DPSIR (Driver - Pressures – State - Impact - Response) & nested DPSIR

Driver & Pressure information can be found on the REFROM WIKI website - http://wiki.reformrivers.eu/index.php/Category:Pressures

The DPSIR framework is a holistic approach that identifies key relationships between society and the environment (Table 1, Figure 1). It supports managers in their decision making, especially to structure and communicate policy relevant restoration projects (Atkins et al. 2011). Drivers are the key demands by society such as agricultural and urban land use, flood protection, inland navigation and hydropower, all of which are discussed in *D5.3 Restoration practises climate and land use change*. These drivers are responsible for pressures that cause biological and abiotic state changes and further impacts within the river system (EEA 1999):

- *Abiotic state* – reflects the magnitude, frequency and concentration of the environment including;
  - *Physical variables* – climate variables (air and sea temperature, precipitation, storms & hurricanes, drought);
  - *Chemical variables* – contaminants, nutrients, pH, atmospheric CO2 levels, salinity. The abiotic environment determines the survival, growth, and distribution of living organisms in the Biological state;
- *Biological state* – includes the biological components of the ecosystem and their interactions;
- *Living habitat* – is generally defined by the ecosystem of interest.

Natural variability, invasive species and climate change are indirect pressures that can also cause changes in river state and combine with pressures from human activities to intensify impacts on the ecosystem. The DPSIR approach disentangles these knock-on effects and identifies mitigation response to the impacts on ecosystem services and ecosystem function through the application of river restoration to prevent or improve state changes in the environment.

DPSIR Methods:

1) Complete a DPSIR table listing all drivers present, the pressures they create, the resulting state changes, subsequent impacts and potential rehabilitation measures (Table 1). A detailed example can be found in REFORM *D5.3 Restoration practises climate and land use change – Appendix 1(hyperlink)*.

**It is important to note that both the DPSIR & nested DPSIR framework can be applied at a river basin level and at a reach scale.*

Table 1. DPSIR table to aid decision making in the planning stages for river restoration (description in text).

Driver	Pressure	State	Impact	Response
E.g. *Flood protection*	*Channelisation*	*Steep banks & simplification of the channel*	*Loss of lateral connectivity*	*Connect floodplain by disused gravel pits*

2) Create single cyclic DPSIR frameworks to understand the interactions, linkages and feedback loops for a given driver and pressures (Figure 1).

A feedback loop between human response (river restoration) and pressures identifies the need to review the chosen rehabilitation measure and its effect on ecological risk and uncertainty (*D5.4 Risk and uncertainty*).

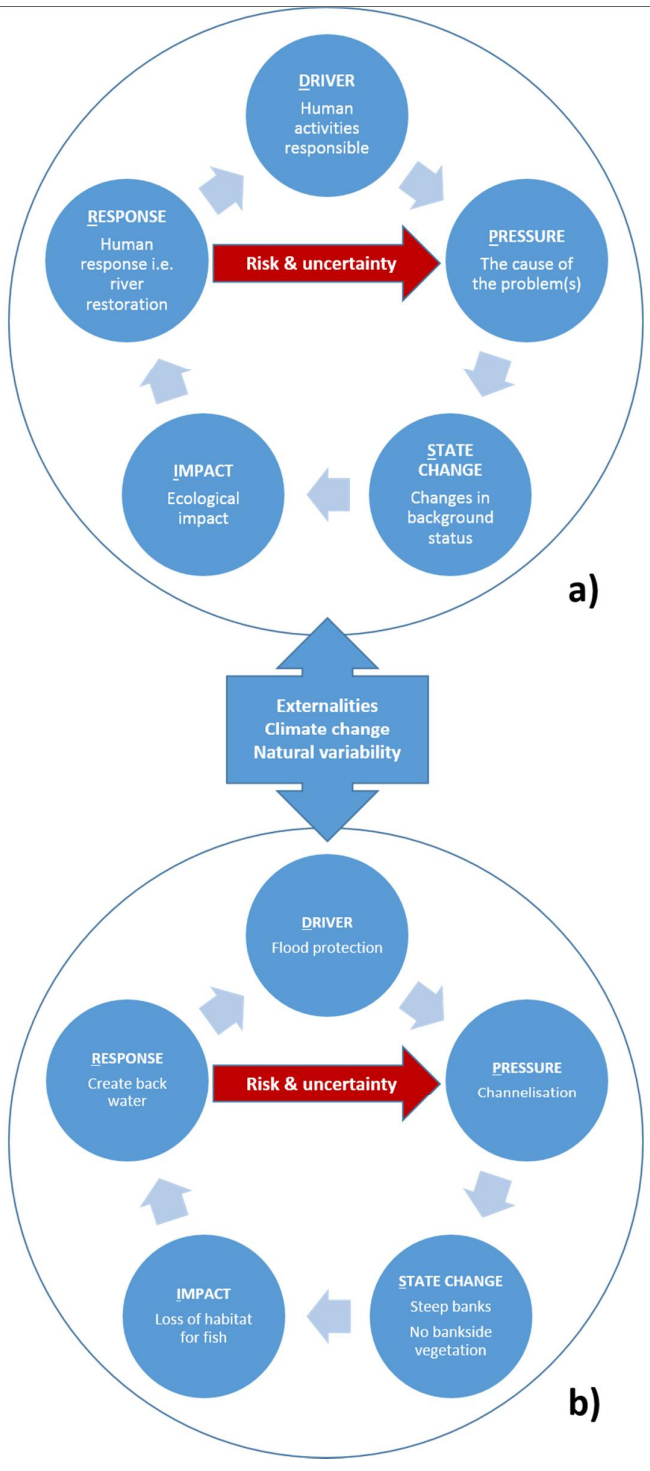

Figure 1. The DPSIR framework as a cyclic system in the environment (Diagram a - adapted from Atkins et al. 2011). Diagram b – example of DPSIR framework for a river.

3) Create DPSIR concept map

A DPSIR map of concepts (Figure 2) visually aids the decision maker to see complex interactions

between all stages in the DPSIR framework. It demonstrates how actions cannot be dealt with in isolation by identifying which activities interact with, or impact upon another activities.

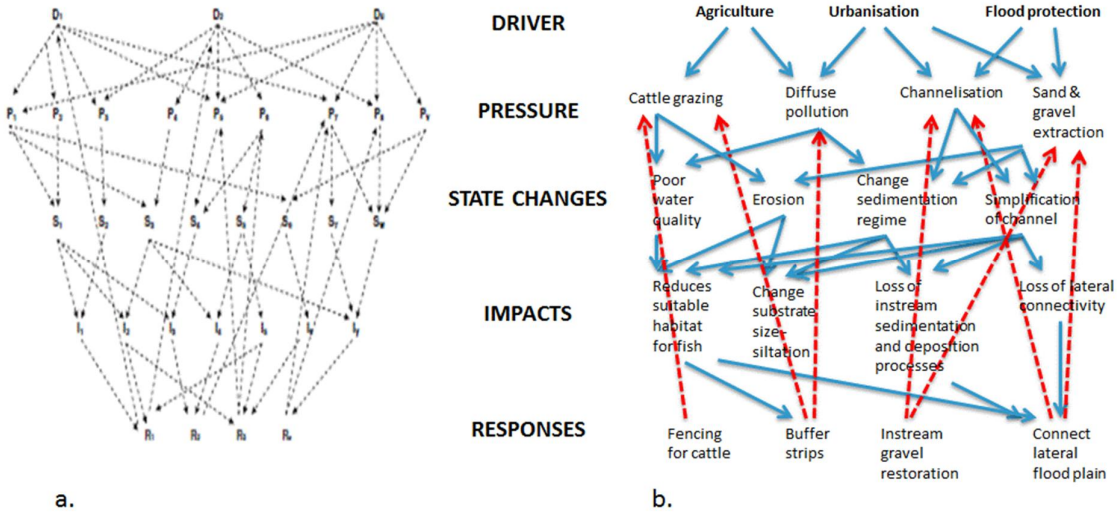

Figure 2. a) The multiple interactions, links and feedback loops within a nested DPSIR framework, b) An example of how it can be applied to rivers (adapted from Atkins et al. 2011).

The term 'concept' is the sequence of interactions within the DPSIR and can span single or multiple sectors/drivers. The generic DPSIR concept map is intended to serve as a starting point from which users may remove or add components relating to their system and chosen restoration. Components can be removed or added to create different concepts to see specific problems in the system and how they can be overcome with restoration with little impact on human uses and to hopefully produce multiple benefits. A DPSIR concept map has several uses within river restoration projects and the decisions process (adapted from US Environment Protection Agency):

- Characterising major pressures, interactions, and tradeoffs related to a decision
- Brainstorming or characterising alternative decision options
- Developing measurable endpoints
- Characterising where data, monitoring and research is needed
- Visualising obstacles and options
- Understanding interactions and needs for development of predictive mathematical models
- Concepts can be annotated with notes, documents, maps and other information
- Recording and documenting the decision process
- Enhancing communication with scientists, decision-makers, or the public

Software programs: Microsoft PowerPoint or Cmap tools (GenericDPSIR.cmap) can be used to generate flow charts showing linking concepts.

4) Nested DPSIR framework

The nested DPSIR framework (Figure 3) is a development of the original DPSIR and is an integrated approach that can assist decision makers when capturing key relationships between society and the environment. It nests many single DPSIR cycles for multiple Drivers (e.g. flood defence and agriculture) considering two factors (adapted from Atkins et al. 2011):

- One activity will impact on others, for example protecting cities from flooding by opening upstream flood plain areas will affect the agricultural sector, and
- the freshwater ecosystem is composed of many sectors each interacting and demanding a share of available resource.

The framework allows complex interactions between pressures, impacts and responses to be visualised for multiple drivers. Integrating these interactions allows users to explore relationships and identify measures that can produce win-win scenarios (Atkins et al. 2011).

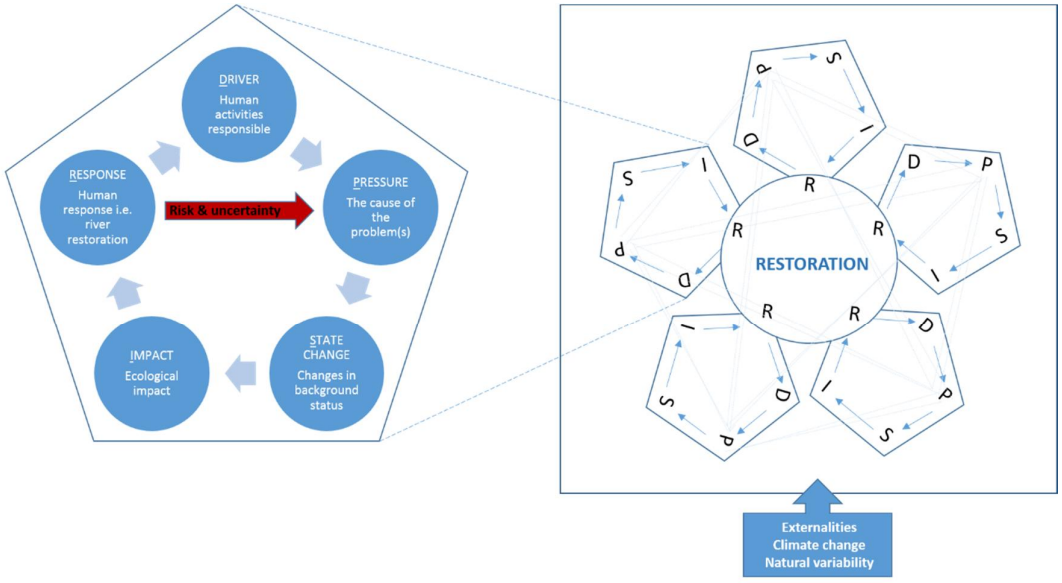

Figure 3. A nested-DPSIR framework for the management of freshwater restoration (adapted from Atkins et al. 2011).