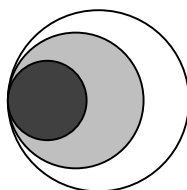


USING THE PRESSURE-STATE-RESPONSE MODEL TO DEVELOP INDICATORS OF SUSTAINABILITY

OECD FRAMEWORK FOR ENVIRONMENTAL INDICATORS



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ABSTRACT

The OECD has been active in the field of environmental information for about 20 years, with regular publications on the state of the environment (1979, 1985, 1991), environmental data (since 1984, biennial since 1985) and environmental indicators (since 1991). Initially efforts were concentrated towards producing a first generation of environmental data and establishing state of the environment reports. This was further consolidated and enhanced during the 1980s, when state of the environment reporting became more and more frequent at national and international levels, and environmental data collection was reinforced. More recently, information strategies moved in the direction of environmental indicators and measurement of environmental performance. The Pressure State Response (PSR) model has been used in a large part of this work as it provides a means of selecting and organising data/indicators in a way useful for decision-makers and the public. By highlighting the relationships between the environment and economic dimensions of sustainable development, it also helps policy-makers design policies that address problems at the appropriate level. There is now a further need to extend the PSR framework to cover the environmental/social interface of sustainable development in order to better track the course towards a sustainable future.

OECD APPROACH TO DEVELOPING ENVIRONMENTAL INDICATORS

INTRODUCTION

This paper outlines the approach that has been taken and framework that has been used by the OECD to develop environmental indicators. In particular it sets out:

- ◆ Demand for environmental indicators
- ◆ Several types of indicators
- ◆ The OECD approach
- ◆ Uses of environmental indicators
- ◆ A common framework
- ◆ Using the PSR model in OECD work
- ◆ Other frameworks and models
- ◆ Conclusions
- ◆ Future work

DEMAND FOR ENVIRONMENTAL INDICATORS

The importance of environmental policies and related reporting has steadily increased in OECD countries over the last 25 years. This has largely been a result of:

- ◆ public awareness of environmental issues, their international aspects, and how they are related to economic and social issues; and
- ◆ concern about whether development is environmentally sustainable.

There is now a further need to monitor and assess environmental conditions and trends in order to increase countries' accountability and their capacity to evaluate how well they are meeting their domestic objectives and international commitments. In this context, environmental indicators are cost-effective and valuable tools.

SEVERAL TYPES OF INDICATORS

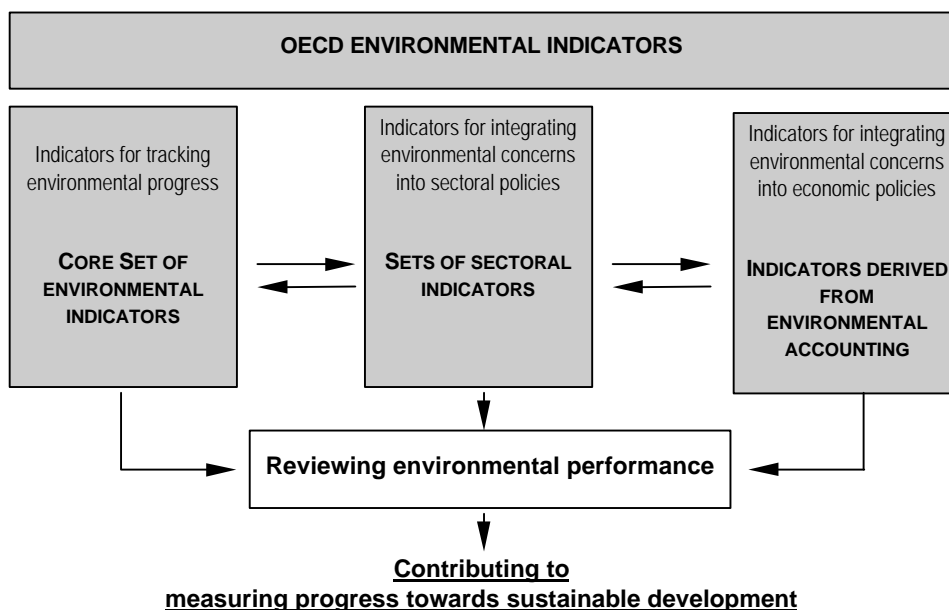
The OECD environmental indicator programme recognises that there is no universal set of indicators and that in practice several sets exist, corresponding to specific purposes and audiences. Indicators can be used, both at the international and national level, in state of the environment reporting, to measure environmental performance and also to report on progress towards sustainable development. They can further be used at national level in planning and clarifying policy objectives, and setting priorities.

The OECD work focuses principally on indicators to be used in national, international and global decision making, yet the approach may also be used to develop indicators at subnational or ecosystem levels.

The OECD initiated its programme on environmental indicators in 1989. Work¹ includes several types of environmental indicators, each corresponding to a specific purpose and framework:

- ◆ the OECD Core Set of environmental indicators, to keep track of environmental progress;
- ◆ several sets of sectoral indicators, to promote integration of environmental concerns into sectoral policy making: transport-environment indicators, energy-environment indicators, agri-environmental indicators², as well as sustainable consumption indicators;
- ◆ indicators derived from environmental accounting, to promote both integration of environmental concerns into economic policies and sustainable use and management of natural resources.

All these indicator sets are closely related to each other, the OECD Core Set being a synthesis and representing a minimum set common to OECD countries and common to equivalent sets of indicators; i.e. the most important sectoral indicators are part of the Core Set, as are major indicators derived from resource accounting.



APPROACH

In developing harmonised international environmental indicators, OECD countries adopted a pragmatic approach, which led in particular to:

- ◆ agreement on a common conceptual framework, based on a common understanding of concepts and definitions and on the (PSR) model
- ◆ identification of criteria to help in selecting indicators and validating their choice: all indicators are reviewed according to their policy relevance, analytical soundness and measurability;
- ◆ identification and definition of indicators (including an assessment of their measurability);
- ◆ the measurement and publication of these indicators
- ◆ provision of guidance for the use of indicators (stressing that indicators are only one tool and have to be interpreted in context)
- ◆ the use of indicators in the OECD's analytical work and Environmental Performance Reviews (EPRs).

Building on experience in environmental information and reporting and on strong support from Member countries, results of this work, and in particular its conceptual framework, have in turn influenced similar activities by a number of countries and international organisations (e.g. the UNCSD, with its work on sustainable development indicators).

1. Like other work on environmental information and reporting, the work on environmental indicators is led by the OECD Group on the State of the Environment.
2. Work led by the Joint Working Party of the Agriculture Committee and the Environmental Policy Committee.

Inset 1 **Criteria for selecting environmental indicators**

As indicators are used for various purposes, it is necessary to define general criteria for selecting indicators. Three basic criteria are used in OECD work: policy relevance and utility for users, analytical soundness, and measurability.*

POLICY RELEVANCE	An environmental indicator should: <ul style="list-style-type: none">◆ provide a representative picture of environmental conditions, pressures on the environment or society's responses;◆ be simple, easy to interpret and able to show trends over time;◆ be responsive to changes in the environment and related human activities;◆ provide a basis for international comparisons;◆ be either national in scope or applicable to regional environmental issues of national significance;◆ have a threshold or reference value against which to compare it, so that users can assess the significance of the values associated with it.
ANALYTICAL SOUNDNESS	An environmental indicator should: <ul style="list-style-type: none">◆ be theoretically well founded in technical and scientific terms;◆ be based on international standards and international consensus about its validity;◆ lend itself to being linked to economic models, forecasting and information systems.
MEASURABILITY	The data required to support the indicator should be: <ul style="list-style-type: none">◆ readily available or made available at a reasonable cost/benefit ratio;◆ adequately documented and of known quality;◆ updated at regular intervals in accordance with reliable procedures.

**These criteria describe the "ideal" indicator; not all of them will be met in practice.*

USES

Those indicators from the OECD core set and the sectoral indicators for which internationally comparable data exist are regularly published and used in current OECD work, particularly in OECD EPRs. In the EPRs, environmental indicators are used throughout the various chapters and annexes to support and illustrate the analysis made. They are present in the form of tables and graphics (line and bar graphs, pie charts), and are complemented with lists (laws and regulations, economic instruments, conventions), organigrammes (institutional set-up), and maps. They are a valuable way to monitor the integration of economic and environmental decision making, to analyse environmental policies and to gauge the results. Beyond their immediate application in OECD EPRs, these indicators also contribute to the broader objective of *reporting on sustainable development*.

A COMMON FRAMEWORK

Frameworks have an important role in organising data and information and guiding in the selection of indicators needed to answer certain questions. By considering issues in a systematic way, they ensure that important considerations have not been overlooked. In particular, an indicators framework/model provides an overview for considering environmental or sustainable development problems and the associated interconnections between them in ways which are useful to decision makers and the public. Furthermore by enabling policy makers and the public to understand the interconnections between different issues they can help to identify, design and implement policies that address problems at the appropriate levels.

Although frameworks and models are essential tools for developing and selecting indicators they have their limitations. They can be too rigid in their analysis of issues and interactions and therefore they need to be used as one tool and in a flexible way with additional information supporting or supplementing them. Furthermore there is not necessarily a unique model that can be used for all

purposes e.g. the OECD uses the PSR analytical framework for its work on the core set of environmental indicators and the sectoral indicators but it also uses accounting frameworks to develop indicators on the use of natural resources and environmental expenditure. A number of analytical frameworks for varying purposes and different audiences are often needed to develop and organise sets of indicators.

THE PSR MODEL

The PSR framework was initially proposed by Tony Friend and David Rapport for the purpose of analysing the interactions between environmental pressures, the state of the environment and environmental responses. OECD has applied an adapted version of the framework, since the 1970's, to its work on environmental reporting. The relevance and usefulness of the PSR model was reevaluated in 1989/1990 when OECD initiated its work on environmental indicators. In developing the Core set of environmental indicators, OECD countries agreed that the PSR model was a robust and useful framework and should continue to be used in OECD's work on environmental data and indicators.

The PSR model is based on the concept of causality: human activities exert pressures on the environment and change its quality and quantity of natural resources ("state"). Society responds to these changes through environmental, general economic and sectoral responses ("societal responses").

Pressures

- ◆ Environmental pressures relate to pressures from human activities exerted on the environment, including natural resources. "Pressures" cover underlying or indirect pressures, which act as driving forces for environmental issues (i.e. the activity itself and trends of environmental significance), as well as proximate or direct pressures (i.e. the use of resources and the discharge of pollutants and waste materials). Indicators of environmental pressures are closely related to production and consumption patterns; they often reflect emission or resource use intensities, along with related trends and changes over a given period. They can be used to show progress in decoupling economic activities from related environmental pressures. They can also be used to show progress in meeting national objectives and international commitments (e.g. emission reduction targets).

State

- ◆ Environmental conditions relate to the quality of the environment and the related effects or impacts, and the quality and quantity of natural resources. They cover ecosystems and natural environment conditions as well as quality of life and human health aspects. As such they reflect the ultimate objective of environmental policies. Indicators of environmental conditions are designed to give an overview of the situation (the state) concerning the environment and its development over time. Examples of indicators of environmental conditions are: concentration of pollutants in environmental media, exceedance of critical loads, population exposure to certain levels of pollution or degraded environmental quality, the status of wildlife and of natural resource stocks. In practice, measuring environmental conditions can be difficult or very costly. Therefore, environmental pressures are often measured instead as a substitute.

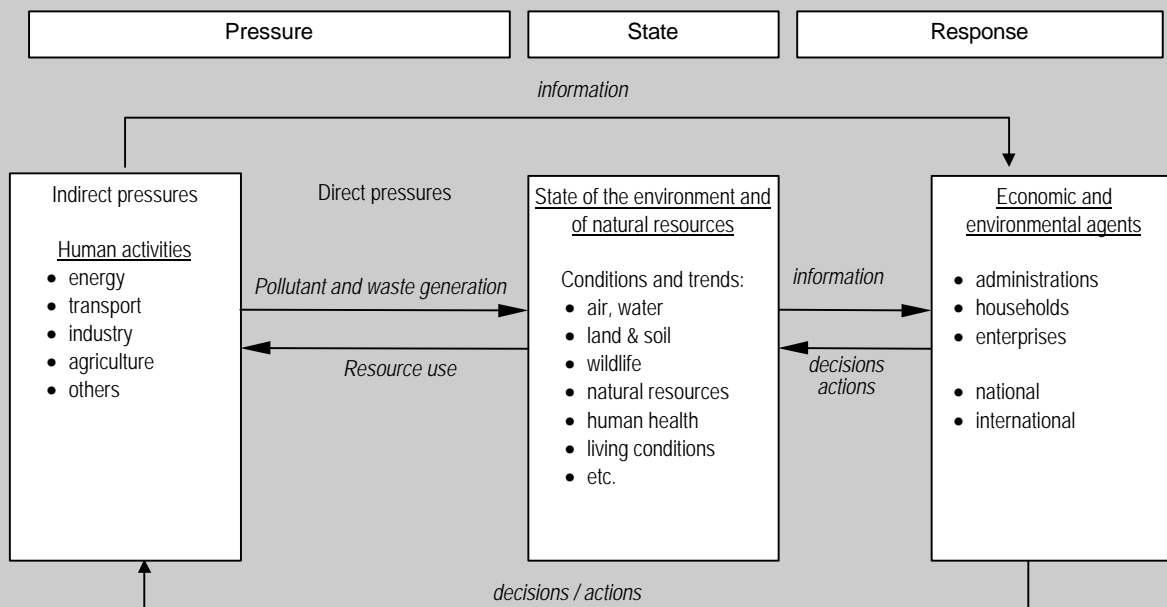
Response

- ◆ Societal responses show the extent to which society responds to environmental concerns through environmental, general economic and sectoral policies and through changes in awareness and behaviour. They refer to individual and collective actions and reactions that are intended to:
 - mitigate, adapt to or prevent human-induced negative effects on the environment;
 - halt or reverse environmental damage already inflicted;
 - preserve and conserve nature and natural resources.

Examples of indicators of societal responses are environmental expenditure, environment-related taxes and subsidies, price structures, market shares of environmentally friendly goods and services, pollution abatement rates, waste recycling rates. In practice, indicators mostly relate to abatement and control measures; those showing preventive and integrative measures and actions are more difficult to obtain.

Inset 2 The Pressure - State -Response (PSR) Model

The PSR model considers that: human activities exert pressures on the environment and affect its quality and the quantity of natural resources ("state"); society responds to these changes through environmental, general economic and sectoral policies and through changes in awareness and behaviour ("societal response"). The PSR model has the advantage of highlighting these links, and helping decision-makers and the public see environmental and other issues as interconnected (although this should not obscure the view of more complex relationships in ecosystems, and in environment-economy and environment-social interactions).



Depending on the purpose for which the PSR model is to be used, it can easily be adjusted to account for greater details or for specific features. Examples of adjusted versions are the Driving force – State – Response (DSR) model used by the UNCSO in its work on sustainable development indicators, the framework used for OECD sectoral indicators and the Driving force – Pressure - State – Impact – Response (DPSIR) model used by the European Environment Agency.

USING THE PSR MODEL IN OECD WORK

In a large part of its work on environmental information and reporting the OECD uses the PSR model. In particular, it helps to structure the OECD core set of environmental indicators and the sets of sectoral indicators.

OECD CORE SET OF ENVIRONMENTAL INDICATORS

A major part of the OECD's work is devoted to developing a Core Set of environmental indicators. This is a commonly agreed upon set of indicators for OECD countries and for international use, published regularly. It provides a first step in tracking environmental progress and the factors involved in it, and is a major tool for measuring environmental performance. Characteristics of the Core Set are that:

- ◆ it is of limited size (around 50 core indicators);
- ◆ it covers a broad range of environmental issues;
- ◆ it reflects an approach common to a majority of OECD countries.

It includes core indicators common to the majority of OECD countries and common to different sets of indicators serving different purposes.

The conceptual framework to develop the OECD core set of environmental indicators is based on two structural elements. First, it uses the PSR model to provide a classification into indicators of environmental pressures, indicators of environmental conditions and indicators of societal responses.

Secondly, it uses a number of environmental issues which reflect major environmental concerns in OECD countries. For each issue, indicators of environmental pressures, conditions and societal responses have been defined (Inset 3).

These issues depend on changing and sometimes conflicting perceptions and the list is therefore not necessarily final or exhaustive. In fact, it is flexible and new issues can be incorporated or old ones abandoned according to their environmental relevance.

Thirdly, the possibility of disaggregating major indicators at sectoral level is considered. Data availability permitting, this is one tool for analysing environmental pressures exerted by different economic sectors and distinguishing government responses from those of the business sector or private households. Indicators at the sectoral level could be useful in reviewing the integration of environmental and sectoral policies and monitoring resource use and emission intensities in the various economic sectors. Indicators at sectoral level also facilitate the link with economic information systems and models.

Inset 3 Structure of OECD Indicators Core Set by Environmental Issue

	PRESSURE Indicators of environmental pressures	STATE Indicators of environmental conditions	RESPONSE Indicators of societal responses
Major issues			
1. Climate change			
2. Ozone layer depletion			
3. Eutrophication			
4. Acidification			
5. Toxic contamination			
6. Urban environmental quality			
7. Biodiversity			
8. Cultural landscapes			
9. Waste			
10. Water resources			
11. Forest resources			
12. Fish resources			
13. Soil degradation (desertification, erosion)			
14. Socio-economic, sectoral and background indicators			

Broadly speaking, the first nine issues relate to the use of the environment's "sink capacity", dealing with issues of environmental quality, whereas the other issues relate to the environment's "source capacity", focusing on the quantity aspects of natural resources.

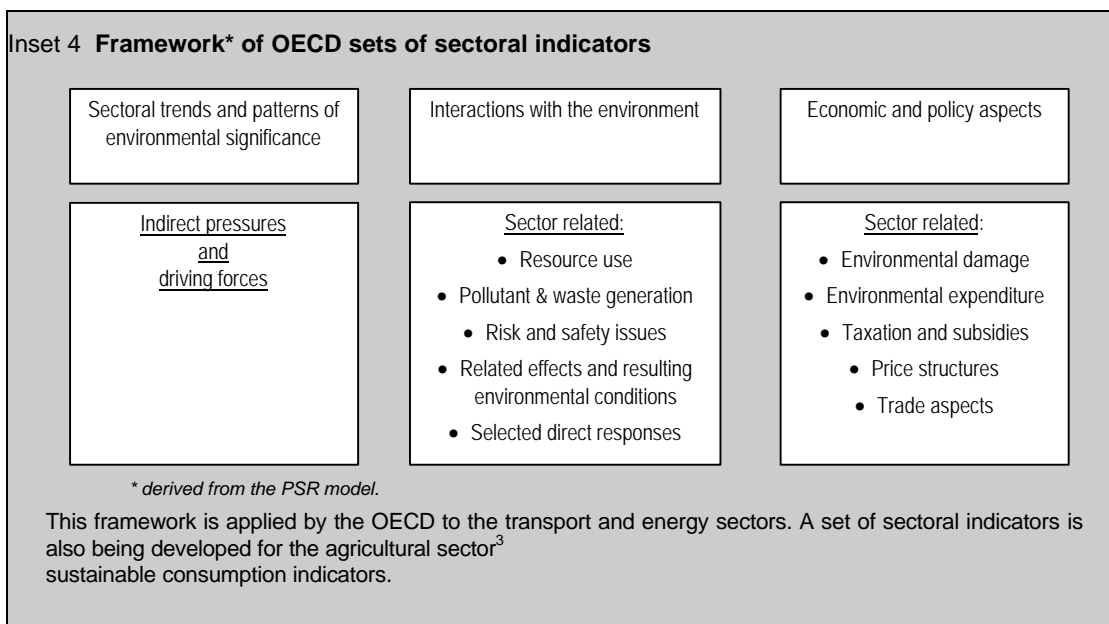
Not all indicators can be directly associated with a specific environmental issue. Some reflect background variables and driving forces, such as population growth and economic growth; others deal with selected sectoral trends and patterns of environmental significance, or factors such as economy-wide environmental expenditure and public opinion. An additional category of indicators has therefore been introduced in the framework. This category also provides an opportunity to further integrate indicators from sectoral sets into the OECD Core Set.

THE OECD SETS OF SECTORAL INDICATORS

OECD has been developing sets of 'sectoral' indicators to better integrate environmental concerns into sectoral policies. The objective is to develop a "toolkit" for sectoral decision-makers which should facilitate the integration of environmental concerns into sectoral policy-making. While limited to a specific sector and its interactions with the environment, these indicators are usually developed in larger numbers than the core set. Sectoral indicators are not restricted to environmental indicators per se. They also describe the sector itself and sectoral trends of environmental significance, as well as related economic and policy considerations, placed in a context of sustainable development. Together with environmental indicators (e.g. pollutant emissions) they may include economic indicators (e.g. sectoral output, prices and taxes, subsidies) and selected social indicators.

The conceptual framework adopted for sectoral indicators is derived from the PSR model but has been adjusted to account for the specifics of the respective sectors. It categorises indicators into those that reflect:

- ◆ sectoral trends and patterns of environmental significance (i.e. indirect pressures and/or related driving forces);
- ◆ interactions between the sector and the environment, including positive and negative effects of sectoral activity on the environment (i.e. direct pressures, such as pollutant releases and resource use, and related effects and resulting environmental conditions, such as ambient concentrations of pollutants and population exposure), as well as effects of environmental changes on sectoral activity;
- ◆ economic linkages between the sector and the environment, as well as policy considerations. This category includes environmental damage and environmental expenditure, economic and fiscal instruments, and trade issues.



OTHER USES OF THE PSR MODEL

The PSR framework is also used by OECD in its regular EPRs to structure chapters on pollution, on resource management and on integration of the environment into specific sectors of the economy.

3.  OECD (1993, and forthcoming), *Indicators for the Integration of Environmental Concerns into Transport Policies*
 OECD (1993), *Indicators for the Integration of Environmental Concerns into Energy Policies*
 OECD (1997), *Environmental Indicators for Agriculture*
 OECD (forthcoming), *Sustainable consumption indicators*

OTHER FRAMEWORKS AND MODELS

Although the PSR model is flexible and capable of being adapted according to its use, it is not unique. Other frameworks may need to be considered for different purposes and audiences and used either alongside the PSR model or in its place. For example the OECD uses a different framework for its work on environmental accounting. Other frameworks also exist to identify, develop and communicate indicators or composite indicators of sustainable development e.g. World Bank indicators, Human Development Index (HDI), Index of Sustainable Economic Welfare

ACCOUNTING FRAMEWORKS

Accounting frameworks are generally based on the national accounts approach. The OECD uses accounting frameworks in its work on environmental accounting from which a number of indicators are derived. The work focuses on physical natural resource accounts as a tool for sustainable management of natural resources, as well as on expenditure for pollution abatement and control and other environmental measures. In addition, the OECD participates in international work on environmental accounting and acts as a forum for exchanges of experiences in this field. (Inset 5)

To progress towards a common methodology, the OECD reviewed different approaches of OECD Member countries in the field of natural resource accounting (NRA). This work resulted in the establishment of OECD pilot accounts on forests and water. The basic methodology used in the pilot accounts is simple and provides a guide to countries that are developing natural resource accounts. The format was set up to provide a tool for decision-makers.

The pilot accounts propose physical input-output tables tracing the production, transformation and use of each resource throughout the economy. This provides an analytical tool with which to assess the impact of sectoral economic activity on the resource. Basic flow relations from these accounts form the input for calculating indicators of sustainable use of natural resource quantities. Examples of such indicators are: intensity of use of forest resources and intensity of use of water resources.

The OECD has also pursued work on pollution abatement and control (PAC) expenditure for a number of years. The data are derived from environmental expenditure accounts. They are published regularly and supplement economic information from national accounts. Indicators which are developed from this work reflect the level of PAC expenditure compared with GDP, as well as the structure of such expenditure per environmental domain and per source sector.

Inset 5 Environmental accounting: definitions and concepts		
Environmental accounting can be defined as the systematic description of interactions between the environment and the economy by means of an accounting framework. There is no unique model for environmental accounting; approaches vary according to purpose.		
Approach	Environmental categories taken into account	Characteristics
Adjustment of national economic accounts	Valuation of: <ul style="list-style-type: none"> ◆ Environmental damages ◆ Environmental services ◆ Stock of natural capital 	Modifies SNA framework and boundaries
Satellite accounts	Valuation of: <ul style="list-style-type: none"> ◆ Environmental damages ◆ Environmental services ◆ Stock of natural capital ◆ Environmental expenditure Corresponding physical flows and stocks	Complements SNA without modifying it General coherence with SNA
Natural resource and environment accounts	<ul style="list-style-type: none"> ◆ Physical flows and stocks of natural resources ◆ Physical and monetary flows associated with anthropogenic exploitation of natural resources 	Independent from and complementary to SNA

Accounting frameworks prove to be useful in developing indicators that measure asset stocks and changes including natural and human capital stock⁴. They are also a powerful tool for structuring statistical data in an accounting logic and for linking economic, social and environmental data in both physical and monetary terms.

WORLD BANK INDICATORS

The environmental indicators, published by the World Bank in 1995, focus on the applicability of indicators in policy development. They are sorted according to the PSR model but provide additional information:

- Social, economic and institutional criteria are included
- Indicators are linked where possible to sustainability targets. These indicators are called “performance indicators”.
- The concept of “wealth of nations” is evaluated. This extends the definition of wealth to include human capital, man made capital, natural capital and social capital.

COMPOSITE INDICATORS

The UN Development Programme UNDP has developed a Human Development Index which indicates progress or decline in human development. The HDI combines indicators of health (life expectancy), education (literacy and years of schooling) and economic welfare (per capita income) into a single measure. This index does not, however, incorporate the environmental dimension of sustainable development although this amendment has been proposed. Another application takes household consumption expenditure as a point of departure and adjusts it for a range of “positive” and “negative” factors of economic, environmental and social nature to derive Indicators of Sustainable Economic Welfare (ISEWs). However controversies are raised about the choice of component indicators and their relative importance within an overall index.

CONCLUSIONS

A number of national and international organisations have found that the PSR framework is a very useful way to develop indicators and state of the environment reporting. It has proved valuable in highlighting the cause effect relationships between human activities and environmental and social conditions. As such it helps decisions makers and the public see that environmental, economic and social issues are interconnected, and also helps policy makers to design policies that address the key problems at the appropriate level. It therefore provides a means of selecting and organising indicators in a way which is useful for decision-makers and the public. It also has the following advantages. It is:

- one of the easiest frameworks to understand and use
- neutral as it only shows where linkages exist rather than whether they have negative or positive impacts
- a flexible model which can be adjusted easily to account for greater details, for specific features, different audiences and purposes e.g. capable of being used at different spatial scales
- widely recognised
- a model which ensures important considerations have not been overlooked by analysing issues in a consistent way.

Despite its many advantages, discussions of the PSR model have generally revealed the following weaknesses.

- ◆ Because of its simplicity, the PSR model tends to suggest linear relationships in the human activity - environment interaction and does not reflect the more complex relationships in ecosystems and in environment - economy interactions.
- ◆ The PSR model was developed to highlight environment and economic relationships. The links between the environment and the social or the social and economic dimensions of sustainable development are thus not adequately covered

4. Pearce and colleagues distinguish between “weak sustainability” where growth in human capital can be substituted for natural capital (as long as critical ecosystems are maintained) and “strong sustainability” where growth in human capital can not come at the expense of remaining total natural capital. The principal issues faced by economists and ecologists working in this area are determining measures of critical natural data and compiling data for all forms of capital. Also some economists argue that we should be improving our measures of income rather than capital because real income is a better measure of sustainability.

These weaknesses are not, however, perceived as major obstacles and do not outweigh the many strengths of the model. But when trying to use the PSR model to structure the development of indicators of sustainability, these weaknesses need to be given further consideration.

The PSR model was initially developed to provide a framework for environmental reporting and indicators. There is now a growing demand to develop indicators of sustainability at the international scale, and thus, also an increased need to adapt the PSR model to incorporate the environment, economic and social dimensions of sustainable development. The PSR model already covers two key aspects of sustainable development: relationships between the environment and the economy, and sets of indicators which allow the integration of economic and environmental concerns for particular sectors within a country. It, however, needs to be extended to better cover the social dimension of sustainable development. This may simply mean adapting the current PSR model. On the other hand it could require the development of an additional framework to be used alongside the PSR which solely examines the environment/social interface or alternatively a new framework to replace the PSR model which covers all three strands of sustainable development. Either way, the OECD will be considering the frameworks that are currently being used at the international, national and sub-national levels to develop indicators of sustainable development.

FUTURE WORK

As part of its programme on sustainable development, the OECD is working, together with other relevant international organisations, on indicators to measure progress towards sustainable development. A conference is planned to take place in Rome at the end of the year to discuss the progress made in this area. In addition, further work is being done by the OECD to broaden its core set of environmental indicators to include environmental/social aspects for the second cycle of EPRs.

Progress is also needed in:

- ◆ improving the quality and comparability of existing indicators;
- ◆ linking the indicators more closely to established goals and commitments;
- ◆ further integrating environmental and sectoral indicator sets in a broader set of sustainable development indicators.

This necessitates:

- ◆ greater policy relevance and increased quality and timeliness of basic data sets, as well as a
- ◆ closer link between environmental data and existing economic and social information systems.