"Capacity Building and Strengthening Institutional Arrangement / Data Yearbook"

Workshop: "Environmental Indicators and their use for indicator-based reporting activities"

Indicators/Environmental Reporting Frameworks (DPSIR/PSR)

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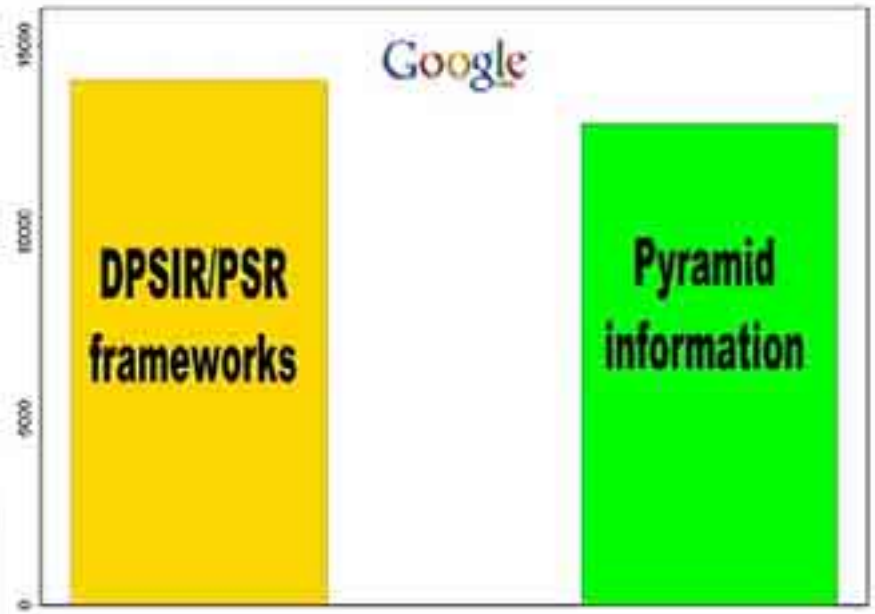
APAT

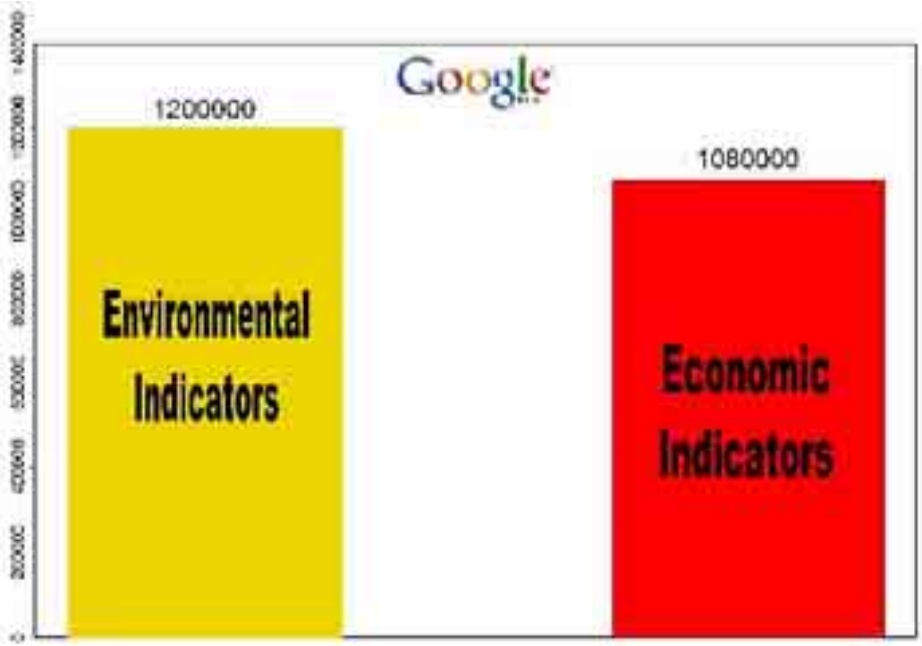
Agency for Environmental Protection and Technical Services

General Overview

- Indicators/Environmental Indicators
- Some Useful Definitions: data, statistics, indices
- Pyramid of Information
- Reporting Frameworks: DPSIR & PSR

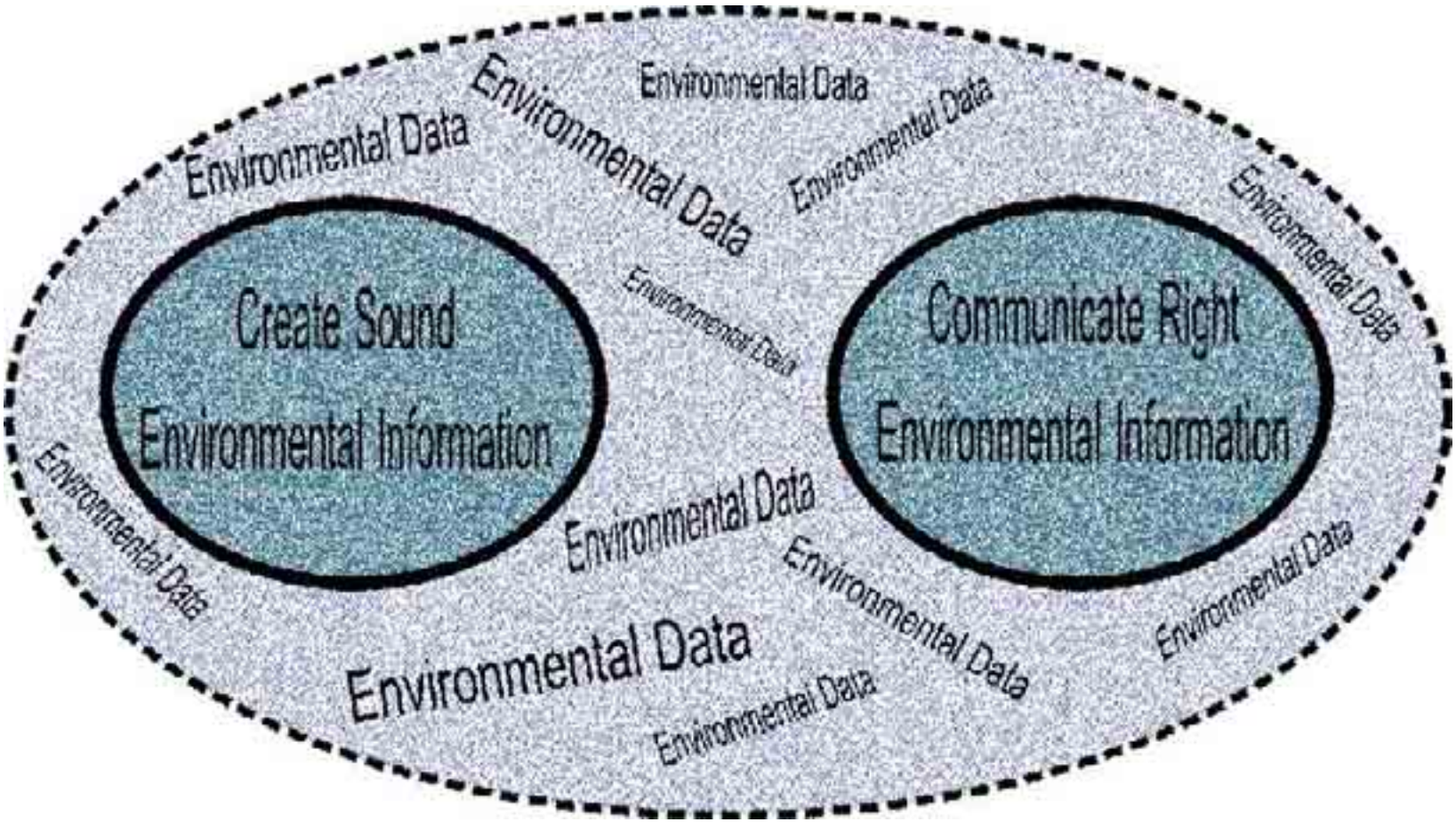
Number of results (web-sites)





What information behind the data?

Two main problems:



Right: it is essential to know **whom** to communicate with and for **what** purpose

Right:

To the right people (stakeholders)

At the right time

In the right format (content and presentation)

Stakeholders

A stakeholder is a person or organisation that has a legitimate interest in a project or entity

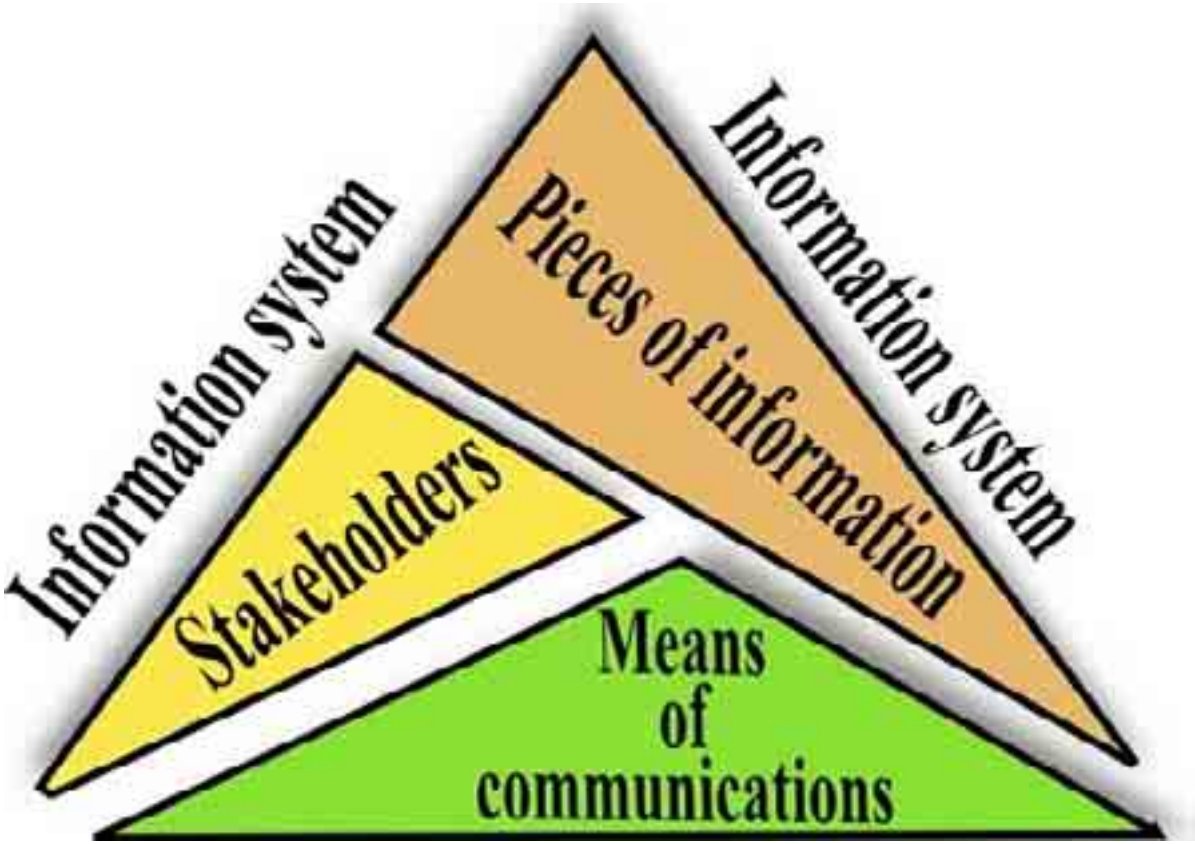
An example

Which tools?

An abudance of information is often available but this may not be in a form relevant for decision-makers and the public

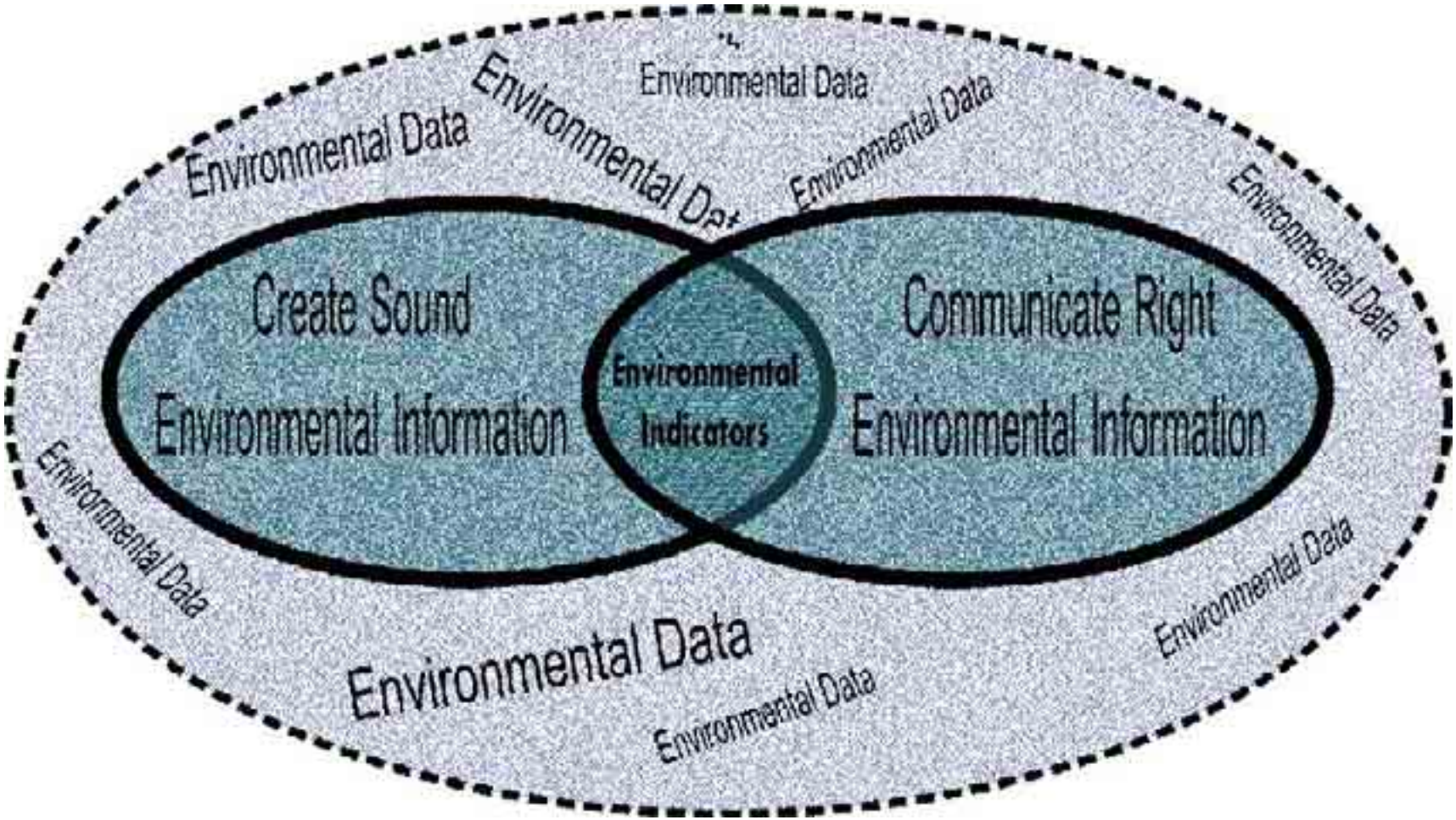
Once we know why we want to "communicate" environmental information and to whom, we must decide the most effective means!

In other words:



The information system should be structured in such a way that it facilities data aggregation, information organisation, analysis and communication.

Indicators play an important role in turning data into relevant information for decision-makers and the public



Role of Indicators:

Communication

Indicators should enable or promote information exchange regarding the issue they address

In particular:

Environmental indicators should provide information about phenomena that are regarded typical for and/or critical to environmental quality

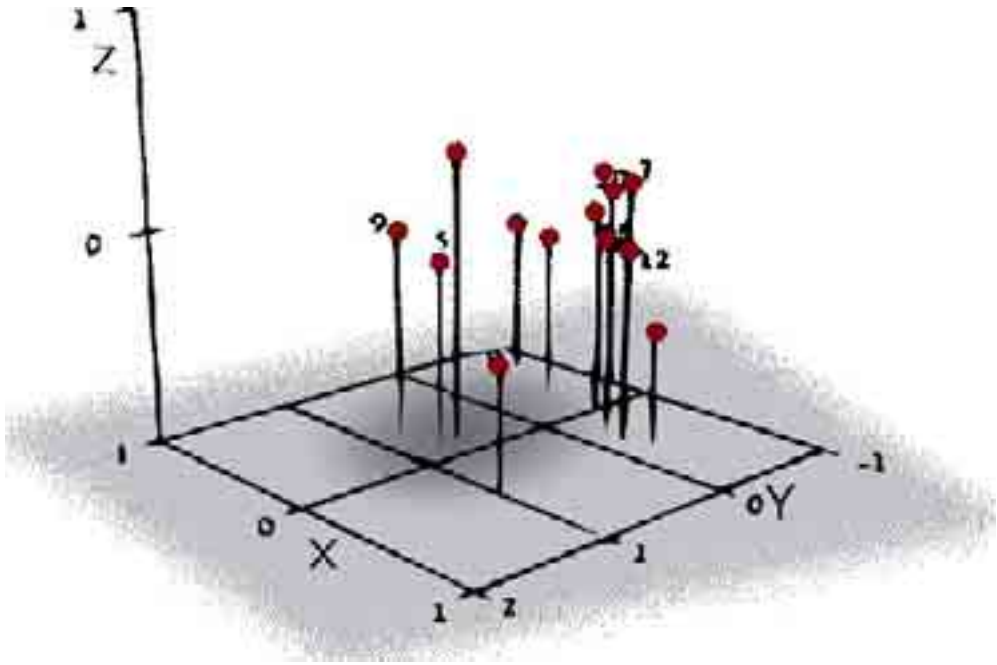
But remember, communication demands simplicity….

Role of Indicators:

Simplify a complex array of information

Remember:

The curse of dimensionality (Bellman, 1961)



Aggregation causes a loss of information!

Role of Indicators:

In relation to policy-making (1)

1. To supply information on environmental problems, in order to enable policy-makers to value their seriousness

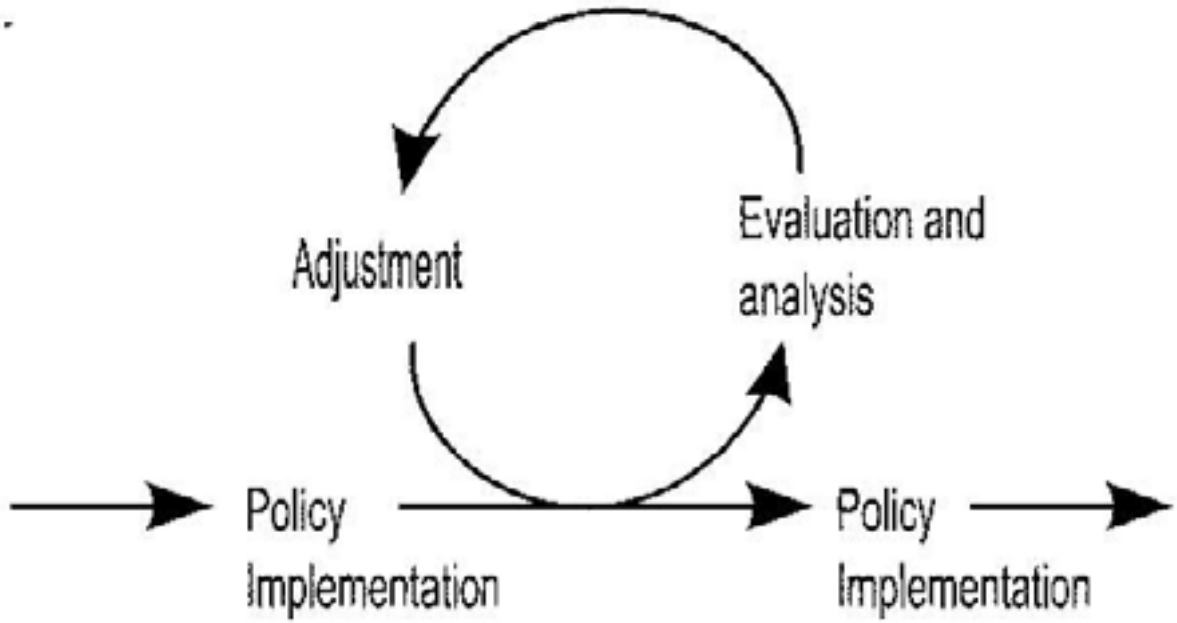
2. To support policy development and priority setting, by identifying key factors that cause presure on environment

3. To monitor the effects of policy responses

Role of Indicators:

In relation to policy-making (2)

Incorporate environmental knowledge into decision making at the evaluation and analysis phase



Role of Indicators:

An example (Pinter & Swanson, 2004)

Use of indicators to influence the climate change policy cicle

- Goals & targets: climate change policy that sets goals and targets to reduce GHG and monitors progress with the use of a set of indicators.
- Strategies & instruments: financial incentives (e.g. energy taxes), legal instruments (limits on emissions), other strategies (e.g. budgetary support for public transportation)
- Policy implementation: monitoring & enforcing emission limits in industry, improving and increasing bus, subway and train services…
- Impact evaluation: use of indicators to measure the effectiveness of the policy change, to inform decision makers…..

Role of Indicators:

Environmental reporting - SoE

A report about the state of the environment in a particular region.

Chapter 40 of Agenda 21 calls for improved environmental information for decision-making (1992 UNCED conference in Rio)

The contents of SoE should depend on environmental priorities
In your society.

Commonly present issues

Air quality, Climate Change, Fish resources, Forest resources, Nature & Biodiversity, Ozone layer, Soil & land resources, Waste, Water resources, Acidification, Hazards and accidents, Health, Noise, Radiation, Toxic substances, Coastal & marine areas, Urban settlements

Role of Indicators:

Contribute to monitoring and evaluation of policy -effectiveness

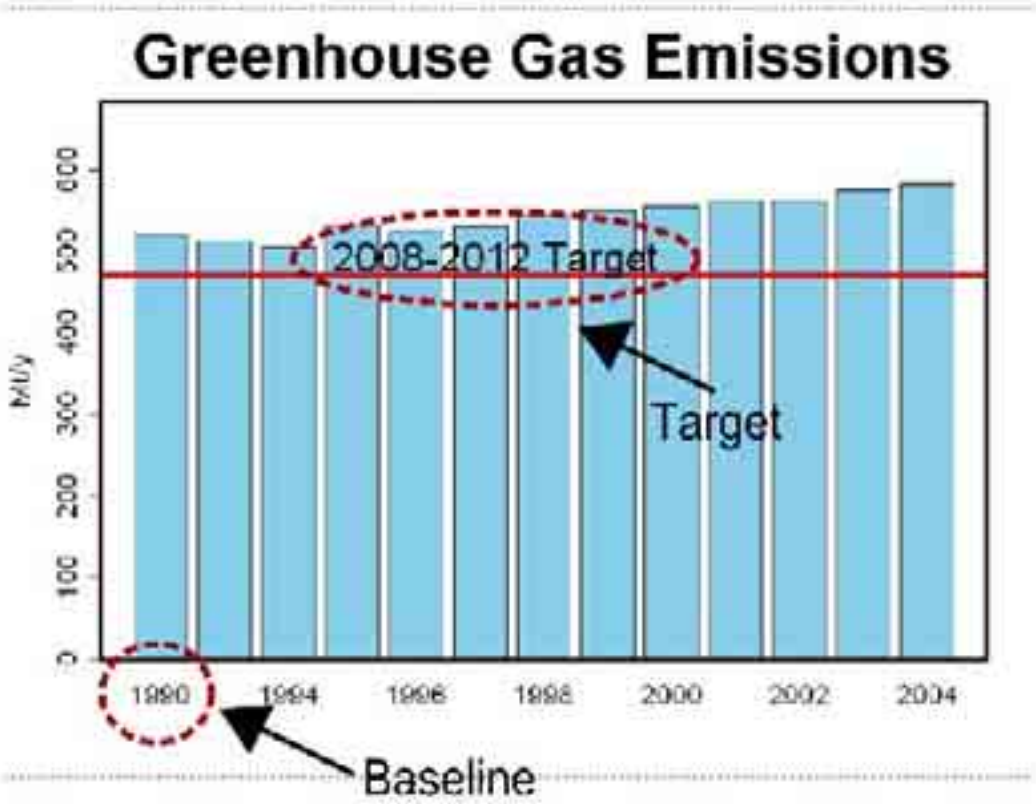
Baseline: a reference value to show a positive or negative environmental change

Threshold: a value to know when to react to what the indicator reveals (e.g. in Italy the daily limit for PM_{10} is 50 $\mu g/m^3$, not to be exceeded more than 35 dats per calendar year)

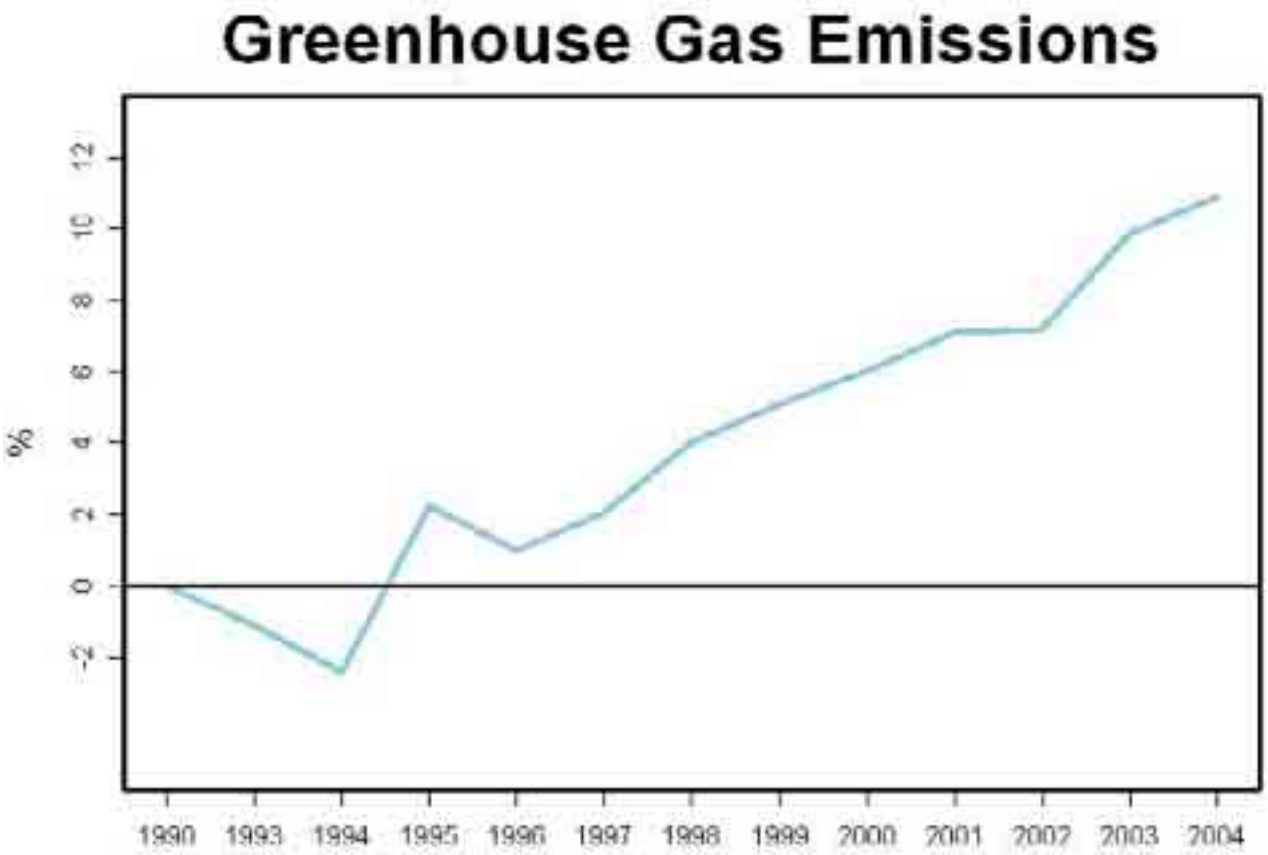
Target: very similar to the use of a threshold, but useful in initiatives that have environmental improvement as one of their objectives

Baselines and targets (1)

An example: in the context of the Convention on Climate Change and, in particular, of the Kyoto protocol, Italy has undertaken to reduce overall national GHG emissions by 6.5% betwenn 2008 and 2012, with respect to the base year



Baselines and targets (2)



Same figure, but this graph focus on the baseline

Role of Indicators:

The last but not the least:

A powerful tool to raise public awareness on environmental issues

Evironmental Indicators

The inspiration for environmental indicators derives from experience with economic indicators.

Interest rates, unemployment and inflation, GDP (Gross Domestic Product): a way of assessing aspects of economic development in a country

Economic indicators:
Influence many decisions
Unaffected by economic theory and political ideology

Indicator: general definition

From the Latin word "*Indicare*" (to point out, make publicly known, disclose…)

"*Indicator as the one that indicates*"
Merriam-Webster's dictionary

The obvious question is:
"What does it indicate?"

A tool to describe the economic, environmental, Social, and/or institutional conditions of a system (i.e. a country, region, community etc.)

Indicators consist of two elements:

The indicator itself, the "**device**" (e.g. a value, an attribute..)

The target (the thing it indicates)

Only understanding the link between the two, we can interpret an indicator

Linking indicators and targets (1)

Four main types of association can usefully be recognised

- **Causal**: the indicator causes (or is caused) by the target
  - CO2 emissions for global warming
  - Traffic accidents and injuries from road traffic

- **Component**: the indicator represents a subcomponent of the target (or vice versa)
  - Petrol consumption for overall fuel consumption in the transport sector

Linking indicators and targets (2)

Four main types of association can usefully be recognised

- **Conditional/Contingent**: the indicator is a precondition for the target (or vice versa)
  - Road length and road traffic volumes
  - Number of establishments liable to be affeted by a major accident hazard and anthropogenic risk

- **Statistical**: indicator and target are statistically correlated. They tend to vary in broad harmony, often because they are both related to some common factor
  - Levels of air pollution and traffic noise
  - Lung cancer and deprivation

Indicator: some formal definitions

No generally agreed definition has yet emerged

- *". . . a set of statistics serving as a proxy or metaphor for phenomena not directly measurable."* – Cobb and Craig, (1998)

- *A measurement that reflects the status of some social, economic, or environmental system over time. Generally an indicator focuses on a small, manageable, tangible and telling piece of a system to give people a sense of the bigger picture.* –The Community Indicators Handbook (1997)

- *Physical, chemical, biological or socio-economic measures that best represent the key elements of a complex ecosystem or an environmental issue* (Saunders et al 1998)

A legendary indicator
"The canary in the coal mine"

During the 1800s, the canary was used for detecting toxic or explosive gases in coal-mines, before there was a better way to do it. More sensitive to such gases than humans, they would collapse long before the miners were affected, and a collapsed canary was therefore a signal to the miners to get out immediately, and to management to look at the problem and clean up the mine

Frogs like canaries: an early indicator of global disaster

Because they are more vulnerable than many other creatures, frogs are considered a ``canary in the coal mine'' for environmental damage

Environmental Indicators

OECD's definition of indicator:

"*A parameter, or a value derived from parameters, which points to, provides information about, or describes the state of a phenomenon, environment, area, with a significance* ***EXTENDING BEYOND*** *that directly associated with a parameter value.*"

Environmental Indicators

OECD's definition of parameter:

"*A parameter is a property that is measured or observed*"

The total amount of waste generated by a country
The percentage of threatened species compared to the total
The total surface of protected terrestrial areas
Tourism intensity

…..are all examples of ***parameters***

Environmental Indicators

Whatever the definition, the underlying concept is the same:

The significance of an indicator goes beyond that obtained directly from the observed properties

Environmental Indicators

The significance of an indicator goes beyond (1)……

Remember the canary in the coal mine….

Are we interested in the "Number of dead canaries per coal mine"?

Maybe, relevant for animal lovers….

The real significance is in the message: the death of the canary is an alarm for miners

Environmental Indicators

The significance of an indicator goes beyond (2)……

The number of sea turtles in a certain area may be satisfying in itself. More relevant when compared to the same number in a similar but less disturbed area

The real significance is in the message: the abundance of turtles is a clue of the environmental quality in that specific area.

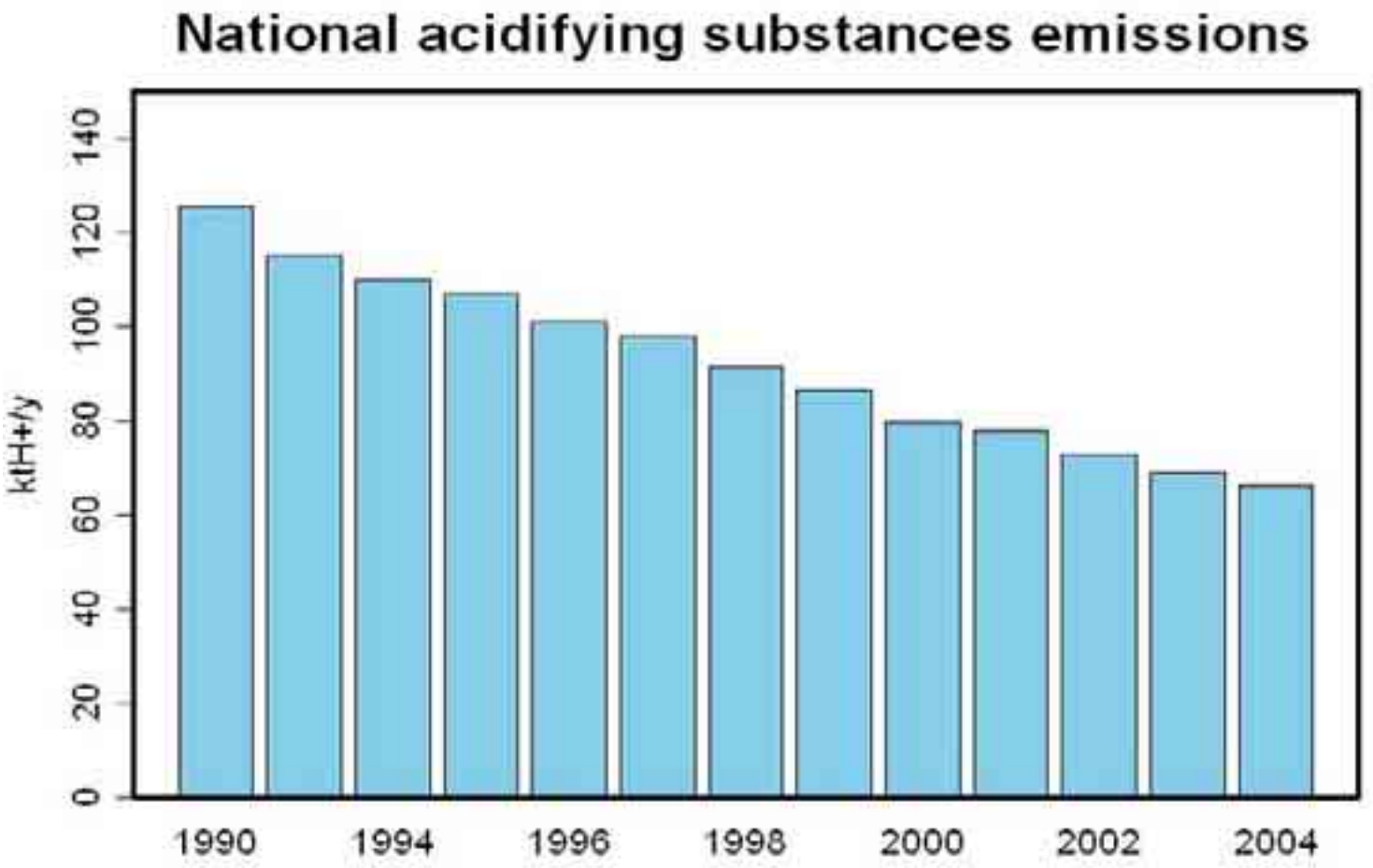
Environmental Indicators

The significance of an indicator goes beyond (3)…

The estimate of national emissions of acidifying substances is a quantification of the substances released into the atmosphere responsible for climate change, stratospheric ozone depletion, acidification ….

The real message is in their temporal evolution, especially in relation to the Kyoto Protocol

What is the message beyond the mere data values?



Environmental Indicators

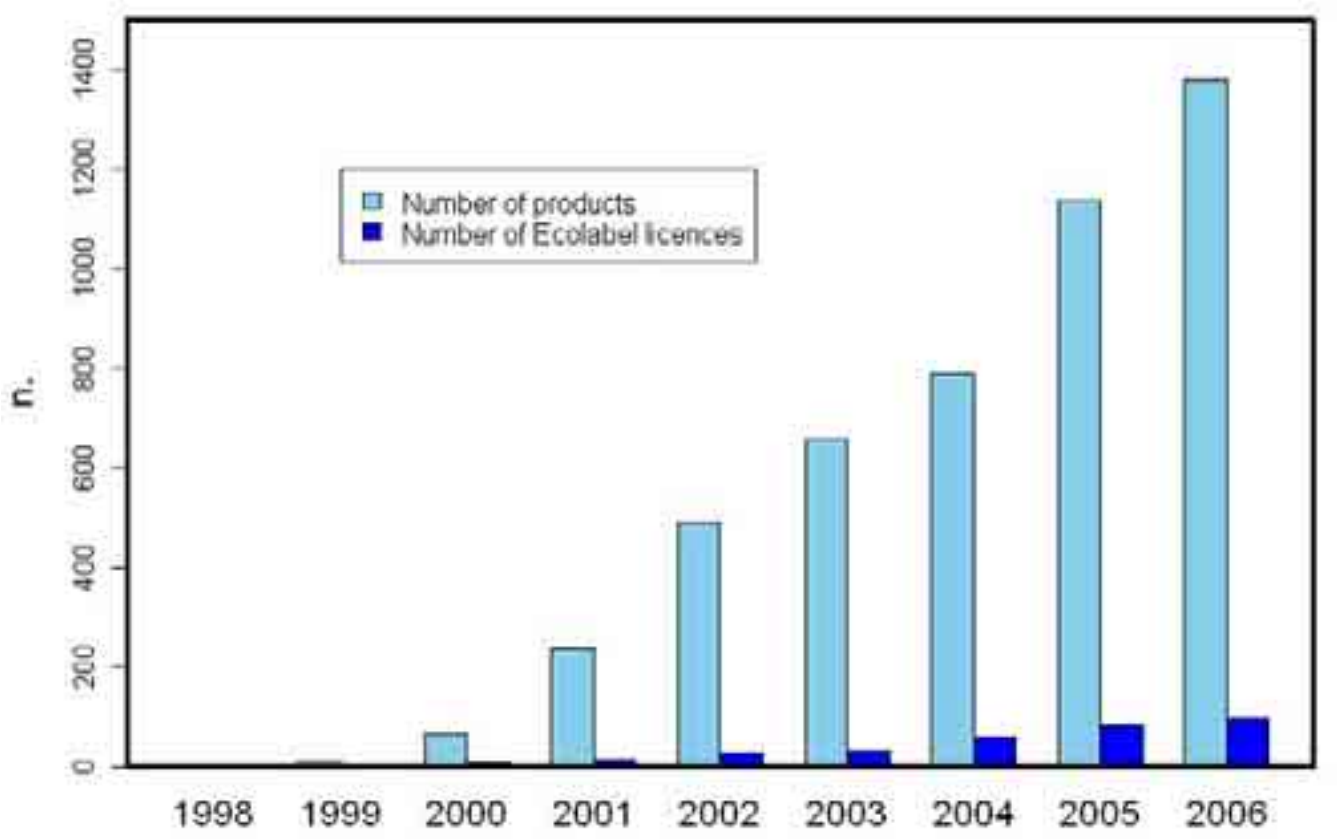
The significance of an indicator goes beyond (3)……

Ecolabel is the European label of ecological quality

*The real message beyond the indicator "**Number of ecolabelled products**" is that a general increase in the number of ecolabelled products shows that there is a market for green products, and that the market can be used to support sustainable development. In addition, this indicator reflects the degree of eco-friendliness of manufacturers.*

What does the indicator actually tell us apart from the general increase of ecolabelled products?

Ecolabel licences



Environmental Indicators

The significance of an indicator goes beyond (4)……

The percentage of threatened species and the total surface of protected areas are “indicators”: their significance is related to the preservation of biodiversity. Likewise, the temporal evolution of the total amount of waste generated in a country is related to the impacts of waste production/management.

Indicator format….(1)

Qualitative vs. Quantitative

- **Quantitative** – having to do with a quantity or number (How many, How often, How much ?)

- **Qualitative** – having to do with the qualities or characteristics of what is being discussed (When, Who, Why, How..?)

Qualitative.....	Quantitative.....
Vehicle noise and vibration	Water demand by sector
"Oiliness" of water	Emissions of Pb by sector…
Location and severity of incidents …	Population exposed to noise
Main habitat types in protected areas	Final energy intensity….

Indicator format….(2)

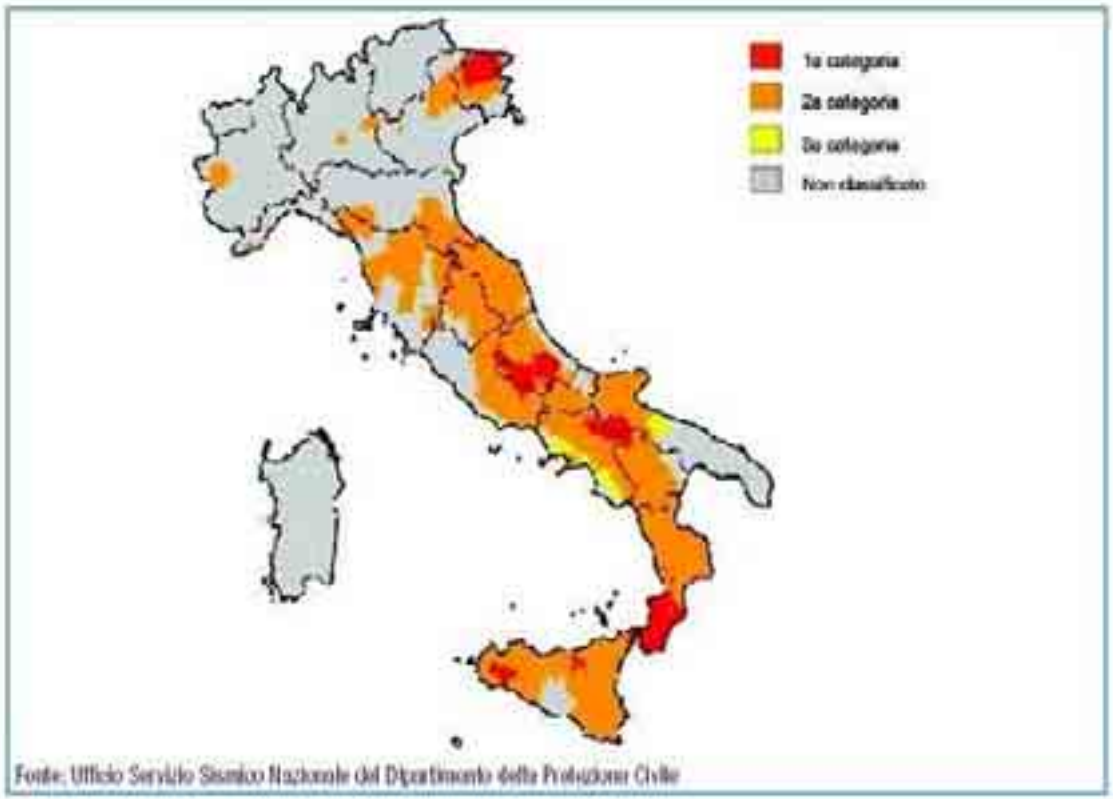
- They are not only number or time series
- Anything may be used as indicators, it depends on the context

Yes/No statements (ratification of a convention), maps, diagrams or text (e.g. list of laws)

…..and a hieroglyph, why not?

Indicator format….(3)

Seismic Zoning Indicator: up-to-date picture of the different Italian seismic danger zones and the corresponding building construction guidelines and regulations



An indicator may be a map ….

Criteria for selecting indicators
Indicators must be TRUE

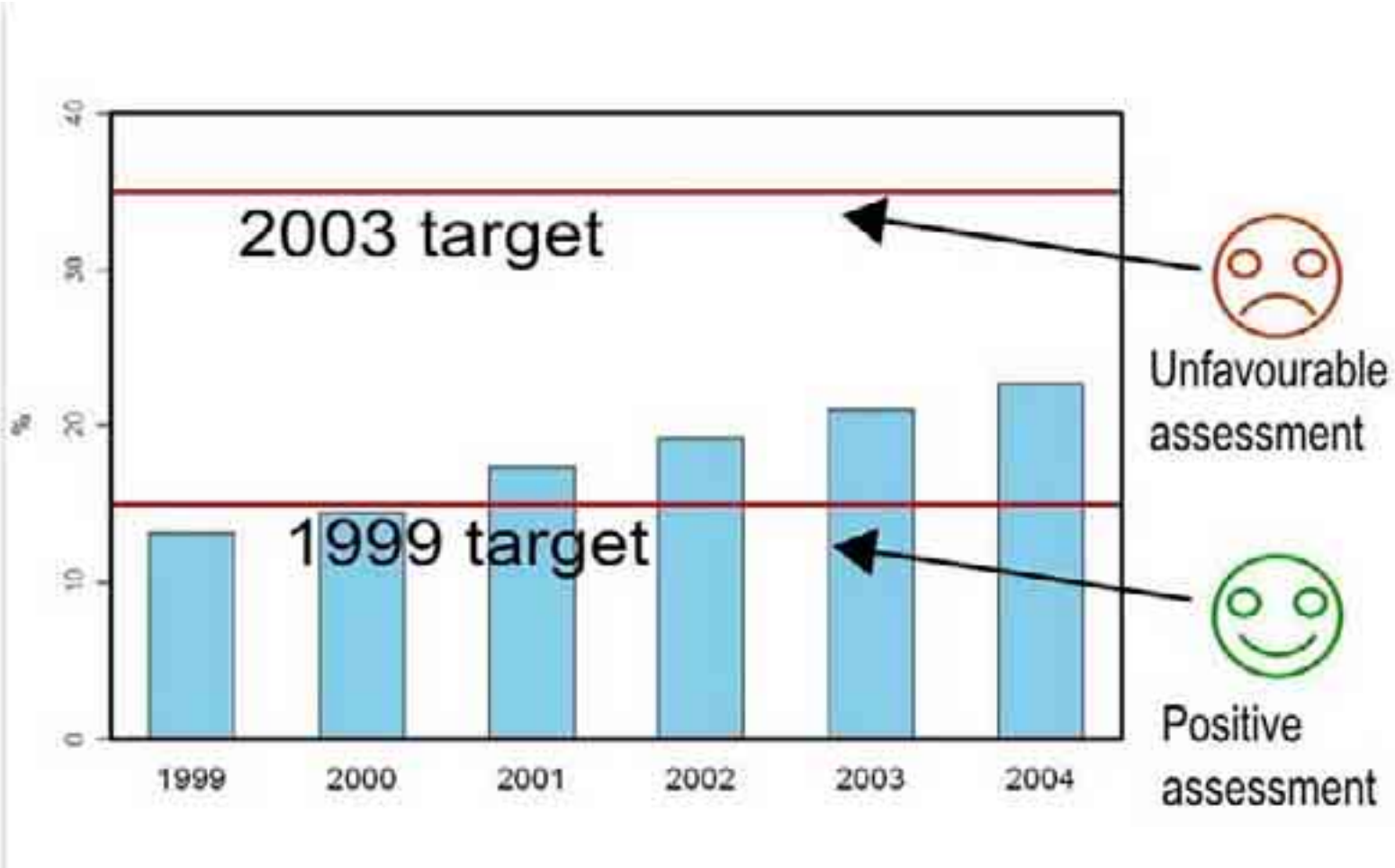
- **T**: Timely, targeted and sensitive to targets/thresholds
- **R**: Reliable, relevant, resonant and responsive
- **U**: Useful for the public, policy-makers and programme administrators
- **E**: Easily accessible periodically from reputable sources

…..or if you prefer, SMART

- **S**: Simple - easily interpreted and monitored
- **M**: Measurable - statistically verifiable, reproducible and show trends
- **A**: Accessible - regularly monitored, cost effective and consistent
- **R**: Relevant - directly address issues or agreed objectives
- **T:** Timely - provide early warning of potential problems

Indicator target-sensitiveness

An example: *Separate collection of municipal waste*



Indicator characteristics

The ideal indicator meets most of the several illustrated criteria, but…

….does such an indicator exist?

There will always be the necessity for trade-offs between the different requirements!

Data unavailability is a big problem for indicator development!

Indicators: neutral tools or ammunition?

Should indicators be used as neutral tools or to defend/attack a particular viewpoint? Are experts imposing their ideas and values?

If indicators are to be used by as many players as possible, they must be neutral!

Two reccomendations:
- make the development process transparent
- be sure to provide relevant non-controversial information

Headline indicators

Comparable to the newspaper headlines, to catch the attention of the public

Very limited number: 5 - 20

EXTRA

The Environment Gazette

Emissions of acidifying gases have decreased significantly in most EEA member countries between 1990 and 2004

Ozone Precursors

Emissions of fine particles (PM10)

What progress is being made in reducing emissions of acidifying pollutants across Europe?

Emissions of acidifying gases have decreased significantly in most EEA member countries.

Relevant for general conditions that people value

Bear in mind:

- An indicator does not necessarily disclose all aspects behind a change (more indicators may have to be considered)!
- Sets of indicators evolve over time!
- Sets of indicators are seldom incomplete!
- Good indicator development relies on good data!
- A single set of indicators applicable to all nations/countries/cities is very difficult to find!
- Use of indicators can't avoid the need for data!
- Indicators can't address questions they are not designed for!
- Indicators can't replace good science!
- There is no single environmental indicator that reaches the level of attention of other economic indicators (e.g. GDP)!

Terms commonly related to indicators

- Indices
- Statistics
- Raw/Primary data

Different meaning for different people in different contexts

Raw/Primary Data: definition

The most basic component of indicator work

A general definition:

figures that need further processing (e.g. aggregation to national level, adjustment for climate, season economic cycles...)

A single data may be an indicator (a poor quality indicator…)

Raw/Primary Data (Examples)

- Daily measured concentrations of various key pollutants in a river sampling station
- Water temperature
- Dissolved oxygen
- Suspended solids
- Volume and rate of flow

Raw/Primary data: some steps

- Collect Data (determination of the most relevant variables and data collection)
- Compile Data (assessment of data quality, data validation, structuring of data bases...)
- Treat-Analyse Data (statistics, indicators and indices)
- Disseminate Data (news, short bulletins, reports, electronic media ....)

Raw/Primary data

Data Collection:

- Statistical censuses and surveys
- Administrative registrations and records (data routinely gathered for specific administrative goals, such as:citizenship, home-owner records, licence plate records, tax data)
- Monitoring data (mostly acquired by instrument readings, by satellites LANDSAT, SPOT, by aerial photographs, by direct field observations)
- Computational methods (CORINAIR,IPCC, SEEA)

Computational methods

- When it is not possible to generate data by using other statistical methods
- IPCC (Intergovernmental Panel on Climate Change): guideline to calculate greenhouse gas emissions;
- CORINAIR: guideline to calculate emissions by source
- EPA (Environmental Protection Agency) coefficients to calculate industrial pollutions

Statistics/Analysed data

Initial consolidation of primary data

Purpose:

- Quatification of environmental phenomena
- Synthetic presentation of data

E.g.: the analyses may be reported as time series information, showing changes in the parameter measurements over time at a given location

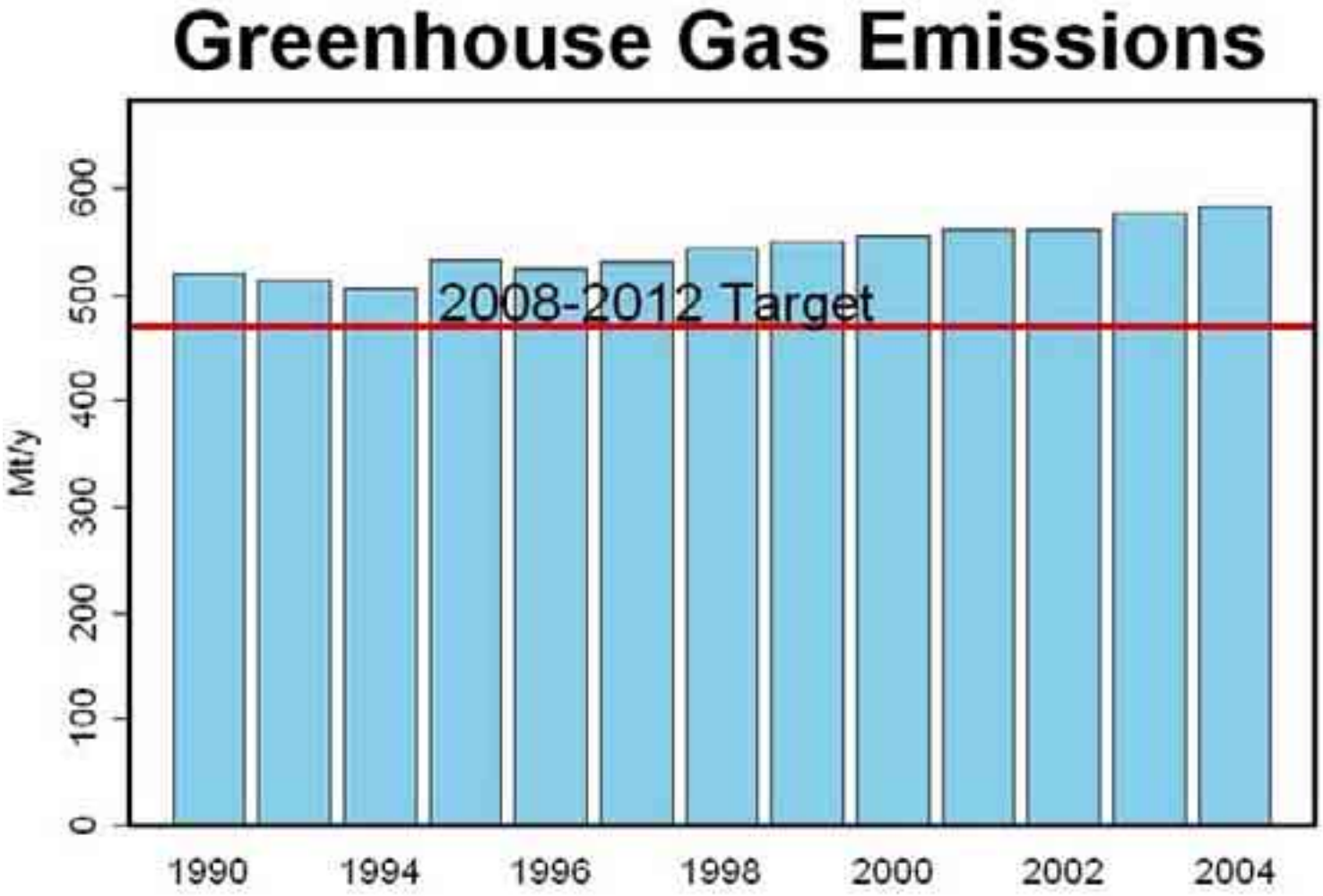
E.g.: the analysed data may include annual averages, variances and totals for each water parameter

A question: can primary data/statistics act as indicators?

What separates indicators from statistics is that they are targeted at an environmental concern

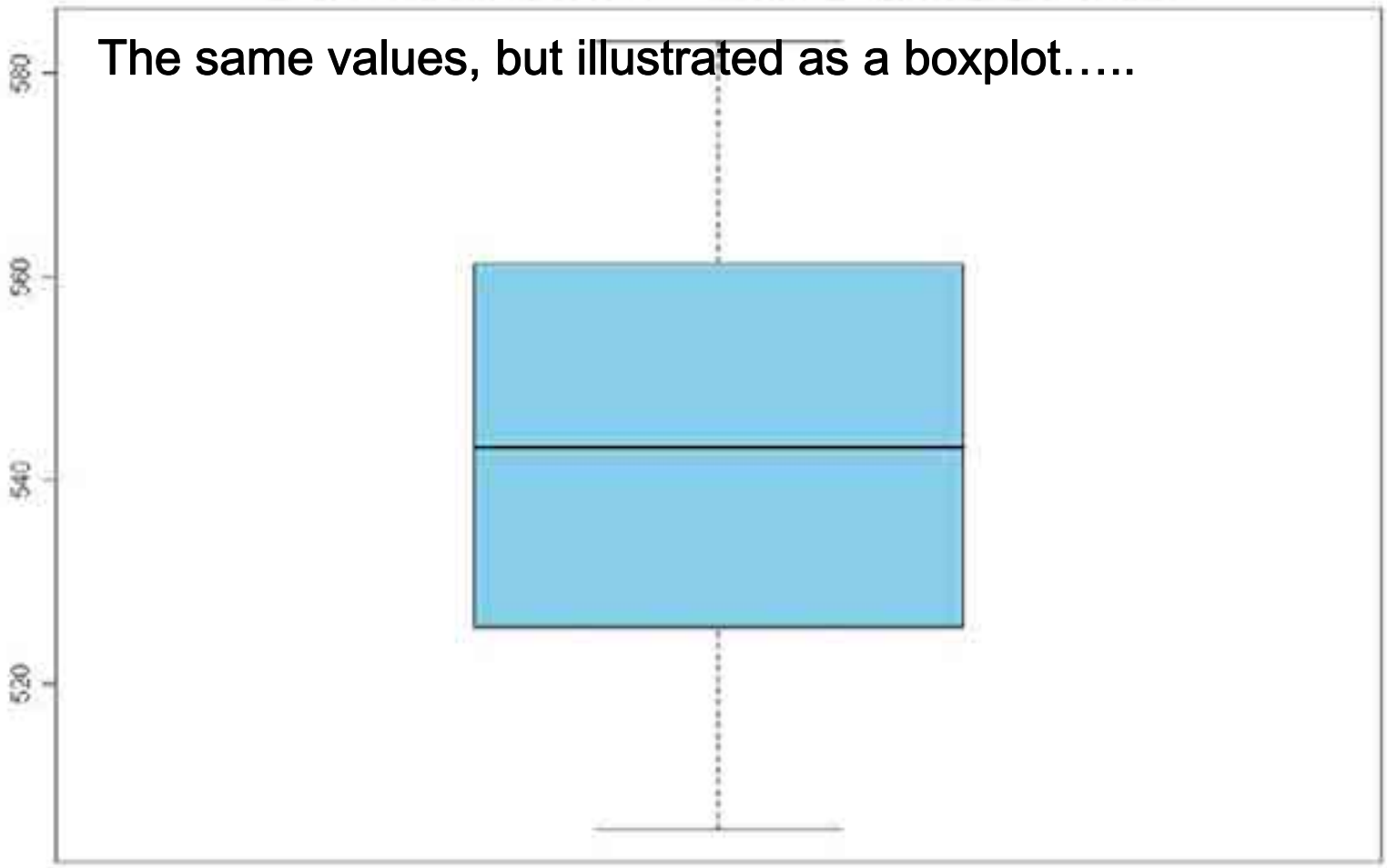
Remember the OECD's definition……..

The figure suggests an unfavourable assessment…



Greenhouse Gas Emissions

The same values, but illustrated as a boxplot…..



What kind of assessment does this statistical representation provide?

Indices

What is an index?

- A single measure condensing a wide range of information on different but related phenomena
- Aggregation of indicators with similar impact

An index aggregates qualities or properties that are not necessarily commensurate (e.g. data describing diverse properties with different measurement units)

Particularly valuable for drawing comparisons between countries

Indices: an example

Pollutant Standard Index (USA, ’70s)

- Based on measurements of the concentrations of five pollutants: particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, and ozone.
- Air quality standards have been developed for each of these
- For each pollutant, a value of 100 is assigned to the maximum permitted concentration of that pollutant.
- PSI for the day: the highest of the five values
- Standard verbal descriptions for various ranges have been specified.

Indices: an example (2)

Pollutant Standard Index (USA, '70s)

Index Value	PSI Descriptor	General Health Effects	Cautionary Statements
Up to 50	Good	None for the general population.	None required.
50 to 100	…..	…..	….
100 to 200	Unhealthful	Mild aggravation of symptoms among susceptible people, with irritation symptoms in the healthy population.	Persons with existing heart or respiratory ailments should reduce physical exertion and outdoor activity. General population should reduce vigorous outdoor activity.
…..	…..	…..	….

Indices: an example

Marine Trophic Index (TRIX): index of water quality

Use of TRIX in Italy: classification of marine coastal water state

Reliable in showing trends of the trophic state at temporal and spatial level

Trix is obtained by the combination of four indicators:

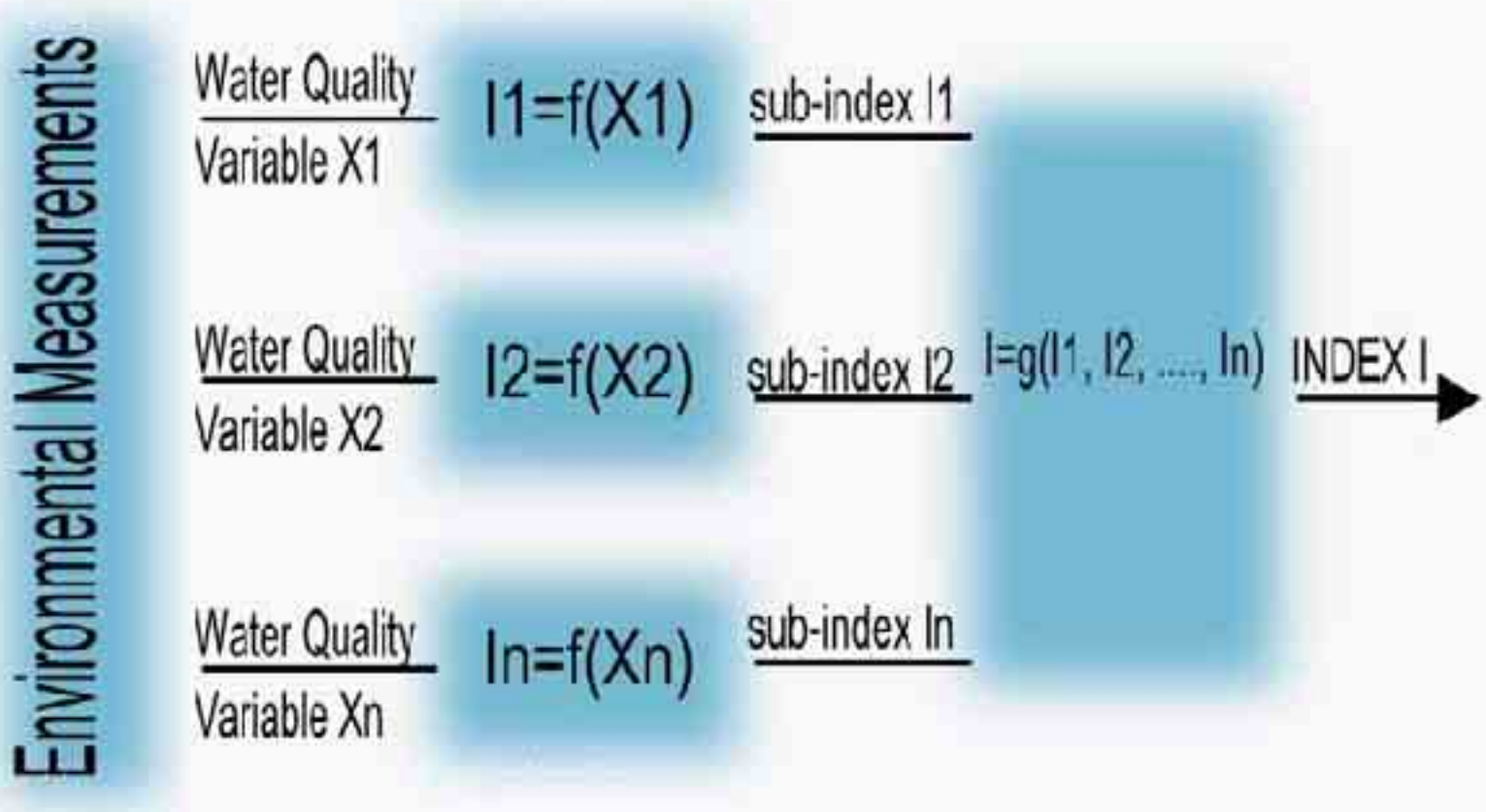
- Chlorophyll a
- Oxygen saturation
- Mineral nitrogen
- Total phosphorus

Trophic Index	Water State
2-4	Excellent
4-5	Good
5-6	Mediocre
6-8	Poor

Indices: an example (2)

TRIX within 500m from the coast

Information flow process in the development of water quality indices



Indices: an example

CO_2, N_2O, HFCs, PFCs, SF_6 can be condensed in a single value order to show the total contribution to Climate Change caused by these gases

These pollutants can be weighted by their global warming potential and then condensed ina single measure

Indices: some shortcomings

The construction of an index may be challenging

The choice of the components and of the corresponding weights may be largely subjective

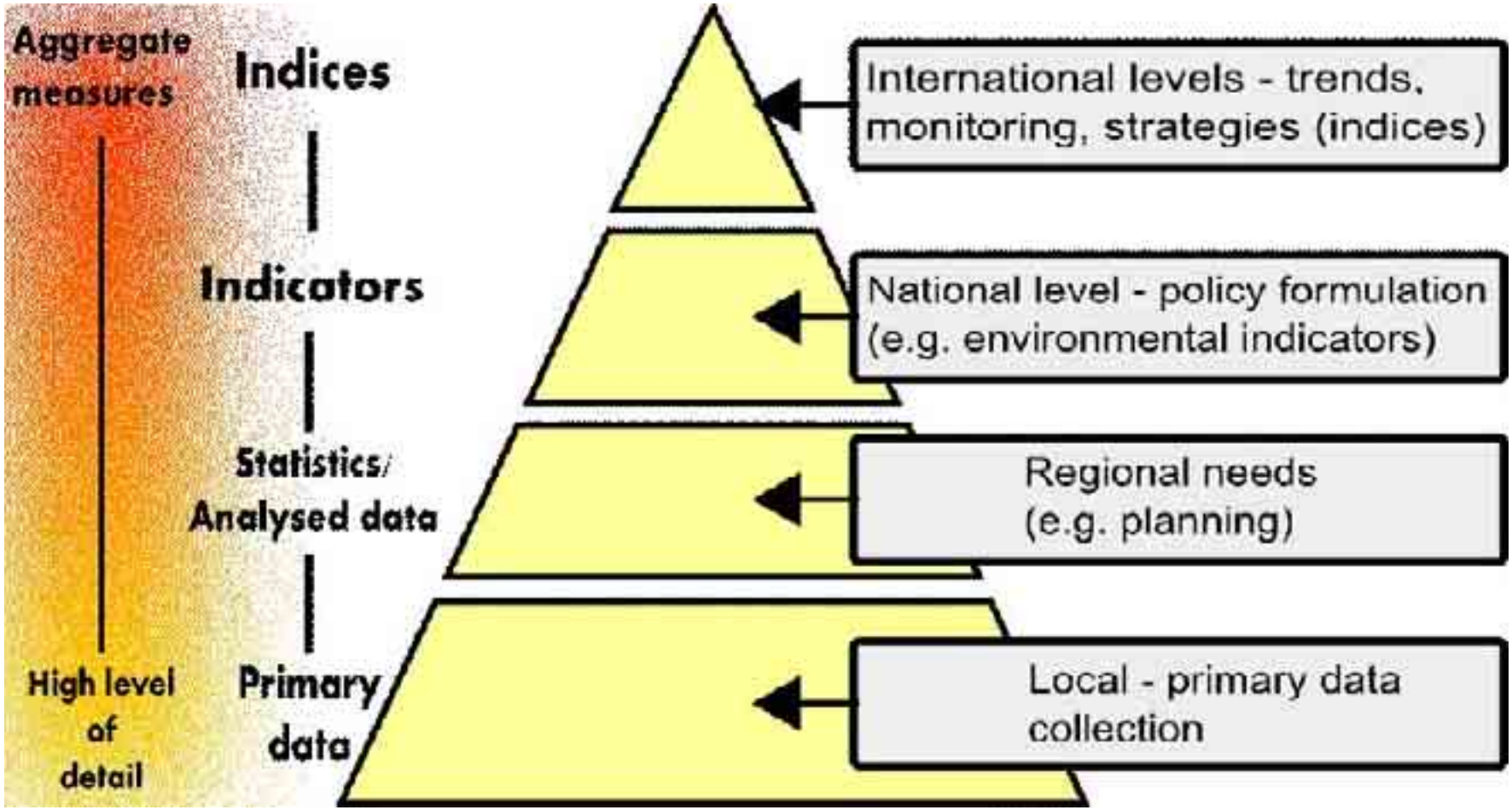
Testing or veifying composite indicators can be difficult, since they may not relate to specific, measurable conditions.

Significant trends of an underlying component ca be masked by other components,

Information Pyramid

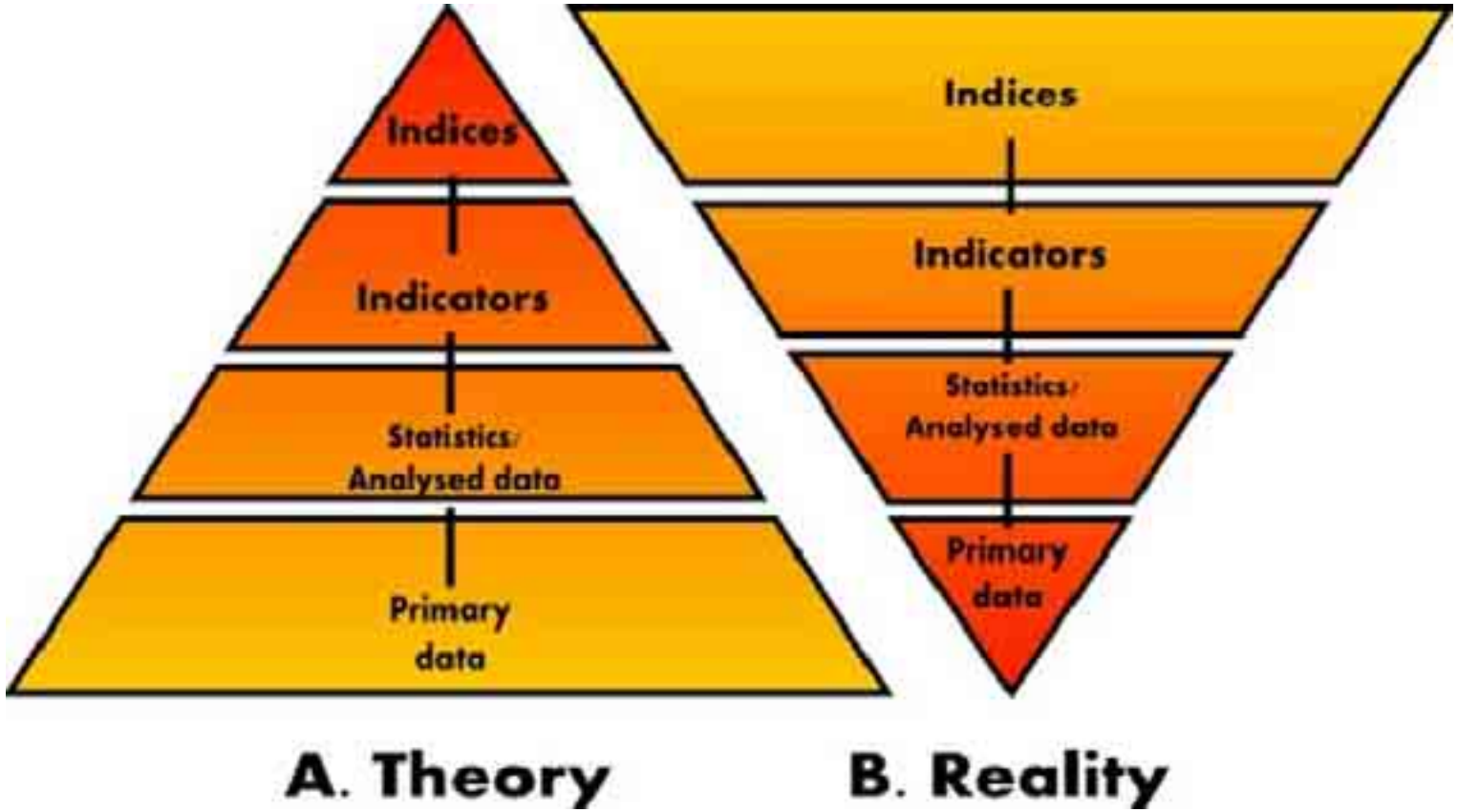
- Highlights the differences between data, statistics, indicators and indices.
- Suggests increasing (hierarchical) levels of data aggregation.
- The layers are not independent categories: the lower layers are used to build the upper ones

Information Pyramid



Information Pyramid (2)

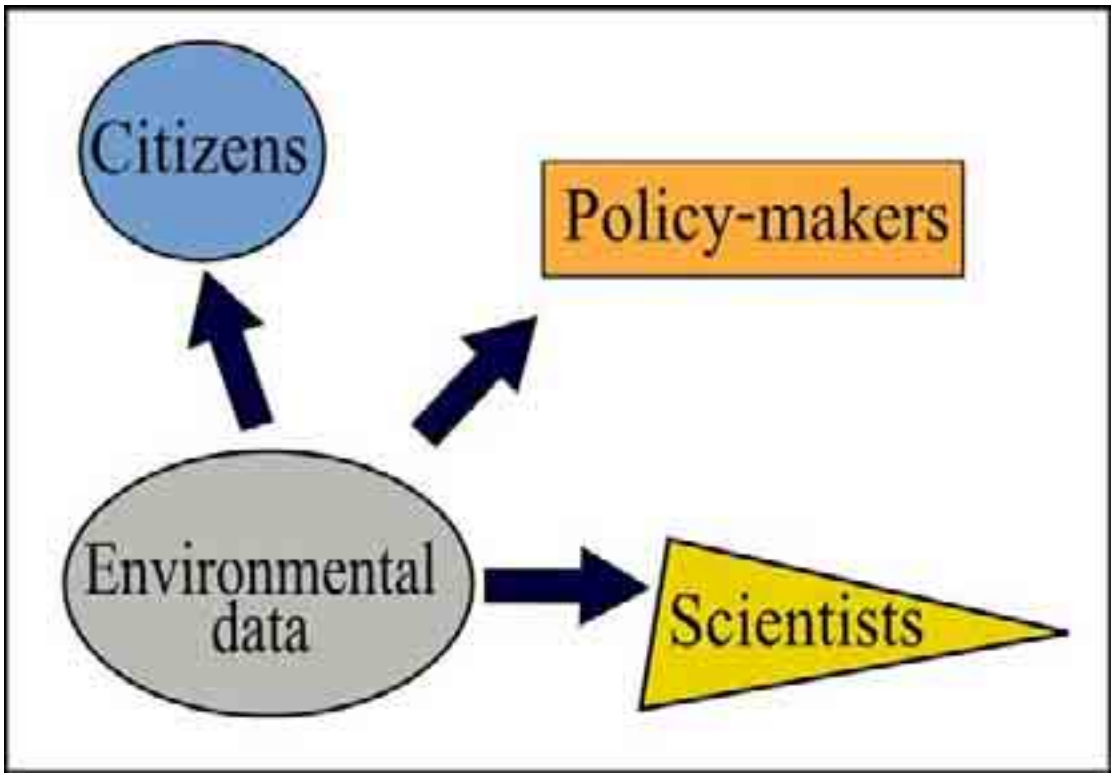
The lack of (reliable) data is a common problem in the indicator context



Reality: many indicators/indices developed using the samed, limited data sets currently available

Who are the indicator players?

The public prefers simple messages presented as single indicators



Policy makers prefer data/indicators related to evaluation criteria, targets, goals….

Scientists are more interested in raw/primary data

Environmental reporting frameworks

Environmental reporting, several purposes:

- to track progress towards environmental goals
- to record ambient environmental conditions
- to document outcomes of environmental management policy

A prerequisite for the assessment and reporting on the state of the environment and its evolution:

an adequate sets of indicators to be surveyed

and the definition of a functional scheme (framework) to……

The need for a conceptual framework

•To provide an overview of an environmental problem, so to
➢…determine whether all concerns are being monitored and addressed
•To avoid over-abundance of possible indicators, so to
➢…coherently develop and select indicators
•To sistematically sort out sets of indicators, so to..
•…make their interpretation and integration easier
•To facilitate the organisation and presentation of information,
➢…across the many issues that pertain to environment

We want to focus on frameworks able to improve the understanding of the interaction between humans and the environment, and the impact of this interaction (causal framework)

Environmental reporting frameworks

The use of a framework suggests an approach for developing, selecting and organising environmental indicators into types, levels of aggregation, issue relevance, uses and potential users.

The need for a conceptual framework

- There is no unique framework! Its choice depends on the detail of analysis and purpose of the monitoring

- A framework may change over time

- Many proposals, the most thoroughly discussed is the PSR and its variants.

A short history of PSR/DPSIR frameworks

- Stress-response model (Rapport & Friend)
- OECD PSR (1991)
- EEA (European Environment Agncy) DPSIR
- Presently, the DPSIR framework is the basis for state-of-environment reports
- DPSIR as an evolving model (e.g.: DPSEEA …..ExposureEffectAction)

DPSIR framework

Driving Forces – Pressures –State – Impacts -Responses

Basis for most sets of indicators presently used by nations or international bodies

Useful to describe the overall cause-effect relationships

DPSIR, a causal framework

Causal = the model assumes the existence cause-effect relationships

- Cause-effect relationships = well-known, but hard to quantify
- Cause-effect relationships = conceptual and qualitative in nature, no mathematical equations

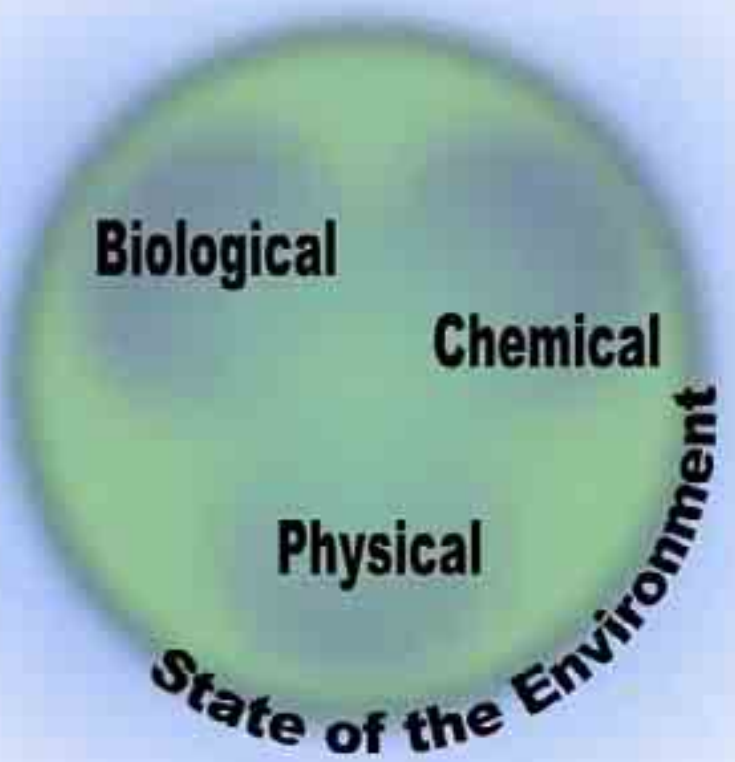
DPSIR framework

Based on the concept of causality

- **Driving forces** (e.g. industry and transport) produce
- **Pressures** on the environment (e.g. polluting emissions) which then degrade the
- **State** of the environment, which then
- **Impacts** on human health and eco-systems, causing society to
- **Respond** with various policy measures (e.g. taxes)

State of the environment

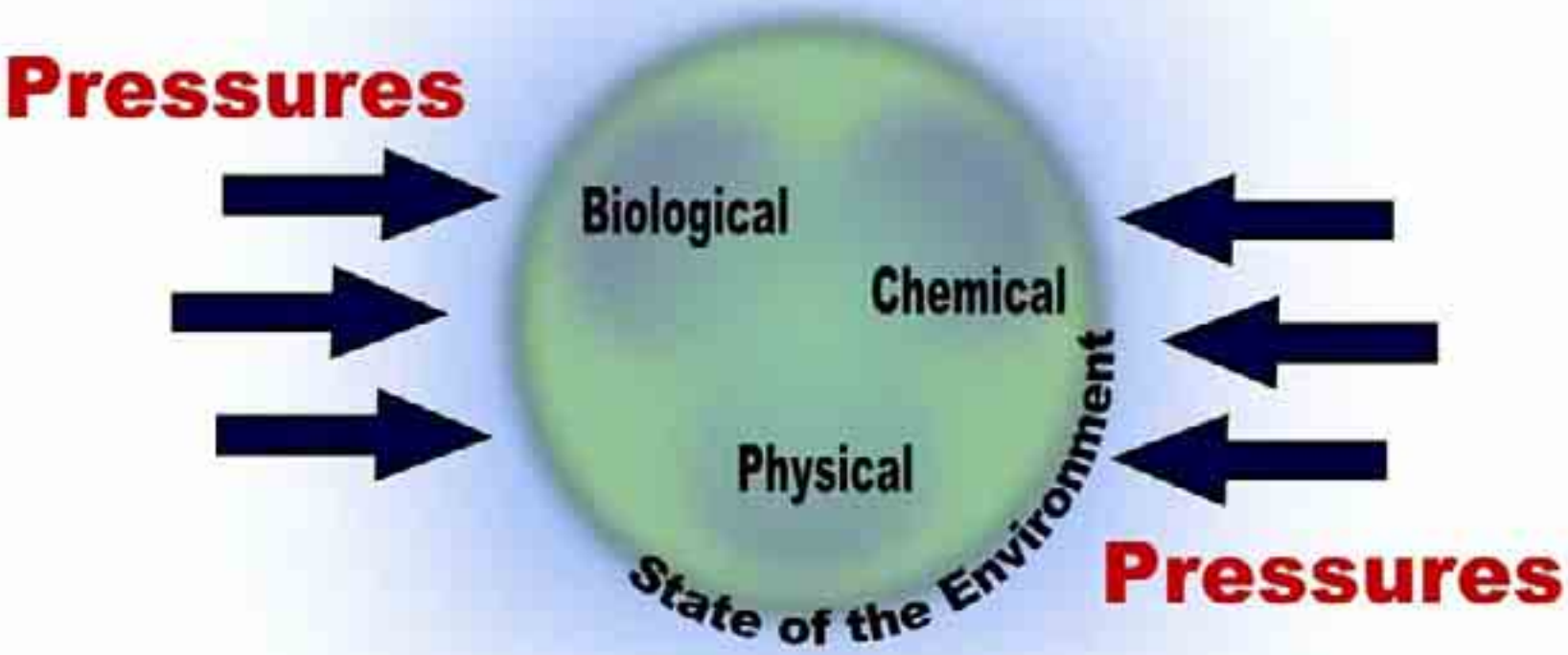
Biological State
Extinction of species & ecosystems, abundance and health of plants, animals, fish, birds….



Physical State
Hydrology, meteorology, ….

Chemical State
Quality of air, water and soil (presence and concentrations of various substances, organic matter, nutrients…)

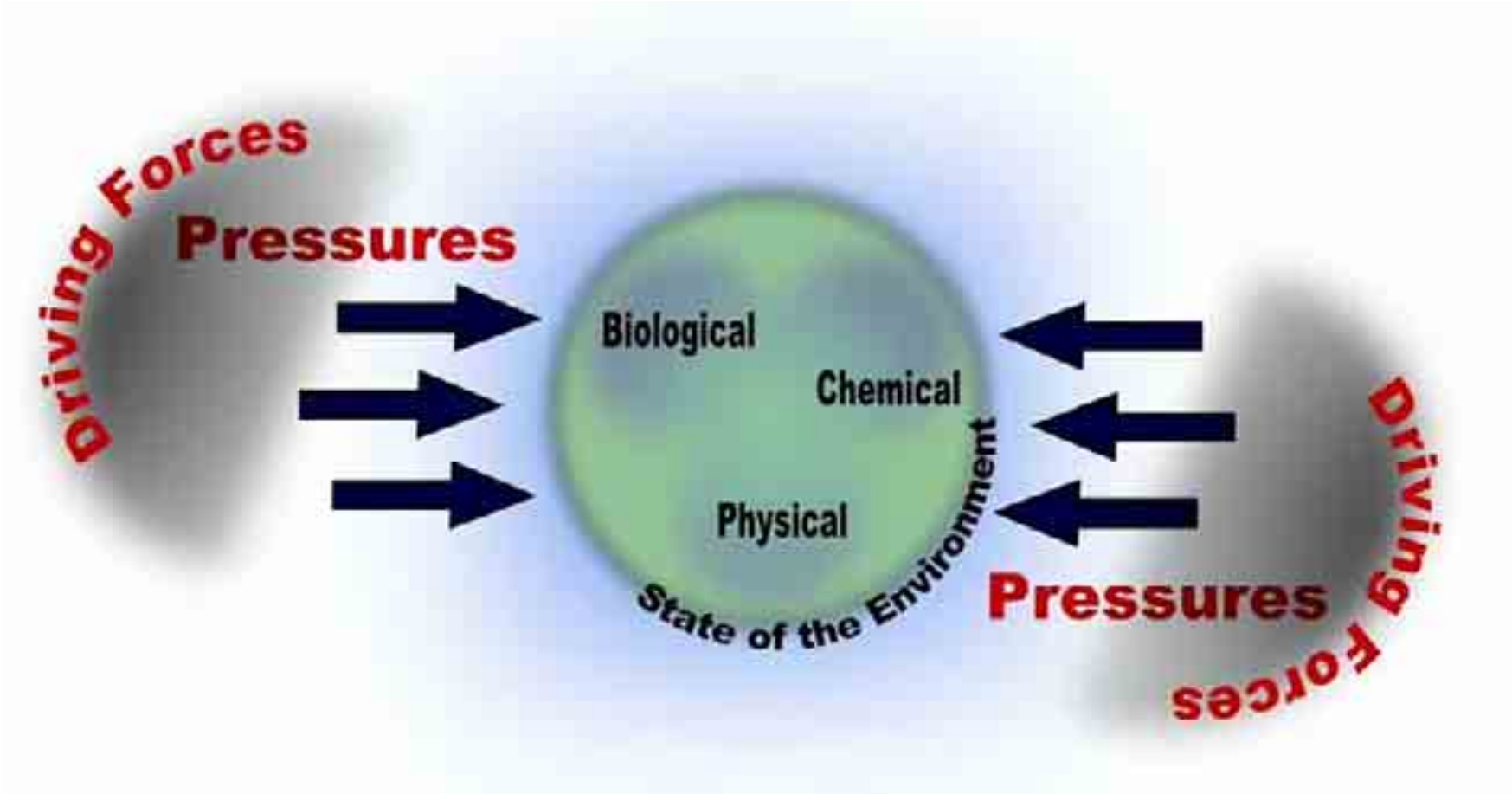
The state of the environment is affected by many Pressures (e.g. environmental disasters)



Anthropogenic pressures

Emissions, effluents, waste depositing, use of natural resources, land use….

The human activities constitute the Driving Forces behind the pressures

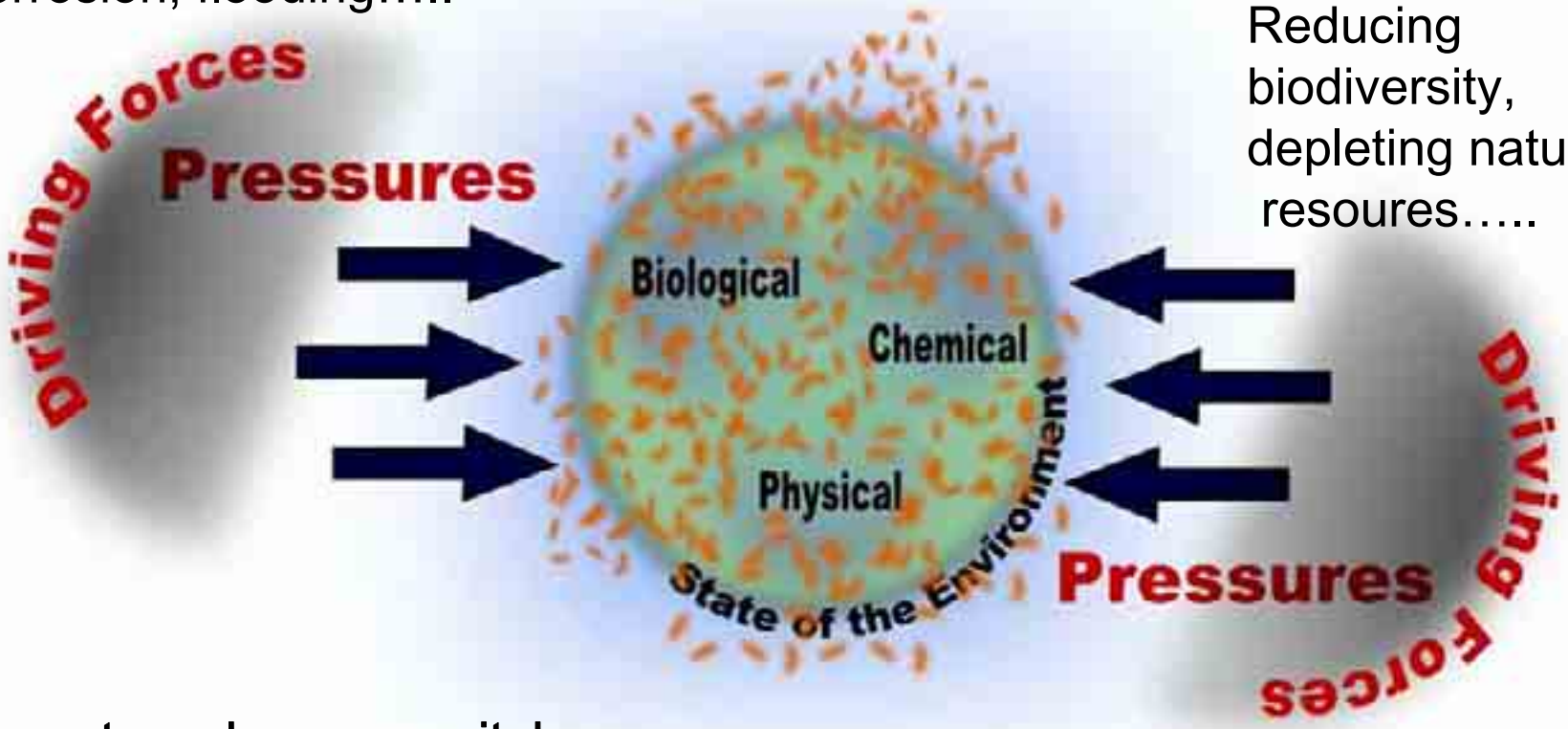


Driving Forces
Industry, agriculture, transport, energy…..

The pressures at work affect the state of the environment resulting in a number of environmental Impacts

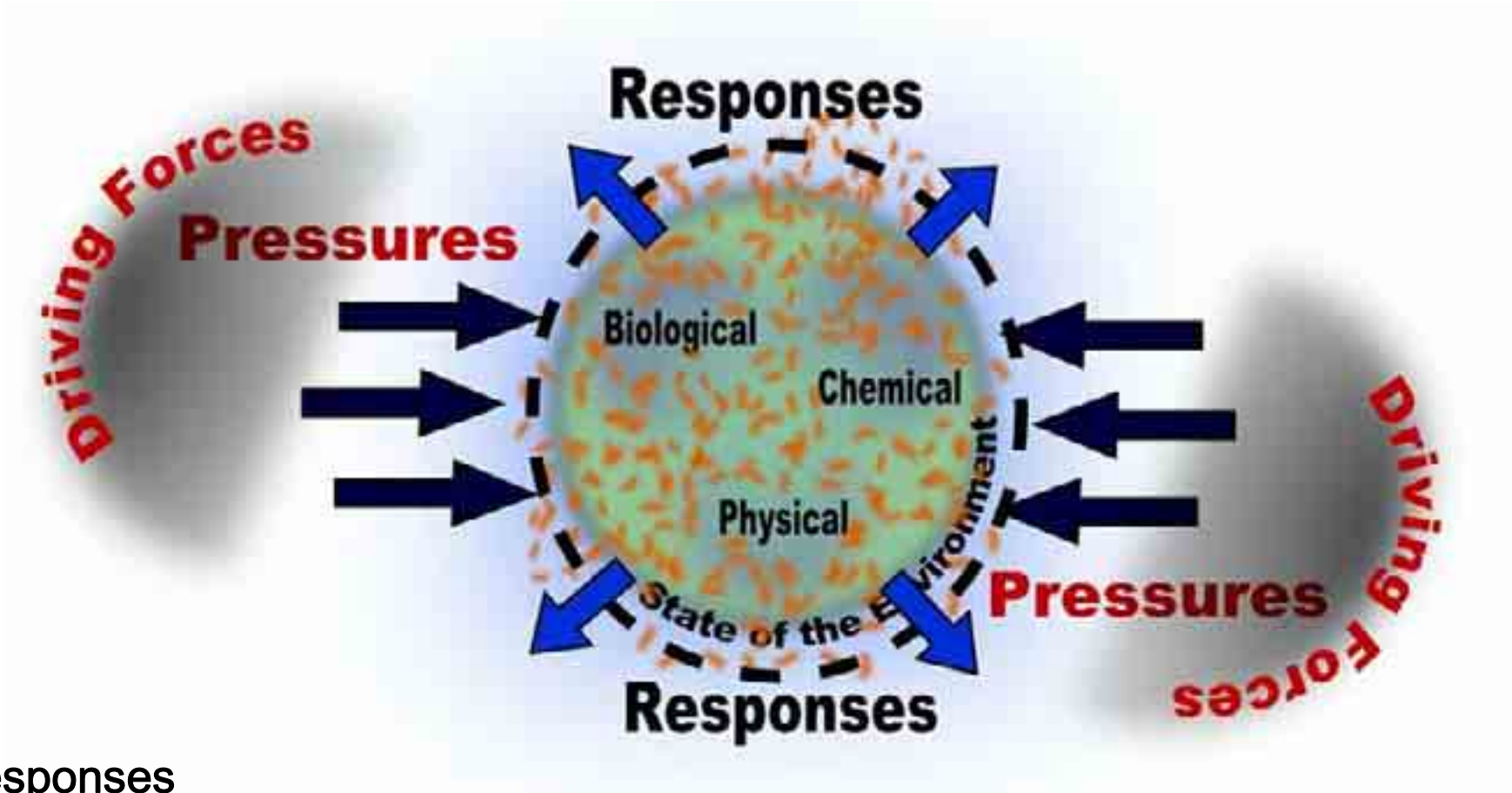
Impacts on man-made capital
Corrosion, flooding…..

Impacts on natural capital
Reducing biodiversity, depleting natural resoures…..



Impacts on human capital
Negative health effects…..

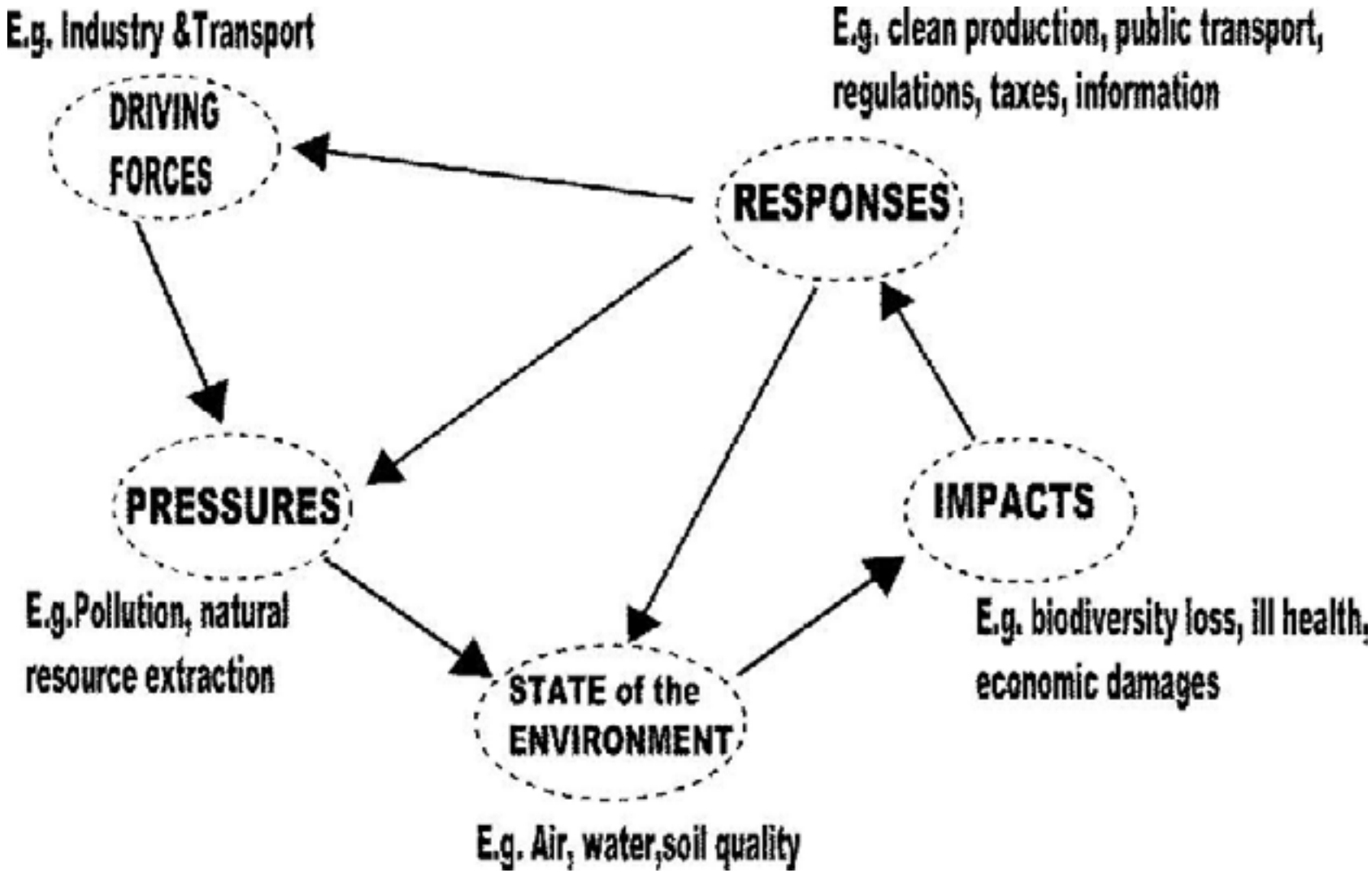
The society applies Responses to counteract the unwanted impacts



Responses

Guidelines and advices, public investments, information, legal measures, Financial measures, persuasive measures….

The classic representation of the DPSIR framework



DPSIR Indicators (1)

The model divides the indicators in **five** groups

- Driving force indicators are related to underlying causes influencing a variety of relevant variables
- Pressure indicators relate to the factors that cause environmental problems
- State indicators describe the current state of the environment
- Impact indicators are related to the ultimate effects due to changes in the state of the environment
- Response indicators monitor the effort of society to counteract environmental problems

DPSIR Indicators (2)

- **Driving force indicators** are not very **elastic/responsive**
- Behind the monitored phenomena (e.g. road traffic) there are very powerful economic forces
- Will a politician ever suggest to abolish the use of cars?

Driving force indicators are **useful** to:
- calculate a variety of pressure indicators
- plan “responses” to avoid future pressures / long term planning

DPSIR Indicators (3)

- **Pressure indicators** should be **responsive**
- A decision-maker has a chance to reduce the indicator (i.e. the problem) by appropriate actions
- Useful to demonstrate the effectiveness of political action

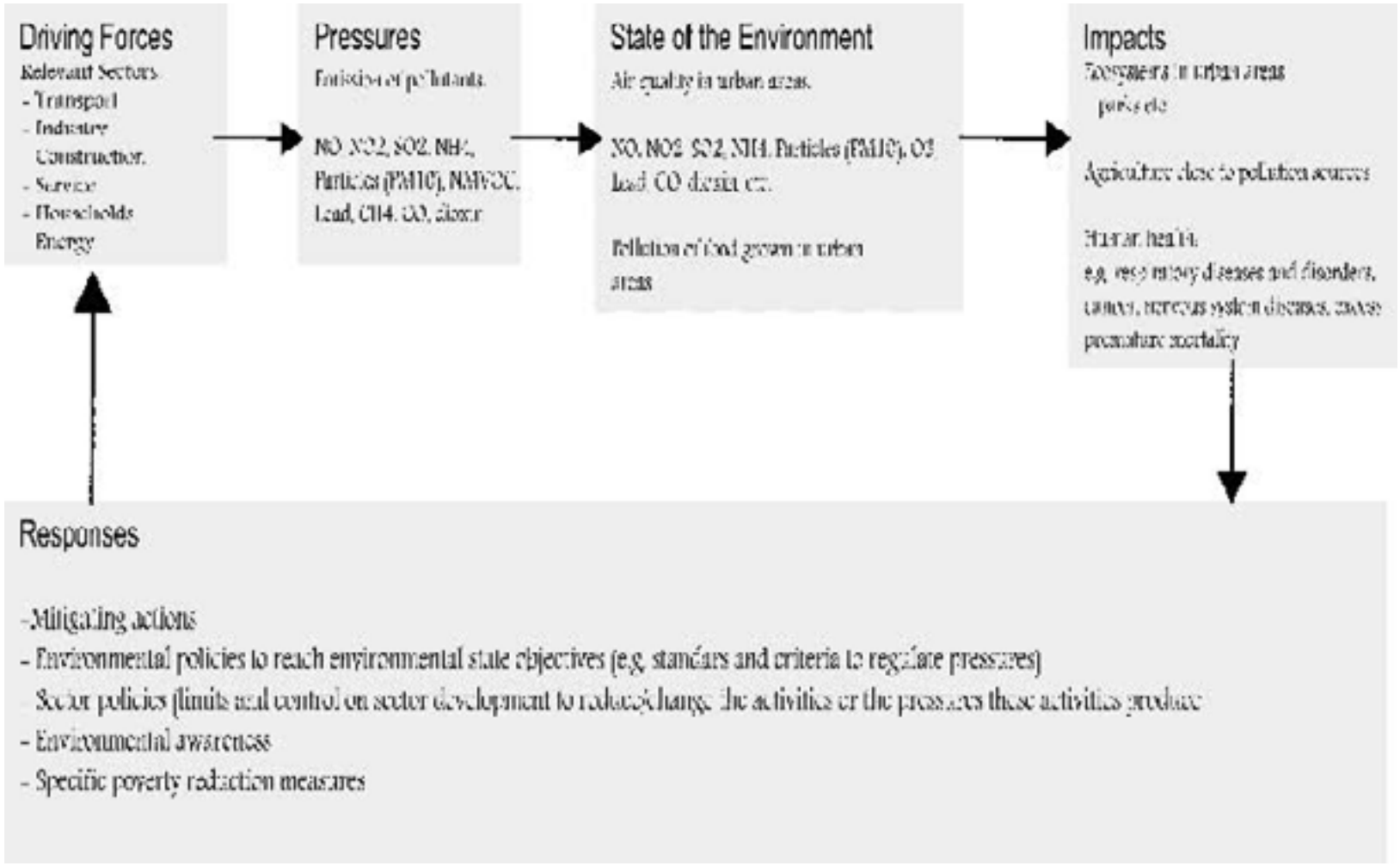
- **State indicators** are often **very slow** (e.g. acidity of forest soils)
- Useful to plan habitat restoration and clean-up activities

DPSIR Indicators (3)

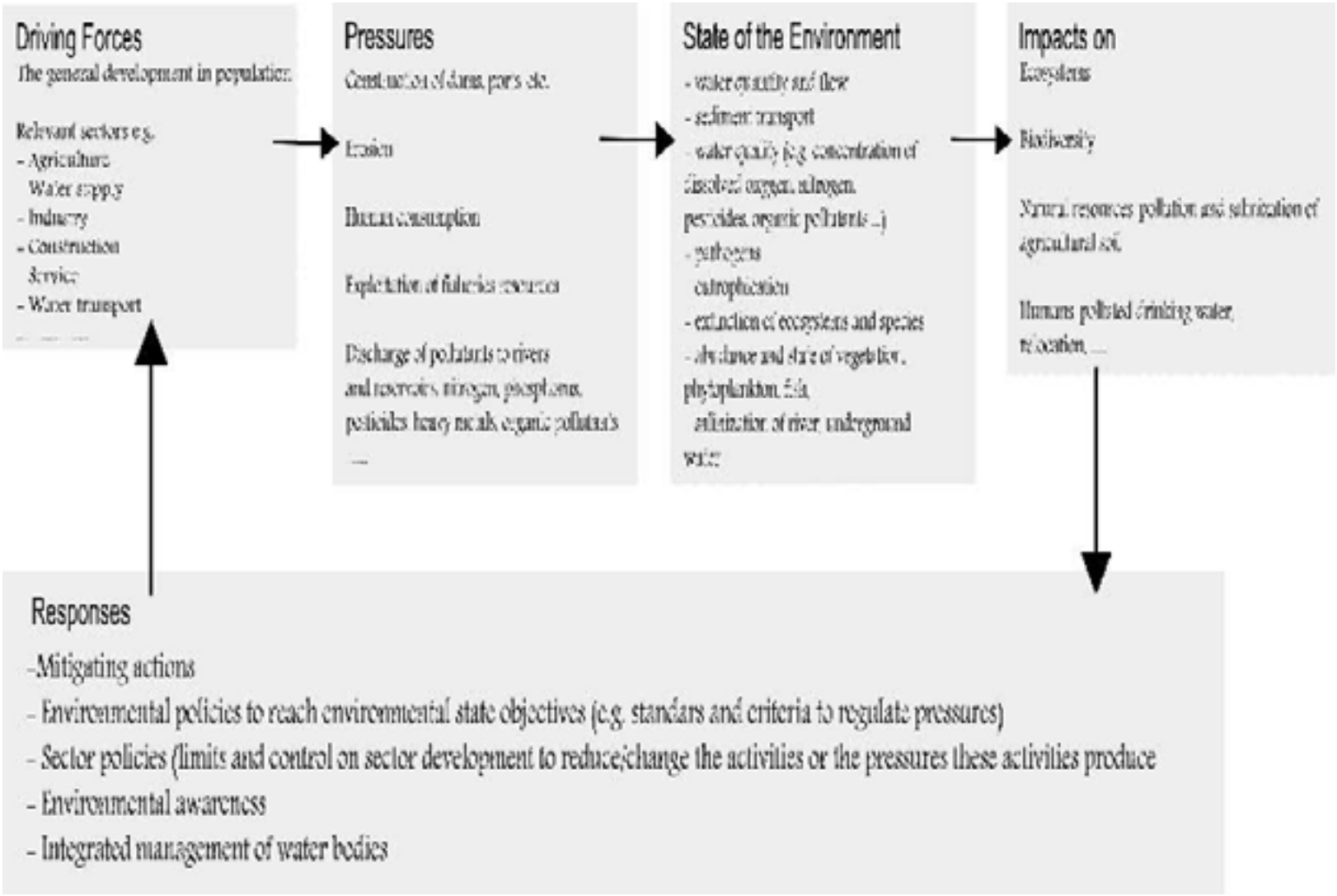
- **Impact indicators** are even slower than state indicators
- When the impacts are felt, it is ususally to late for action
- Useful to highlight cause-effect relationships

- Response indicators are very fast
- No guarantee that political responses will be efficient
- The monitoring of succes can be performed only through pressure & state indicators

Air pollution DPSIR diagram - Urban air pollution



Water Resources DPSIR diagram



PSR framework

Based on the concept of causality

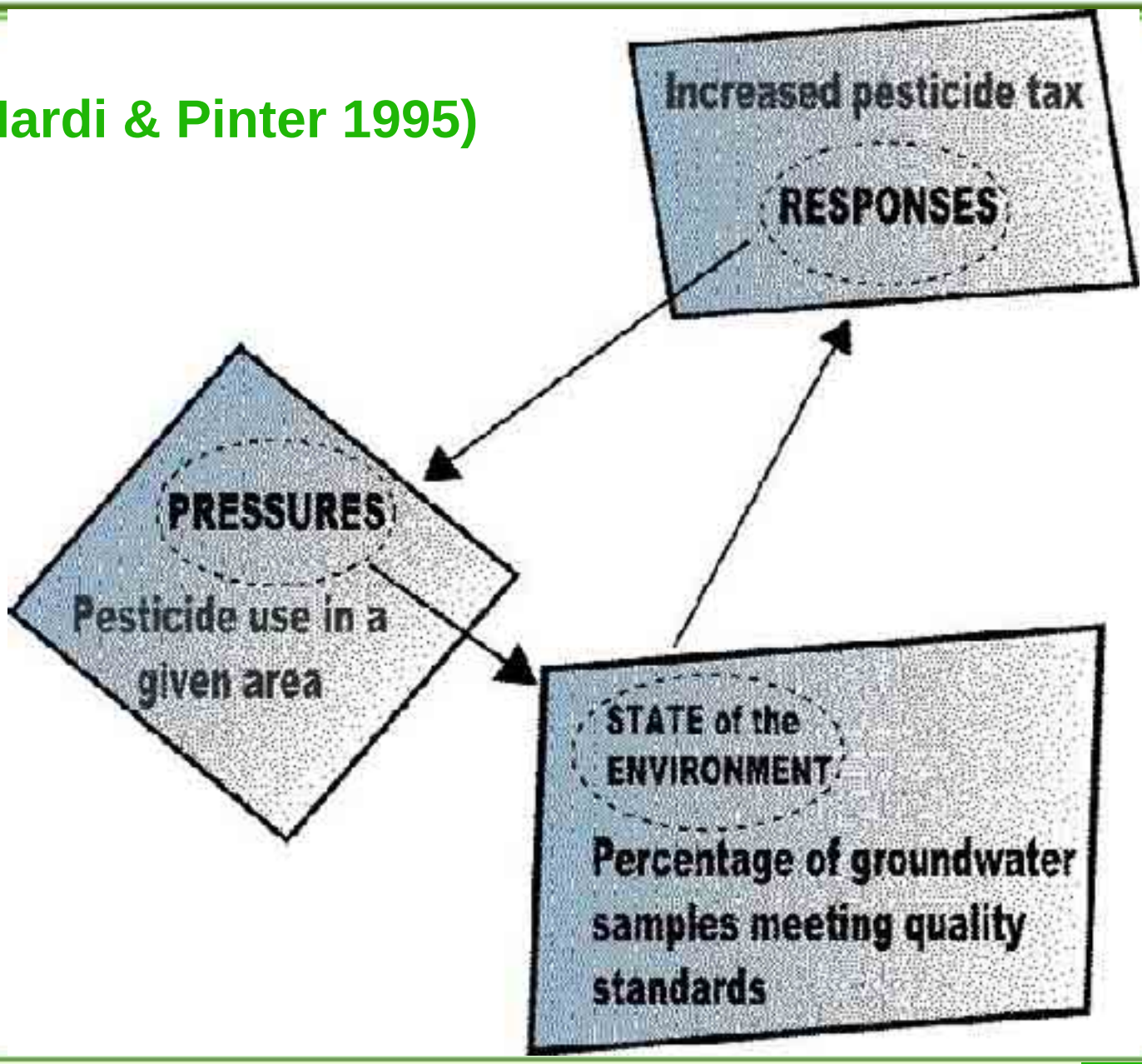
- Human activities exert **Pressures** on the environment,
- changing its **State** (quality/quantity of natural resources)
- Society responds through environmental, economic and sectoral policies (**Responses**)

PSR indicators

Three types of indicators:

- Indicators describing pressures frm human activities exerted on the environment
- Indicators of environmental conditions, relating to the quality of the environment
- Indicators of societal responses, which measure the extent to which society is responding to environmental changes and concerns

An example (Hardi & Pinter 1995)



Other variants of the PSR model: DSR, PSIR

- Some organizations prefer variants of the PSR framework
- E.g.: UNCSD prefer the DSR framework
- Pressure indicators are best used for environmental issues only
- Driving Force indicators accomodate more for social, economic and institutional aspects
- PSIR model captures the effects the pressures may have on the state of the environment

DPSIR/PSR some shortcomings (1)

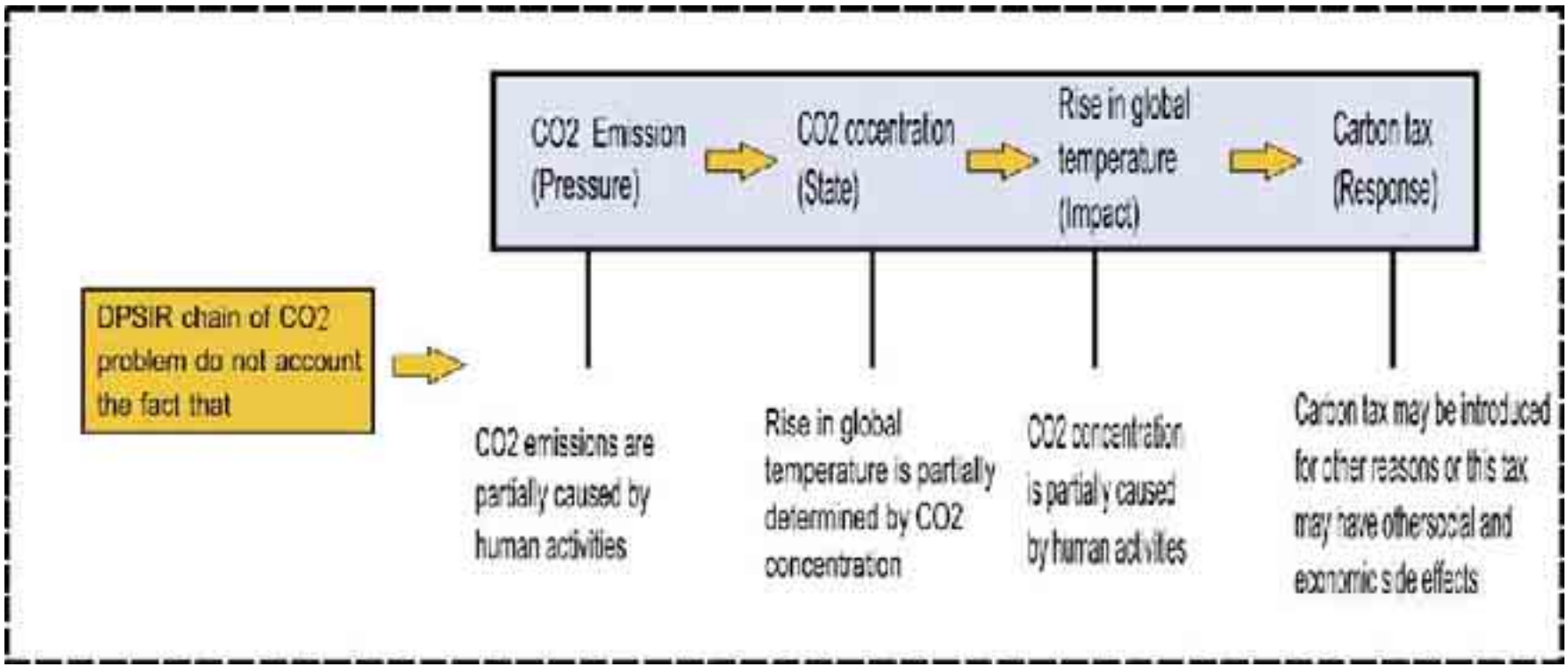
The distinction between pressures, states and responses is not always clear-cut (it depends on the policy objective)

The clearing of forestland for agriculture may be identified as a pressure when studying biodiversity, and as a response when studying rural poverty

DPSIR/PSR some shortcomings (2)

- Their simplicity (e.g. considerable relationships between the causes themselves and impacts themselves…..)
- Multiple pressures and impacts are not considered
- They suggest linear relationships in the human activity-environment interaction
- The model only deals with human responses and not ecological ones, but a degraded environment could affect human welfare…
- Despite their broad use, a reference document is lacking. This contribute to diversified interpretations….

DPSIR/PSR some shortcomings (3)



Example from Bossel (1999):

Indicator factsheets

- The original format was developed by the EEA
- A simple indicator management system

The function of indicator factsheets is many fold:
•To document indicators in a standard way
•To ensure data quality and encouraging data updating
•To effectively use and re-use information and data for other assessment products

<u>Given the role of indicators, the tools used for presentation are important</u>

Indicator factsheets (1): an example

Indicator factsheet of the Italian Environmental Data Yearbook

Metadata (inserire icone di chernof)

- Title, reflecting its main purpose
- Description, its main features, purpose and methodology
- Unit of measurement
- Data Source
- Geographical and Temporal coverage
- Frequency of data collection (how often?)
- Quality of information (Relevance, Accuracy, Comparability over time and across space)
- Objectives and shortcomings

Indicator factsheets (2): an example

Indicator factsheet of the Italian Environmental Data Yearbook

Metadata

- Quality of information (Relevance, Accuracy, Comparability over time and across space)
- Objectives and shortcomings
- Policy references
- State and Trend, an assessment accompayning the visual one provided by the Chernoff icon
- Comments to tables and graphs
- Policy references
- State and Trend, an assessment accompayning the visual one provided by the Chernoff icon
- Comments to tables and graphs

Useful Websites & Documents

Indicators and DPSIR/PSR frameworks

- http://esl.jrc.it/envind/theory/handb_01.htm
- http://www.virtualcentre.org/en/dec/toolbox/Refer/EnvIndi.htm

Composite Indicators

- http://farmweb.jrc.cec.eu.int/CI/

State of the Environment reporting

- http://www.grida.no/soe/index.htm

Reporting frameworks

- http://www.environment.sa.gov.au/reporting/frameworks.html

Environment Statistics

- http://www.adb.org/documents/handbooks/environment/default.asp