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Cosme, Nuno Miguel Dias; Olsen, Stig Irving

Publication date:
2014

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Quantitative Sustainability Assessment
Department of Management Engineering

Produktionstorvet 426
2800 Kgs. Lyngby, DENMARK
www.qsa.man.dtu.dk

The DPSIR approach applied to marine eutrophication in LCIA as a learning tool

Nuno Cosme (nmdc@dtu.dk), Stig I. Olsen

WEPC10

INTRODUCTION

- Human activities are driven by social and economic development
- Human systems put an important pressure on the environment making its state to change and impacts to arise.
- Indicators are used to assess the sustainability of such interventions.

Environmental indicators became an important tool in decision-making

Benefiting from conceptual frameworks based on the causality chain framework

The **Drivers-Pressure-State-Impact-Response** (**DPSIR**) is formally an adaptive environmental management approach that integrates the environmental and human systems into a common conceptual framework [1].

It deals with the **D**rivers that generate the **P**ressures to the environment, that modify its **S**tate, causing the **I**mpacts, and then helps to identify **R**esponses.

Life Cycle Impact Assessment (**LCIA**) indicators aim at modelling the **P**-**S**-**I** and provide a good background for understanding **D** and **R**.

DPSIR provides a good conceptual understanding that is well suited for sustainability teaching and communication purposes.

OBJECTIVE

Educational example of environmental assessment that supports the learning of complex **sustainability** issues, through:

- Science-based tools to quantify impacts (**LCIA**)
- Communicate knowledge (**DPSIR**)
- Support decisions (**DPSIR** and **LCIA**)
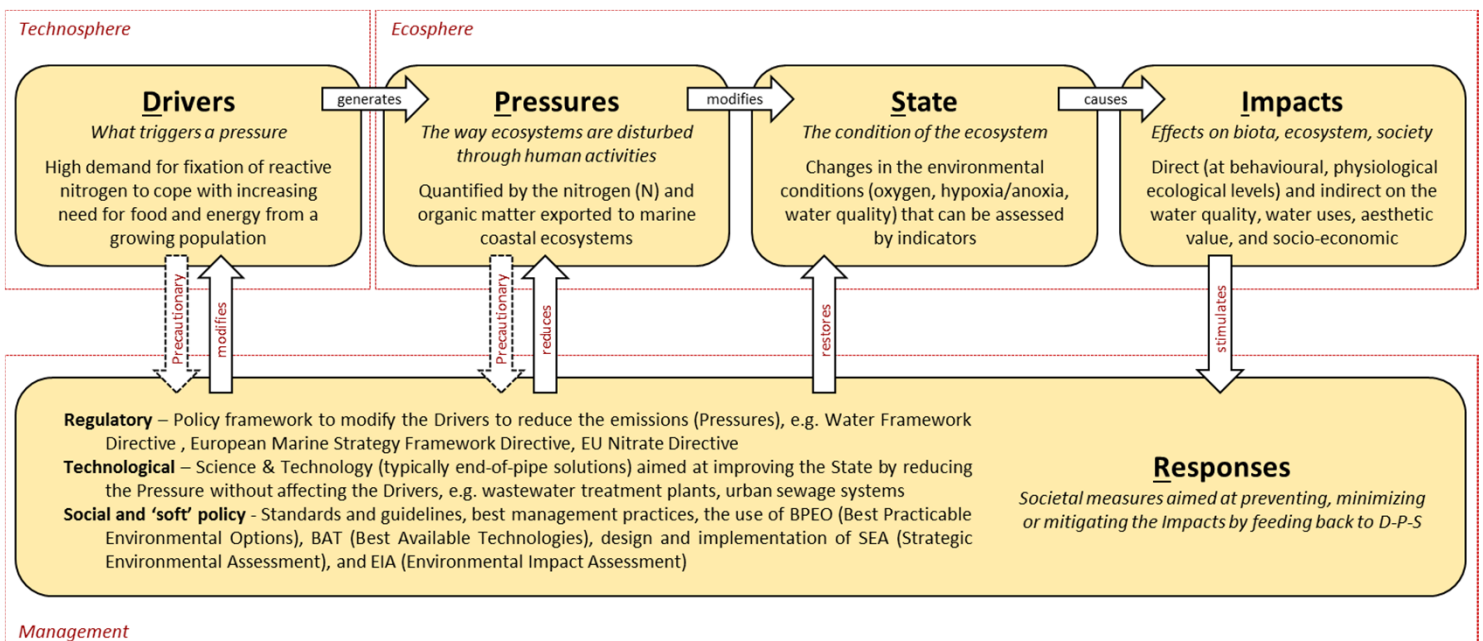
METHODOLOGY

Active learning stimulates deep learning and increases its outcomes [2].

Case-based learning -> students carry out their own case (active process)

A **good educational example** should enable students to:

- View the problem in a larger context
- Define their own problem
- Apply theory
- Solve problems
- Suggest solutions

*Cases within the DPSIR framework can include all of the above and is exemplified here by the impacts to **marine eutrophication**:*

Technosphere — Ecosphere

Drivers
What triggers a pressure
High demand for fixation of reactive nitrogen to cope with increasing need for food and energy from a growing population

generates

Pressures
The way ecosystems are disturbed through human activities
Quantified by the nitrogen (N) and organic matter exported to marine coastal ecosystems

modifies

State
The condition of the ecosystem
Changes in the environmental conditions (oxygen, hypoxia/anoxia, water quality) that can be assessed by indicators

causes

Impacts
Effects on biota, ecosystem, society
Direct (at behavioural, physiological ecological levels) and indirect on the water quality, water uses, aesthetic value, and socio-economic

Precautionary / modifies — Precautionary / reduces — restores — stimulates

Regulatory – Policy framework to modify the Drivers to reduce the emissions (Pressures), e.g. Water Framework Directive , European Marine Strategy Framework Directive, EU Nitrate Directive
Technological – Science & Technology (typically end-of-pipe solutions) aimed at improving the State by reducing the Pressure without affecting the Drivers, e.g. wastewater treatment plants, urban sewage systems
Social and 'soft' policy - Standards and guidelines, best management practices, the use of BPEO (Best Practicable Environmental Options), BAT (Best Available Technologies), design and implementation of SEA (Strategic Environmental Assessment), and EIA (Environmental Impact Assessment)

Responses
Societal measures aimed at preventing, minimizing or mitigating the Impacts by feeding back to D-P-S

Management

THE EDUCATIONAL INTEGRATION

- Develop a case study taking a specific point in the DPSIR framework, like **I**mpact based on incidences of eutrophication (e.g. severe oxygen depletion) or **P**ressure based on knowledge of an activity with a significant N-emission.
- Add a theoretical introduction to the **eutrophication model**.
- The student works with the case study as an assignment or a project and go through all the **DPSIR** steps.
- Wrap-up with presentation and discussion.

Works as an introduction to environmental sustainability and the student learns about the complexity of sustainability problems, causality and societal responses.

CONCLUSIONS

- **DPSIR** integrated into assessment of environmental impacts is effective in the definition of solutions to real problems [3].
- Introduces **knowledge supported on evidences of causality** and alternatives for management – relevant for **informed decisions**.
- The marine eutrophication indicator embedded in DPSIR seems a useful tool to **improve communication and learning** – it bridges science and management while providing an overview of the basic **elements of sustainability** in a **practical educational application**.

Other LCIA indicators can be adapted to fit different audiences.

References
[1] EEA (1999) Technical Report 25. European Environmental Agency. Copenhagen, Denmark.
[2] Biggs J, Tang C (2011) Teaching for quality learning at University. Open University Press. 480 pp.
[3] Tscherning K, Helming K, Krippner B, Sieber S, Gomez y Paloma S (2012). Land Use Policy 29:102-110

Presented at:
Basel 2014
SETAC Europe