

Science for Environment Policy

Bridging the gap between life cycle assessments and planetary boundaries: a cross-EU chemical footprint

A methodology for assessing 'chemical footprints' has been developed by researchers to evaluate human pressures on the environment and the impact of chemicals released by the production and consumption of goods. The study integrates a life cycle approach with different methodologies, such as those developed in the context of environmental risk assessment and sustainability science, with the aim of assessing the extent to which chemicals impact on ecosystems beyond their ability to recover (i.e. surpass planetary boundaries).

Environmental 'footprints' can be used to assess human pressures on the environment and environmental sustainability. They enable a quantitative understanding of the use of natural resources by humans, and integrate several different modelling approaches under one methodology. Carbon and water footprints are widely used to assess human impacts; however, despite the widespread use of chemicals in many products and services, these methods do not normally include assessment of chemicals emissions and potential impacts.

In this study, researchers from the European Commission's Joint Research Centre¹ developed a conceptual framework for assessing chemical footprints, capitalising on knowledge in sustainable chemical management, namely, in the context of life cycle assessment (LCA) and ecological risk assessment.

The researchers anticipate that a comprehensive approach like LCA would prevent shifting the burden of responsibility for chemical emissions from one product life cycle stage to another; on the other hand, risk assessments and the underpinning precautionary principle are desirable inclusions since many chemicals' physical properties, as well as direct and indirect effects, are still barely known.

The researchers posit that these factors should sit in the context of a sustainability assessment approach, which takes account of the current situation and future scenarios in terms of 'planetary boundaries': earth's limits, which could not be surpassed without triggering abrupt environmental change on the planetary scale.

Based on these concepts, the chemical footprint is assessed via two steps. The first step, based on LCA, assesses the intensity of chemical pressure in terms of emission into the environment from all sources and the potential impact of these. This can be calculated using impacts within a single country (production-based), or the overall impact of a product, taking into account trade impacts (consumption-based), or a more comprehensive global understanding, including all the environmental impacts that occur abroad, but which are driven by a national or a European demand for imported goods.

To illustrate a consumption-based approach, the researchers present a case study at the macroscale — across the then EU-27, using domestic, import and export data — in which the first step is calculated for the year 2005 to assess the impacts on freshwater ecosystems.

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1. <http://ec.europa.eu/dgs/jrc/>

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Bridging the gap between life cycle assessments and planetary boundaries: a cross-EU chemical footprint (continued)

Their preliminary analysis, based on some representative products, revealed that impacts on freshwater ecosystems from domestic consumption in the EU-27 were mainly driven by pesticide and metal emissions. Further work is ongoing to refine the assessment, expanding the number of representative products and improving the impact assessment of chemicals.

Based on the first step, the second step links the chemicals released into the environment with the capacity of affected ecosystems to recover from the potential impact caused (the 'carrying capacity' of the ecosystem). The definition of what the planetary or 'safe' boundaries are for chemical pollution — and how the boundaries should be identified — is an ongoing scientific challenge. However, the researchers posit that 'Good Ecological Status' (GES) and the associated chemical and biological conditions to be achieved by EU rivers, as stipulated in the Water Framework Directive, could be seen as a preliminary policy-based definition of such boundaries — especially since GES was built to integrate as much evidence as possible.

The study highlights a number of issues that must be resolved to develop the chemical footprint concept further. These include identification of which chemicals to evaluate and from what source; identifying priority chemical compounds; as well as dealing with emerging contaminants.

There are a range of policy decisions that could be supported by an economy-wide chemical footprint calculation for Europe; it could be useful for evaluating the decoupling of economic growth from environmental impact, for example.

A suitable methodology to link step one with step two is critical, but yet to be identified. The conventional conversion (of a footprint measurement into a land area value or to a dilution volume in water) would be based on a variety of assumptions very distant from realistic impacts, say the researchers. They say it is essential to find a system that allows comparison between the chemical footprint value and the boundary limit values for chemical pollution.

The researchers finally suggest that establishing 'planetary limits' that support progress against measurable targets is a crucial step, as are further efforts in knowledge integration across scientific, technical and regulatory information across disciplines, to enable sustainable chemicals management. They say chemical footprints could be used as a policy tool supporting consistency of product policies and territorial policies, aimed at improving environmental quality at a macro scale.



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