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Merging the Ecosystem Approach with the Conventional PSR/DPSIR Framework
(draft for discussion)

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The development of environmental statistics has been driven by the requirements of emerging environmental policies in industrialised countries, the conceptual model for reporting on the state of the environment (Pressure-State-Response) and the objective of adjusting the national accounts for measuring sustainable development.

Environmental policies have emerged from the Stockholm Conference of 1972 which was accompanied by the creation of environment ministries and agencies in industrial countries[1] and of the first statistical services. Environmental concerns of the time, which have motivated such decisions, were mostly related to the problems of industrial countries: air and water pollution, waste generation, environment and health, landscape amenities and nature conservation – the latter being addressed in terms of protection of endangered species and habitats. As long as the development of environment statistics was fostered in that period by OECD and UNECE, such concerns have shaped the area of environmental statistics. As long as 1/ environment and health assessments didn't result in clear detailed measurements and 2/ nature was addressed in a narrow way with concepts unfamiliar to most official statisticians, environmental statistics put their emphasis on environmental pressures. This choice was justified by the policy priorities of the time (to report on compliance data) as well as the sense of being able to present a realist picture where high levels of pressure are be associated to environmental impacts.

Although inherited from early comprehensive systemic approaches[2], the Pressure-State-Response reporting framework implemented by OECD in the early 1980s, and followed worldwide, turned rapidly to a linear, mechanical interpretation: P resulting in S (environmental degradation) resulting in turn in actions and policy measures (R). The Driver-Pressure-State-Impacts-Response system, a more detailed variant of PSR used by UNEP, the EEA and others, follows the same implicit rationale. The success of this storyline for reporting has influenced the way of framing environmental statistics, with a clear focus on pressure and responses.

Although present in the environmental debate since the early times, the interest for natural resources in the broad sense came to the forefront of the global scene in the Rio Conference of 1992 and the adoption of Agenda 21. This has boosted the development of economic-environmental accounting, following pioneer work in Norway, France, Spain, the Netherlands, the Philippines, or Indonesia. Because the work was lead by economists and official statisticians, the SEEA 1993 adopted a one-way approach of the extension and adjustment of national accounts and approached damage assessment and valuation from the economic pressure side.

Our understanding of the world has changed since that time, partly because the achievements of the period (recognition of environmental statistics, production of

[1] E.g. the USEPA has been created in 1970; the First Environment Action Plan of the European Community has been launched in 1973.

2 Rapport, David, and Friend, Anthony Towards a comprehensive framework for environmental statistics : a stress-response approach, = Projet d'etablissement d'un système general d'information sur l'environnement au Canada : l'approche agression-réaction, Statistics Canada = Statistique Canada, Ottawa : 1979

indicators and regular publication of state of environment reports) have highlighted what has still to be done and also because of some change in the environmental conditions lead to revisions. Such changes result from the relative success of environmental policies within industrial countries and from the market globalisation and its consequence in terms of our relation to nature, the global ecosystem (or the global village…).

Relative success of environmental policies in most sectors can be observed; the original targets have been met, and more ambitious ones considered. However, environmental issues are not yet relegated back to the past as climate change and biodiversity losses show it. This suggests that addressing pressures one by one is not enough: positive and negative synergies have to be considered. In information terms, it means that the first generation of indicators and statistics is not sufficient to measure policies' efficiency and progress. It is costly to assess all possible pressures; it is difficult to add them up to a general aggregate or composite index. It is therefore necessary to approach environmental degradation by the other way, i.e. by the direct observation of the state of the human and natural systems resulting as a consequence of these pressures.

Globalisation is another reason of reconsidering the balance between the P and S indicators. The first reason is that good performance in the Pressure box may result from the delocalisation of resource consuming and polluting industries from industrialised countries. A narrow vision of the economy's environmental performance can be very misleading. Because of the current scramble for natural resources, the flows of "nature" embedded into commodities trade needs to be recorded to keep track of the various "leakages" (biological, social, economic) resulting altogether from economic decisions and environmental policies when they are partial (see the debate on biofuels in Europe), and climate change. An important reason for doing so is that the people's dependency from the natural resource varies a lot in relation to income. Low income populations rely on S factors for their daily life, even though these benefits have a small market value. As the global market results in a global ecosystem (a global relation to the ecosystems), consumption patterns in a region impact basic ecosystem functions in another one.

All these arguments support the idea that statistics should address the anthropogenic pressures and their effects (impacts) in a balanced way. Indeed, the motivation of actions and policies is the environmental situation and its consequences; reducing pressures for meeting the objectives is a mean which is justified only by its consequences.

In their paper on "An EcoHealth-based framework for State of Environment Reporting" Rapport and Singh defend similar opinions. "*Transformation in human-dominated ecosystems results from cumulative impacts of human activity. A comprehensive system for State of Environment Reporting (SOER) must take into account indicators of stress on ecosystems, indicators of the state of the system (i.e., ecosystem structure and function), and indicators of social response (policy interventions). The Pressure–State–Response (PSR) model for State of Environment Reporting developed by Statistics Canada in the mid 1970s incorporated these elements. By adopting an ecosystem perspective, it represented a significant advance from the then prevailing engineering-based approaches, with their focus on contaminants in air, water and land. The PSR model,*

however, has its own inherent limitations: its focus on isolating ''pressures'', ''states'', and ''responses'' tends to provide a static representation of the environment, ignoring the significant dynamic processes that comprise the interactions between these components"

They add-up another argument of importance: "*The PSR model also lacks a 'bottom line' that would provide the policy community and the public with an overall assessment of environmental trends."*

These limitations can be overcome by adopting an ecosystem health approach, which allows for a determination of the overall viability of environments and for the identification of the collective pressures from human activity that threaten that viability. An ecosystem health approach also allows for a more explicit connection between the state of the environment and human well-being"[3].

DPSIR and Ecosystem Health ("ecohealth")

Can the PSR or DPSIR framework help in this endeavour of giving more visibility to S and I statistics? Can it help in defining cost efficient work plans for statistical offices and environment agencies facing well known budget scarcity problems? The answer is yes, as long as we are able to depart from the traditional linear, mechanical and circular use of the model. The linear presentation of DPSIR consists in stating the following:

D ➔ P ➔ S ➔ I ➔ R, then to describe more or less in detail the feedbacks from R to DPSI.

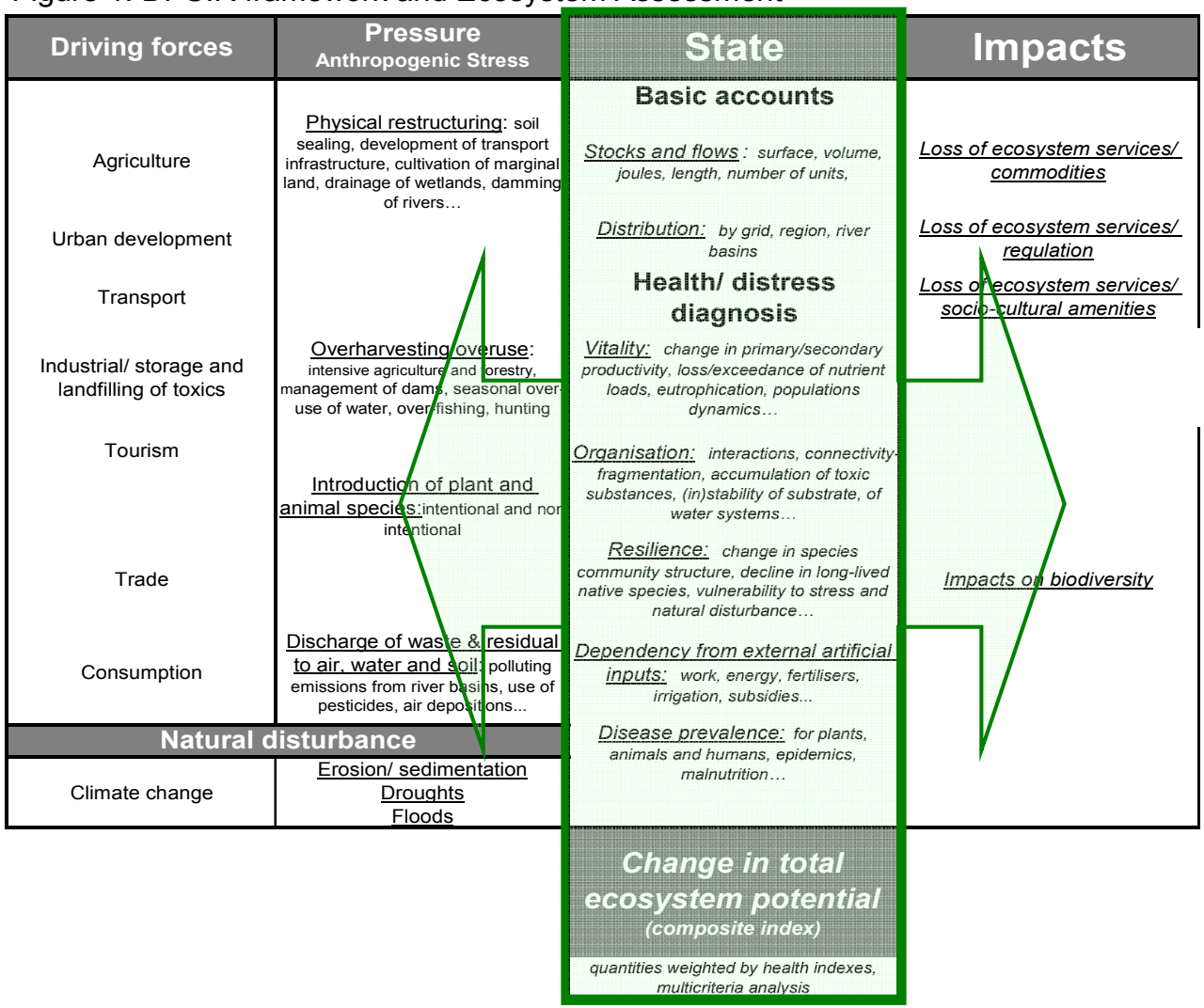
Our suggestion is to consider S as the central point. S is understood as the state of the ecosystem, taken in the broader sense of "socio-ecological system" or "socio-ecological production landscape"[4]. In statistical or accounting terms, S combines (integrates, merges….) "quantity" and "quality", two notions which are not separated in the real world – including in the prices that we give to things.

Revisited from the entry point of ecosystem state (quantity and quality) DPSIR looks like that:

3 David J. Rapport, Ashbindu Singh, An EcoHealth-based framework for State of Environment Reporting, Ecological Health, Elsevier, 2005

[4] The Japanese "Satoyama" concept.

Figure 1: DPSIR framework and Ecosystem Assessment



The DPSIR storyline is enunciated now starting from **S**, the ecosystem state.

S is described and measured in quantitative terms as surface, length, volume, mass or energy. It is described in qualitative terms from a multicriteria diagnosis based on indexes of vitality, organisation, resilience, dependency, disease prevalence[5]. The state of the ecosystem, its degradation or improvement will be expressed as a quantity weighted by a quality (health, sustainability…) coefficient[6].

Degradation (or improvement) of S may result in impacts (I) on the economy (e.g. loss of ecosystem services and possibly of resulting benefits), the society (health, quality of life issues…) and/or biodiversity. These impacts are the real motivation of the responses (R) by the public and private actors.

Responses can be to repair the degradation of ecosystem state (e.g. replanting tree) or to compensate the damages suffered (e.g. indemnities to victims), but the most efficient response is to reduce (eliminate, prevent…) the pressures responsible of the degradation of S.

Pressures are identified from the diagnosis of State distress. The investigation can be organised around broad types of pressures such as ecosystem restructuring (fragmentation…), overharvesting, forcefeeding and residuals, introduction of alien species. Note that natural disturbances need to be recorded separately. Pressures are in that way defined as the effect of the socio-economic Drivers.

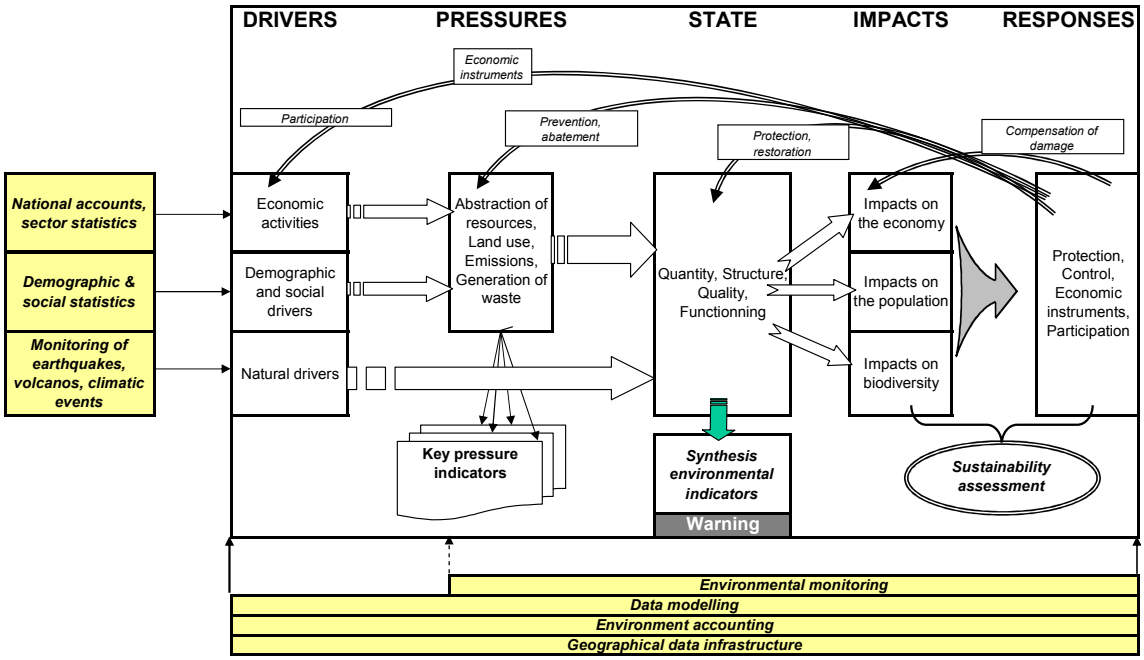
The advantages of this framework for environmental statistics are very important:

- systematic surveys limited to stated variables (e.g. compliance to conventions or regional regulations, national demands relating to impacts and their causes);
- analytical variables selected according to environmental issues;
- clear relation to environmental accounting;
- clear bottom line (maintenance of ecosystem capacity).

The statistical framework supporting DPSIR could accordingly be summarised as such:

[5] According to Rapport classical typology – see e.g. DJ Rapport in "Ecosystems." Encyclopedia of Public Health. Ed. Lester Breslow. Gale Cengage, 2002. eNotes.com. 2006. 16 Oct, 2010 <http://www.enotes.com/public-health-encyclopedia/ecosystems>

[6] An alternative solution consists in estimating the potential of ecosystems in terms of exergy[6] (the useful energy), reflecting in one single measurement the quantitative and qualitative aspects. In that case ecosystem degradation is measured by exergy losses – see Naredo J. M. and Valero A.


DRIVERS
PRESSURES
STATE
IMPACTS
RESPONSES
Economic instruments
Participation
Prevention, abatement
Protection, restoration
Compensation of damage
National accounts, sector statistics
Demographic & social statistics
Monitoring of earthquakes, volcanos, climatic events
Economic activities
Demographic and social drivers
Natural drivers
Abstraction of resources, Land use, Emissions, Generation of waste
Quantity, Structure, Quality, Functionning
Impacts on the economy
Impacts on the population
Impacts on biodiversity
Protection, Control, Economic instruments, Participation
Key pressure indicators
Synthesis environmental indicators
Warning
Sustainability assessment
Environmental monitoring
Data modelling
Environment accounting
Geographical data infrastructure