the indicator is more or less desirable. This requires a gradient that can have different forms:

- **Nominal scales** consist of only two values such as yes and no. Nominal scales provide little meaningful information, but are easy to agree on in case of controversial themes. For example, whereas the effectiveness of a national sustainability council may be questionable, their existence is easy to report.
- **Ordinal scales** are based on a hierarchy of qualitative states, e.g. the quality of training of personnel, the transparency of decision-making processes or the possibilities for public participation in them. To apply these scales properly, the hierarchy has to be made explicit and the relative distances between the different classes defined. However, these distances are often based on value judgments and not easily agreed on.
- **Cardinal scales** give quantitative information. If sustainable development goals are linked to a quantitative target, the distance towards this goal can be measured. Such indicators are called "performance indicators". To derive the scales, quantified targets have to be agreed on.

Cardinal performance indicators are preferred, with ordinal indicators providing an alternative. In general, indicators have to be:

- **General**, i.e. not dependent on a specific situation, culture or economic organization,
- **Indicative**, i.e. truly representative of the phenomenon intended to be characterized,
- **Sensitive**, i.e. they have to respond early and clearly to changes in what they are monitoring,
- **Robust**, i.e. with no significant changes in the case of minor changes in the methodology or improvements in the database.

Sustainable development indicators need a benchmark that gives them an objective. The assessment process can then begin, in which sustainable and unsustainable tendencies are measured.

The main framework models for the integration, design and presentation of indicators are:

- PSR model
- DPSIR model
- Framework of themes and sub-themes.

PSR MODEL

The Pressure-State-Response (PSR) framework model is used by international institutions – especially the OECD. The indicators are structured according to three basic categories (Fig. 1).

- **Pressure** refers to human activity that creates some type of pressure on natural systems such as emissions of greenhouse gasses, production of waste, etc.
- **State** refers to the changes in the quality and in the quantity of natural resources, and the measure of these changes evaluated in a certain period of time. This gives us the "state" of

the natural system. Examples of state indicators include global mean temperature, threatened species and concentrations of substances.

- **Response** refers to the answer in terms of policies or specific actions that were taken as a response to changes detected in the natural system such as recycling rates, international commitments, etc.

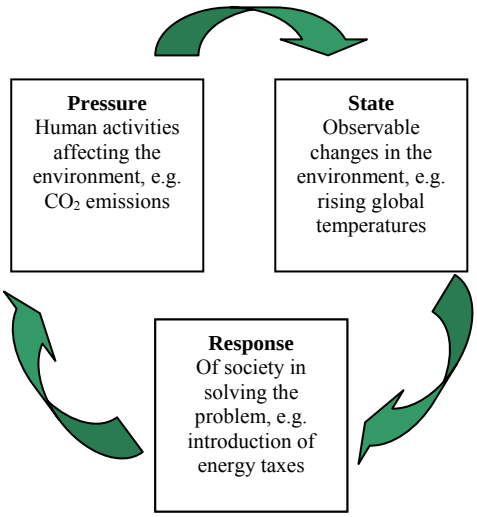

Fig. 1. *PSR model*

DPSIR MODEL

An enlarged version of this model is called DPSIR (Driving forces – Pressure – State – Impact - Response). It widens the PSR framework by adding the Driving forces of Pressure and Impacts of state on society (see Figure 2).

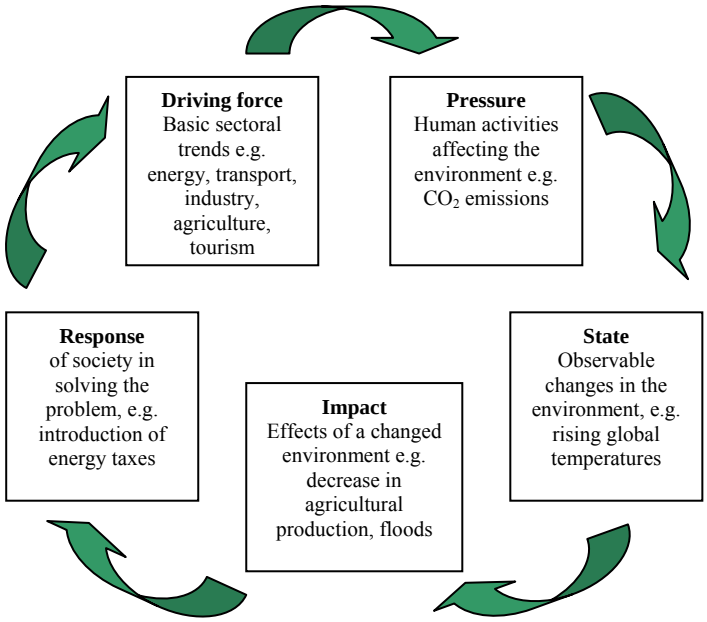

Fig. 2. *DPSIR model*

CSD FRAMEWORK

This framework, which was drawn up by the UN World Commission on Sustainable Development (CSD), recognizes four key dimensions of high priority:

- Environmental
- Social
- Economic
- Institutional.

Each of these dimensions is divided into themes and sub-themes that reflect the main priorities established in the chapters of Agenda 21. Finally, each sub-theme leads to one or more indicators. The set of indicators obtained presents the four dimensions, 15 themes and 38 sub-themes.

CSD THEMES AND SUB-THEMES Table 1

SOCIAL DIMENSION		ENVIRONMENTAL DIMENSION	
Themes	Sub-themes	Themes	Sub-themes
Justice	Poverty	Atmosphere	Climate change
	Equity		Ozone layer
Health	Nutritional state		Air quality
	Mortality	Land	Agriculture
	Sanitation		Forests
	Drinking water		Desertification
	Health benefits		Urbanization
Education	Educational level	Oceans and coasts	Coastal areas
	Illiteracy		Fisheries
Housing	Living conditions	Freshwater	Water quantity
Security	Crime		Water quality
Population	Population dynamics	Biodiversity	Ecosystems
			Species
INDUSTRIAL DIMENSION		ECONOMIC DIMENSION	
Themes	Sub-themes	Themes	Sub-themes
Industrial framework	Strategies for sustainable development	Economic structures	Economic development
	International cooperation		Trade
Institutional capacity	Access to information		Finance
	Communications infrastructure	Patterns of consumption and production	Energy use
	Science and technology		Production and management of waste
	Preparation for and aid capacity in natural disasters		Transport

Measurement tools

In the following passage we are introducing some of the best known tools used for measuring aspects of sustainable development.

Life cycle assessment - LCA

LCA is a tool that allows the total environmental impact of a design or a product to be analysed. It can be used during different phases of the design process. It can also be used to optimize the environmental performance of a design.

LCA quantifies the environmental impact of a certain product or system. The LCA of an existing product or system can set the bottom line for a new design. The product system encompasses all phases of the product life, such as:

- Raw materials acquisition and refining
- Processing and production of product and product equipment
- Distribution and transport
- Use, re-use and maintenance
- End-of-life: landing, incineration, litter and recycling.

In all these phases, the contribution of the product to different forms of pollution (e.g. the greenhouse effect, ozone layer depletion, acidification etc.) is calculated.

Ecological footprint

One of the best known sustainable development indicators is the ecological footprint. This method produces an index that gives a quantitative reference of the way of life of individuals, a certain group of persons, a region or a country. This index is not measured in monetary units, but in surface area. The ecological footprint is the quantity of land that a person needs, directly or indirectly, to:

- Consume products and services
- Produce resources and assimilate waste.

This in turn means the land needed to produce the food and the materials for housing, buildings, reads, infrastructure and the trees that regenerate the CO_2 produced by burning fossil fuels.

The name *ecological footprint* therefore refers to the land area that people, a country, a region or a city would use if they were sustainable.

The size of the ecological footprint depends on a number of factors, including:

- The development and lifestyle of the subject
- The quality of utilized resources
- The utilized technology
- Social and economic organization.

Conclusion

Measuring sustainability can be crucial for decision-making in a variety of ways. It can translate physical and social science knowledge into manageable units of information that can facilitate the decision-making process. It can help to measure and calibrate the process towards sustainable development goals.

Sustainable Development is a framework for a long-term vision of sustainability in which economic growth, social cohesion and environmental protection go hand in hand and are mutually supporting. In this point of view we can consider sustainable development as one of the measures for the solution of actual economical crises, due to equal consideration of social-economical and environmental development of society.

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