A national nitrogen target for Germany

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The anthropogenic nitrogen cycle is characterized by a high complexity. Different reactive nitrogen species (NH_3, NH_4, NO, NO_2, NO_3 and N_2O) are set free by a large variety of anthropogenic activities. At the same time the release of reactive nitrogen has negative impacts on the environment, such as loss of aquatic and terrestrial biodiversity, deterioration of groundwater and surface water quality, air pollution and the emission of greenhouse gases. To enhance public awareness and the sensitivity for policy action, we developed a new, impact-based integrated national target for nitrogen (INTN) and present its first calculation for Germany.

To calculate the INTN, the six most relevant impact indicators affected by excessive amounts of reactive nitrogen were chosen: Vegetation affected by NH_3-concentration, terrestrial ecosystems affected by eutrophication, surface water quality and groundwater quality affected by nitrate, nitrous oxide emissions affecting climate change and human health affected by NO_2-concentration. For each of these impact indicators critical target values exist for Germany. In most of the cases, these are concentration limits to protect air, water and living beings from excessive nitrogen pollution. We selected those target values reflecting the current legislative situation in Germany or, where no legal value was available, those reflecting the latest scientific knowledge. Our basic approach was to calculate for each impact indicator a maximum permitted nitrogen loss per year on the national level, such that related quality targets “state indicators”, are met in Germany at the spatial average. Where such values for maximum loss rates were available from current legislation, we adopt those directly as target values. Sectors, targets and maximum permitted nitrogen loss per year on the national level are shown in the table.

	Impact indicator	State indicator	Pressure indicator	Maximum annual pressure indicator (current nitrogen losses) (Gg a^{-1})
1	Vegetation affected by ambient NH_3-concentration	NH_3-Critical Level for higher plants: 3 µg m^{-3} NH_3	NH_3-emissions	441 (625) NH_3-N
2	Terrestrial ecosystems affected by eutrophication (deposition)	35 % reduction of exceedance of the Critical Load for eutrophication from 2005 – 2030	NH_3- and NO_x-emissions	402 (625) NH_3-N 168 (361) NO_x-N
3	Surface water quality (to prevent coastal water from eutrophication)	NO_3-concentration to protect North Sea (2.8 mg N l^{-1}) and Baltic Sea: (2.6 mg N l^{-1})	N_{total}-load	314 (356) N_{total}
4	Groundwater quality affected by nitrate concentration	NO_3-concentration in groundwater: 50 mg l^{-1}	NO_3-leaching	127 (148) NO_3-N
5	Nitrous oxide emissions affecting climate change	N_2O-emission: long-term goal reduction 80-95 %	N_2O-emissions	48 (83) N_2O-N
6	Human health affected by atmospheric NO_2-concentration	NO_2-concentration: WHO-effects level for the background: 20 µg m^{-3}	NO_x-emissions	236 (361) NO_x-N
National nitrogen target (sum of the lowest loss rates per nitrogen species 2 - 5)				**1,059 (1,574) N**

The selected methods allow us to derive a quantitative estimate of annual permitted nitrogen loss rates to the environment in Germany as an objective for political action that at the same time enhances the compliance with many of the media-related quality targets. Simultaneously it is as easily understandable and tangible for the addressed public and policy such as the planetary boundary concept 1.5°C target of the climate community.

Acknowledging the uncertainties and the scope of our approach and enhancing expressiveness of our concept likewise we propose to use 1,000 Gg N a^{-1} as a national nitrogen target when it is used in the political communication (instead of the calculated 1,059 Gg N a^{-1}). Compared to the current situation nitrogen emissions in Germany would have to be reduced by about one third, i.e. by about 500 Gg N a^{-1}.

Für Mensch & Umwelt

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The report by Heldstab et al. is in print and will be published on www.uba.de/en.

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