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Swiss environmental impact exceeds its share of planetary boundaries

In order to manage its environmental footprint, Switzerland should act on a number of key issues identified by the 'planetary boundaries' framework, says a Swiss study, with priority given to the areas of climate change, ocean acidification, biodiversity loss and nitrogen loss. This quantitative framework identifies nine bio-physical limits of the Earth system that, if exceeded, may lead to societal and ecological changes unfavourable to human development and stability. These are upper thresholds rather than targets. The researchers suggest that the concept and their methodology could be used together to think differently about environmental issues, and change the way related assessments and policies are implemented at both global and national levels.

Human activity is putting more pressure on the environment than ever before, and producing a slew of significant effects across the globe — but this cannot continue indefinitely. Proposed environmental boundaries within which humankind can develop safely, without negative consequences for our future, were recently identified via expert consultation to form planetary boundaries in nine key areas: climate change, ocean acidification, nitrogen/phosphorus loss, land-system change, ozone depletion, aerosol loading, freshwater use, biodiversity loss, and novel entities (those that cannot currently be quantified on a global scale, such as the accumulation of persistent chemical substances and synthetic pollutants in ecosystem pathways)[1]. However, it should be noted that, while useful, these boundaries are not exact and remain somewhat uncertain; their identification is subject to several limitations, approximations, and differences in expert judgement.

Based on these boundaries, the researchers developed a methodology to assess the long-term impact of human activity, such as consumption of goods and services by inhabitants, in a given country on its environmental sustainability on a global scale, and applied it to the case of Switzerland, which has a small (but growing), open, and service-oriented economy. Over half the environmental impacts induced by Swiss consumption occur abroad — and the country is highly dependent on other parts of the world for internally-consumed goods and resources. This is also true for most developed countries and much of the EU, and highlights the importance and complexity of characterising a country's environmental impact; while a country may appear 'green', as in the case of Switzerland, this may be because that country externalises its environmental footprint to other countries.

Following a literature review and consultation with experts, the researchers chose indicators for the six boundaries they deemed to have sufficient data to be assessable on a global scale (such as specific greenhouse gas emissions as an indicator for climate-change performance), and omitted 'regional' environmental issues/boundaries for which a global limit could not yet be identified (such as atmospheric aerosol loading, freshwater use and chemical pollution).

The study aimed:

- **to compute values for limits, footprints, and performances at national and international levels;** and
- **to suggest priorities for action.**

Two of the six computed footprints for Switzerland were categorised as 'safe' (land cover anthropisation and phosphorus loss), one as 'unsafe' (nitrogen loss), and three as 'clearly unsafe' (climate change, ocean acidification and biodiversity loss), showing both Swiss and global footprints exceeding set limits. Climate change and ocean acidification showed the largest excesses.

Continued on next page.

1. Stockholm Resilience Centre, Planetary Boundaries research: https://www.stockholmresilience.org/research/planetary-boundaries.html

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(continued)

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For climate change, relevant Swiss emissions — 109 megatonnes of carbon dioxide equivalent per year[2] ($MtCO_{2eq}$/year) — were calculated to be 22.7 times the Swiss limit (4.8 $MtCO_{2eq}$/year), and relevant global emissions (50.8 $GtCO_{2eq}$/year) were 4.1 times the global limit (12.3 $GtCO_{2eq}$/year). For ocean acidification, relevant Swiss emissions (82.8 $MtCO_2$/year)[3] were calculated to be 14.5 times the Swiss limit (5.7 $MtCO_{2eq}$/year), and global emissions (38.6 $GtCO_{2eq}$/year) five times the global limit (7.6 $GtCO_{2eq}$/year). Measures of biodiversity loss place the Swiss footprint (0.3 — a unitless measure of average biodiversity damage potential per land cover types[4]) at nearly twice the global and Swiss limit of 0.16, and determine the global footprint to be 0.2. Swiss nitrogen losses (108.6 tonnes[5]) amount to just over double the Swiss limit (53.8). In all cases, performance is either 'deteriorating' or 'rapidly deteriorating'.

These results are likely due to a mix of per-capita income and the carbon intensity of Switzerland's economic activities, say the researchers. The country has a high per-capita income (and thus high levels of individual consumption) and, while it has a low carbon intensity for its territorial production, the carbon intensity of Swiss consumption is closer to the global footprint, as over half of the carbon emissions driven by Swiss consumption occur outside of the country. Together, this mix of high consumption and average emissions places Switzerland at risk of overshooting its planetary boundaries, as shown in this study. In the case of indicators that change over time, such as climate change and ocean acidification, Switzerland's small (and shrinking) per-capita budget size also plays a role in these being deemed 'clearly unsafe'.

The researchers note that their calculations for climate change are based on the political limits defined by the Paris Agreement (COP21), and that while planetary boundaries may be modelled independently, they are all interlinked in reality. They also stress that this paper focuses only on globally significant environmental processes, and that some regional environmental issues may require action at a global policy level.

The study does, however, confirm the importance of mitigating climate change and biodiversity loss on both national and global scales, and flags other areas of priority. The researchers suggest that application of the methodology to all countries could help with understanding the role of specific countries with regard to these global priorities, and that specific assessments could be performed on environmental domains, economic sectors or even for a single company. They say that combining footprinting with the planetary boundary framework to bring national performance into a global context, as in this study, could be used to guide future policy and better identify environmental priorities on a worldwide scale.

2. Indicator defined as the cumulative greenhouse gas emissions needed for a 50% chance of staying below a 2 °C increase by 2100 compared with pre-industrial levels.

3. Indicator defined as the cumulative carbon dioxide emissions from human activities needed to maintain an acceptable calcium carbonate saturation state.

4. From Baan, L. de, *et al.* (2013). Land use impacts on biodiversity in LCA: a global approach. *International Journal of Life Cycle Assessment*. 18: 1216–1230. https://doi.org/10.1007/s11367-012-0412-0. See explanation in supplementary material at study link.

5. Indicator defined as the loss of reactive nitrogen into the environment. Considering losses into soil, water, and, to some extent, the air.