IS EUROPE LIVING WITHIN THE LIMITS OF OUR PLANET?

An assessment of Europe's environmental footprints in relation to planetary boundaries

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Introduction

Human development patterns and economic activities have resulted in sustainability challenges of unprecedented scale and urgency, e.g. in terms of climate change and global biodiversity loss. This worrying development gives rise to the critical question of whether or not human-induced pressures now approach or exceed planet Earth's environmental limits. Are current pressures on the Earth system in terms of, for example, levels of greenhouse gas (GHG) emissions, ecosystem degradation or global resource use jeopardising the stability of the Earth system?

The planetary boundaries framework identified nine processes that regulate the stability and resilience of the Earth system — 'Earth life-support systems'. The framework proposes precautionary quantitative planetary boundaries within which humanity can continue to develop and thrive, referred to as a 'safe operating space'. It suggests that crossing these boundaries increases the risk of generating large-scale abrupt or irreversible environmental changes that could turn the Earth system into a state that is detrimental for human development. The most recent estimate suggests that four Earth system processes — climate change, biosphere integrity, land system change and biogeochemical cycles — are in a zone of increasing risk of triggering fundamental and undesirable Earth system changes.

The EU has responded to these challenges by committing to a range of long-term sustainability goals with the overall aim of 'living well, within the limits of our planet'. A similar objective is embedded in Switzerland's 2016-2019 sustainable development strategy. The European Commission for the period 2019-2024 raised ambitions further by setting out an agenda for a European Green Deal, stating that, 'Europe must lead the transition to a healthy planet'. Nonetheless, it is not clear what it means for Europe to live 'within the limits of our planet'. What is the environmentally safe operating space for Europe and how can whether Europe is living within it be determined in practice?

Objectives

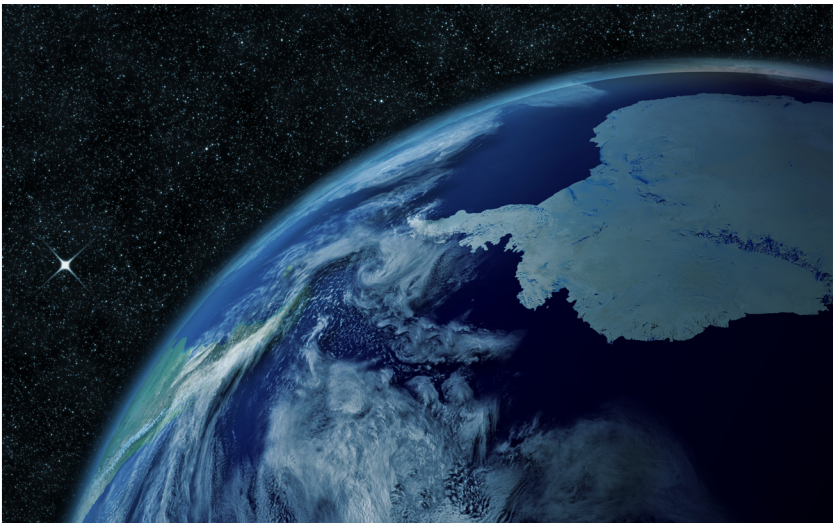
This study builds on past work by the European Environment Agency (EEA) on operationalising the planetary boundaries framework in Europe and the experiences of the Swiss Federal Office for the Environment (FOEN) in measuring its environmental footprints against planetary boundaries. Overall, this study aims to explore ways of defining an environmentally safe operating space for Europe and to test the approach on a number of selected planetary boundaries. This involves two specific steps that build upon each other:

1 The first step explores how to define European shares of the global safe operating space. Such a definition of shares inevitably involves normative choices. Most previous scientific studies have employed the equality principle only, which assumes the basic idea of equal rights for all humans on Earth. This study takes an important step forward by exploring multiple allocation principles to define shares depending on normative choices regarding aspects such as human needs, right to development, sovereignty and capability, independently of any specific planetary boundary. The resulting shares are subsequently used to calculate actual European limits for three selected planetary boundaries.

2 The second step is to evaluate the extent to which current European environmental footprints are compatible with the European limits as calculated for the three planetary boundaries in step 1. The study calculates European footprints based on a state-of-the-art multiregional input-output (MRIO) model and compares them with the calculated European limits to assess whether or not Europe is living within its environmentally safe operating space.

The analysis covers the combined territory of the 33 member countries of the EEA (the 28 EU Member States plus Iceland, Liechtenstein, Norway, Switzerland and Turkey). The study addresses three planetary boundaries in a European-scale analysis: phosphorus and nitrogen cycles (these biogeochemical flows are addressed as two separate Earth system processes in this study), land system change and freshwater use. In addition, a case study for Switzerland on biosphere integrity (genetic diversity) is included.

Defining European shares of the global safe operating space to determine a European safe operating space



Applying the globally defined planetary boundaries framework to Europe requires a definition of Europe's shares of the global safe operating space. Such scale matching of planetary boundaries inevitably involves normative choices regarding aspects of fairness, equity, international burden sharing and the right for economic development. The experience of the United Nations Framework Convention on Climate Change (UNFCCC) negotiations regarding climate change offers insights into different options for implementing the notions of equity and fairness. The report explores five different allocation principles (see the following table), with multiple calculations being used to derive values based on each principle, to effectively represent a range of different ways of implementing these normative choices.

The application of these five allocation principles, by performing a total of 27 different calculations, results in an overall median European share of 7.3 % of the global limit, independently of any specific planetary boundary. The allocation principle of 'right to development' results in the lowest median European share (4.1 %), while 'sovereignty' results in the highest (12.5 %).

ALLOCATION PRINCIPLE	DESCRIPTION	MEDIAN EUROPEAN SHARE
Equality (9)	People have equal rights to use resources, resulting in an equal share per capita. Equality can be envisaged between people living in a particular year or between people over time.	8.1 %
Needs (4)	People have different resources needs. This could be due to their age, the size of the household they live in or their location. As a result, their right to resources could be differentiated.	7.3 %
Right to development (3)	People have the right to have a decent life (e.g. rights for covering basic needs). In the long term, a convergence of welfare between people could be envisaged. People in countries with lower development levels could thus be allocated more resources to meet development objectives,	4.1 %
Sovereignty (5)	Apart from international treaties and regional arrangements (e.g. the European Union), countries are managed based on national policies and have a legal right to use their own territory as they decide. This implies that levels of economic throughput and environmental impacts (generated domestically and in foreign economies) are taken as starting points for allocating the global budget on national scales.	12.5 %
Capability (6)	Countries have different levels of economic wealth. Countries with higher financial capabilities could contribute proportionally more to the mitigation efforts or use less than their allocated share of resource since their ability to pay is higher.	6.2 %

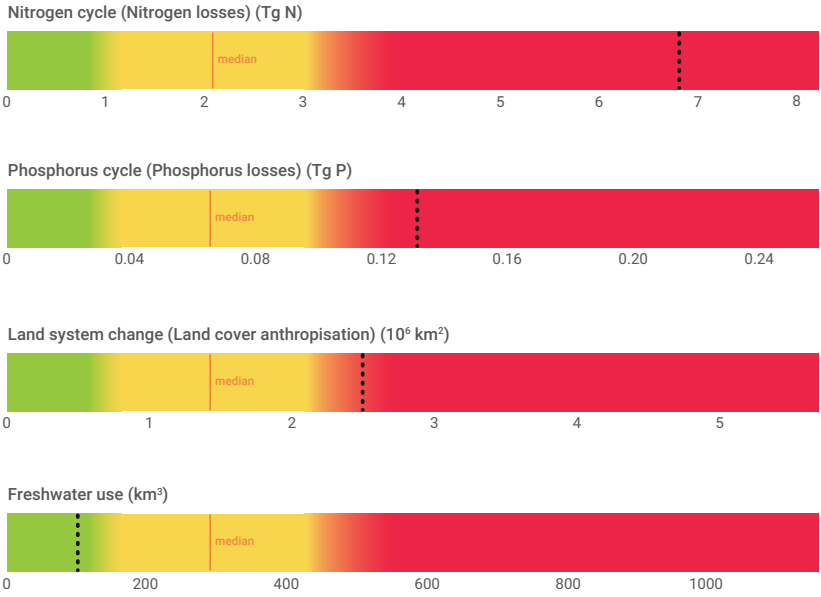
Note: Number of calculations in brackets.

European performance: are Europe's environmental footprints within European limits?

This study's calculation of European performance takes a consumption-based perspective (also referred to as environmental footprint perspective), which relates environmental pressures to final demand for goods and services. It takes into account today's globalised economy with trade flows between regions and countries and therefore also accounts for the environmental pressures caused around the world by European domestic consumption. The footprints have been calculated based on a state-of-the-art MRIO model — Exiobase (http://www.exiobase.eu) — which was developed through a Seventh Framework Programme (FP7) research project (Desire) funded by the European Commission.

A comparison of European footprints with European limits for the selected planetary boundaries shows that the European footprints exceed the European limits for three out of four Earth system processes, namely for the nitrogen cycle (expressed as nitrogen losses in this study) and the phosphorus cycle (expressed as phosphorus losses) — that is, for both biogeochemical flows considered — and for land system change (expressed as land cover anthropisation).

Any analysis of this type to assess whether Europe lives 'within the limits of our planet' is subject to some inherent methodological uncertainties, in particular in relation to estimating global limits, defining European shares and computing European footprints. Nevertheless, the results of this study are based on a consistent footprint methodology (through the use of Exiobase 3.4) and support the findings of two previous Europe-wide studies. Both studies concluded that Europe exceeds its limits for the nitrogen, phosphorus and land systems boundaries and did not overshoot the freshwater boundary. Thus, the results related to overall European performance presented in this study are considered fairly robust.



- Within estimated European share of global safe operating space
- Zone of uncertainty (increasing risk)
- Beyond estimated European share of global safe operating space (high risk)
- European footprint in 2011

Note: The yellow range of the figure represents the average range across the five allocation principles, with a median of 7.7%. This yellow range is defined as the "zone of uncertainty" to reflect the normative process of defining a European "safe operating space."

Source: Own calculations.

Specific key findings

Nitrogen cycle (biogeochemical flows)

the calculated European limit for nitrogen losses is exceeded for all allocation principles. Using the median value across all allocation principles, the European limit for nitrogen losses is exceeded by a factor of 3.3. In comparison, the global limit for nitrogen losses is exceeded by a factor of 1.7.

Phosphorus cycle (biogeochemical flows)

the calculated European limit for phosphorus losses is exceeded for all allocation principles except 'sovereignty'. Using the median value across all allocation principles, the European limit for phosphorus losses is exceeded by a factor of 2. In comparison, the global limit for phosphorus losses is also exceeded by a factor of 2.

Land system change

the calculated European limit for land cover anthropisation is exceeded for all allocation principles except 'sovereignty'. Using the median value across all allocation principles, the European limit for land cover anthropisation is exceeded by a factor of 1.8. In comparison, the global limit for land cover anthropisation is not exceeded.

Freshwater use:

the European limit for freshwater use is not exceeded for any allocation principle. Using the median value across all allocation principles, the European freshwater footprint is below the European limit by a factor of 3. In comparison, the global freshwater footprint is below the global limit by a factor of 3.3. However, this does not preclude the potential local overconsumption of freshwater at the basin level and issues with water scarcity in southern Europe.

Case study on biodiversity for Switzerland

An explorative assessment of Switzerland's biodiversity footprint against planetary boundaries is included. The footprint was calculated by considering the potential for global species loss due to land use. An equal share per capita approach was used to calculate the Swiss share of the biosphere integrity planetary boundary. The Swiss biodiversity footprint exceeds the resulting threshold value by a factor of 3.7. The indicators applied inevitably simplified the complex issue of biosphere integrity.

Implications for policy and knowledge developments

Substantial policy focus on different scales of governance has been dedicated to the challenge of climate change, and increasingly also to global biodiversity loss. These are also high priorities in political guidelines (European Green Deal) for the European Commission in the period 2019-2024. Climate change and biodiversity loss are crucial systemic issues in themselves, but they are also intimately linked to other Earth system processes. In the planetary boundaries framework, climate change and biosphere integrity are the two core boundaries given that they are highly important for the Earth system and their systemic interactions with other Earth system processes (e.g. land system change and biogeochemical cycles). Therefore, progress towards addressing the issues of climate change and biodiversity loss could be hampered by a lack of progress towards addressing the exceedances of other planetary boundaries such as biogeochemical cycles, land system change and freshwater use.

The findings of this study highlight that Europe should prioritise these additional key systemic challenges, in particular the nitrogen and phosphorus cycles and land system change. The findings of this study suggest that the European footprint should be reduced by about a factor of 3 for nitrogen losses and a factor of 2 for phosphorus losses. In addition, a reduction by almost a factor of 2 is needed for land cover anthropisation. Currently, the systemic challenges related to the nutrient cycle (nitrogen and phosphorus cycles) and land system change are not being sufficiently addressed by policy in an integrated and systemic way. The development and implementation of an Eighth Environment Action Programme (8th EAP) under the European Green Deal provides an opportunity to better operationalise the meaning of 'living well, within the limits of our planet' by capturing more comprehensively the systemic nature of the nutrient and land system challenges, their interlinkages and the need to address them in a holistic manner. It also provides an opportunity to address the environmental pressures that Europe exerts abroad.

It is increasingly acknowledged that profound transformations of the current systems of consumption and production will be needed to address the underlying drivers of unsustainability. These systems, such as food, energy and mobility, are ultimately the root causes of the exceedance of many planetary boundaries. The specific boundaries assessed in this study — the nitrogen cycle, the phosphorus cycle, land system change and freshwater use — are particularly driven by the food system.

Thus, a key leverage point is to transform the food system. Embracing a wider food system perspective — beyond thematic and sectoral policies — would be particularly beneficial, because diffuse nutrient pollution is also influenced by society's consumption patterns, such as in terms of food choices and food waste. There are already growing calls for the EU to develop a 'common food policy'. The European Green Deal envisages a 'farm to fork strategy' on sustainable food along the whole value chain, which provides exactly such an opportunity to build a comprehensive policy framework addressing these root causes.

this study supports the growing scientific evidence that the resource use related to current European production and consumption patterns puts Earth's life-support systems at risk and with it society and the foundation for economic development. From a technical point of view, the report provides some important advances in understanding how the concept of planetary boundaries can be operationalised in Europe and also sheds light on knowledge gaps. Examples of such advances are (1) a better understanding of global environmental limits (i.e. some boundaries lack limits and some control variables are only interim), (2) a better understanding of the interdependencies and feedback loops between globally and regionally determined boundaries, and (3) a better understanding of European environmental footprints and the spatial patterns of negative environmental impacts from European consumption in other parts of the world.

This leaflet is based on: EEA and FOEN (2020):

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