Modelling of N and P cycles for inventory and characterisation of marine eutrophication in LCA

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**Background & Objectives**

Marine eutrophication processes include the excessive growth of phytoplankton biomass in response to increased availability of nutrients in the photic zone of marine coastal waters. The anthropogenic input of nitrogen (N) and phosphorous (P) to this compartment is mainly caused by the intensive use of fertilizers in agriculture. The correct estimation of its impacts involves the development of life cycle inventory (LCI) and impact assessment (LCIA) sound methodologies.

Considering that (i) nutrients applied in excess to agricultural soils are eventually exported to marine coastal waters, (ii) the eutrophication impacts depend on fate processes and on the sensitivity of receiving ecosystems, (iii) spatial differentiation is a key point for the discriminating power of the models and overall applicability, (iv) a suitable endpoint impact assessment methodology for marine eutrophication is still lacking in LCIA, and that (v) it has not yet been feasible to fully relate nutrient enrichment to its effects on the ecosystem, this project’s research goals were defined to estimate ecological endpoint characterisation factors capable of relating nutrients emission and the loss of species diversity, thus making it highly relevant to LCI/LCIA.

**Main activities**

- Identification, definition, and quantification of processes in the emission inventory framework – from nutrients application to emission to the environment;
- Definition of the export model framework and integration of third party models for atmospheric deposition, and soil, groundwater, and surface freshwater fate models;
- Development of the fate model in the marine compartment, exposure model (photic zone and bottom waters), and effect model (endpoints and impacts on biota);
- Estimation of spatially differentiated characterisation factors at a suitable resolution and validation of the model components.

**Expected outcome**

- The first deliverable to be expected from the research work is an emission model for the nutrients N and P that is able to estimate the emissions inventory of a product system – the LCI component modelling work;
- The second deliverable is a new characterisation method for marine eutrophication by N and P emissions, integrating fate, exposure, and effect at an adequate spatial resolution – the LCIA component modelling work.

**New value in relation to existing knowledge**

There is today no global endpoint model for the impact assessment of marine eutrophication. This research work proposes to develop a novel impact assessment method and an integrated approach from inventory to characterisation in LCA.

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