Cost-benefit analysis of reactive nitrogen for Germany

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Abstract

Besides of direct benefits from applying nitrogen fertilizer, such as enhanced crop yields, excessive release of reactive nitrogen to the environment by human activities is associated with numerous impacts on ecosystems, climate and human health. Our cost-benefit analysis for Germany allows to quantify these effects, thereby providing a transparent and comprehensive assessment of positive and negative externalities related to the intentional and unintentional release of nitrogen. Despite of large uncertainties inherent to these estimates, our findings show that the benefits of reducing nitrogen pollution outweigh related costs and they highlight the need for an integrated mitigation strategy.

Keywords: cost-benefit-analysis, reactive nitrogen, mitigation measures

1. Introduction

The use of reactive nitrogen in agricultural production is associated with a direct benefit in the form of an increased crop yield, but it is also accompanied by a number of indirect impacts, such as biodiversity loss, damage on human health and global warming. The unintentional release of nitrogen from combustion of fossil fuels also contributes to these indirect impacts.

A transparent analysis of both direct and indirect costs and benefits has never been carried out for Germany and is a prerequisite for a comprehensive assessment of net welfare impacts caused by the release of nitrogen to the environment.

2. Method

We quantify costs and benefits related to nitrogen input to the environment for Germany across all sectors for 2015 and 2030 based on a method proposed by van Grinsven et al. (2013). We consider two scenarios, one reflecting a situation accounting for the autonomous evolution and the impact of existing mitigation action and one accounting for additional measures. For the latter, we also quantify effectiveness and related mitigation and implementation costs.

Given the uncertainty in environmental cost rates and in the magnitude of underlying nitrogen fluxes, we quantify both costs and benefits as ranges by applying minimum and maximum values.

3. Results

Our approach allows a comprehensive comparison of direct and indirect impacts associated with release of nitrogen. The economic benefit of primary agricultural production attributed to application of reactive nitrogen is lower than the sum of direct costs of fertilizer application and social cost due to environmental degradation, both in 2015 and in 2030.

The scenario 2030 with enhanced mitigation action shows that implementation of mitigation measures results in a net benefit (Fig. 1).

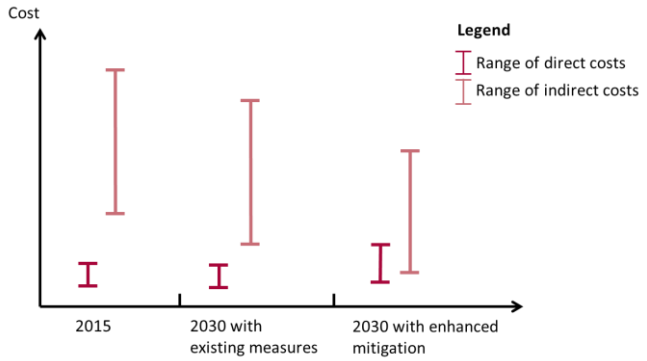

Fig. 1: Schematic representation of cost components

Mitigation and implementation costs cause an increase in direct costs, but the reduction of negative externalities reduces indirect costs thus leading to an overall reduction of costs. These findings can provide guidance in the political decision-making processes and thereby support the development of an integrated mitigation strategy.

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References

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