The nitrogen footprint of Denmark – Applying Danish virtual nitrogen factors to estimate losses from food production

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Abstract

In the past century, human activity has reshaped the global nitrogen (N) cycle, so that the anthropogenic changes to the N cycle have already crossed the safe operating space for the stability of earth system processes. This paper presents the preliminary results of the first approach to the Danish N footprint model. In this paper, the preliminary results of applying different virtual nitrogen factors to the Danish N-footprint will be presented.

Keywords: Virtual N losses, Country specific nitrogen footprints

1. Introduction

In Denmark, where approximately 61% of the land area is cultivated for agriculture, the impact of Nitrogen (N) loads to soils and waterways is of great interest and concern (Dalgaard et al., 2014).

The N- footprint tool (the N-Calculator) allows individual consumers in different countries to estimate their contribution of N losses to the environment through consumption of N in food, energy usage, and the purchase of goods and use of services (Leach et al. 2012). The tool has been developed for USA and Netherlands (Leach et al. 2012), UK and Germany (Stevens et al. 2014), Japan (Shibata et al. 2014), Austria (Pierer et al. 2013), Australia (Liang et al., 2016) and Tanzania (Hutton et al., 2017), and is in the developing phase for Denmark, Portugal, Brazil and Ukraine. In this paper we present the first, preliminary Danish N-footprint based on Danish Virtual Nitrogen Factors (VNF).

2. Methods

The primary N-releasing activities accounted for in the N-Calculator are food (both consumption and production) and energy consumption. The food N footprint is calculated based on food intake and the amount of N lost during the production of that food, presented as VNFs. VNFs includes losses such as fertilizer not incorporated into the plant, crop residues, feed not incorporated into the animal products, processing waste, and household food waste (Leach et al. 2012). The main objective of this paper is to present the first result of a Danish food N-Footprint and to investigate if using Danish equivalents reduces the food N-Footprint.

3. Results and discussion

3.1 Food N-Footprint Denmark

Denmark's food N-Footprint for 2018 is 19,49 kg N released to the environment per capita utilizing the top-down equation

method in Leach et al., (2012). Comparing Denmark's food N-Footprint to the United States, with a 30 kg per capita food N-Footprint and the Netherlands with a 25 kg food N-Footprint, Denmark has a significantly lower food N-Footprint compared to the USA and the Netherlands (Leach et al., 2012). The results from utilizing the N-Institution VNF has a total N released to the environment of 1821 kg, the Sustainable VNF releases 1385 kg N to the environment and the Danish VNF releases 928 kg N to the environment as illustrated in Table 1.

Table 1: Summary of the total food N-Footprints.

	FAO Data Base		
N-Footprint Category	N-Institution VNF	Sustainable VNF	Danish VNF
Total N-Footprint per year	2631,68	2043,90	1364,57
Total N-Footprint / Person	19,49	15,14	10,11
	Canteen Purchase Orders		
Total N-Footprint per year	1065,56	810,11	532,81
Total N-Footprint / Person	7,89	6,00	3,95
	N-Institution		
Total N-Footprint per year	1821,15	1385,24	927,90
Total N-Footprint / Person	13,49	10,26	6,87

This implies that the current food production N-Footprint can be reduced by 23% if the Sustainable VNF is used, or up to a 49% reduction if the Danish VNF is used.

4. Conclusions

The reduction in the food production N-Footprint in comparison to the N-Institution VNF and the Danish VNF is a 49% reduction in N released to the environment. In comparison to the Sustainable VNF, the Danish VNF reduced N by 33%. Thus, a Danish VNF based on Danish parameters decreased the food production N-Footprint considerably. This illustrates the importance of using more detail data inputs and local production parameters. Thus, improving data collection and using parameters for Denmark will decrease the N-Footprint in comparison to the N-Footprint calculated in this thesis.

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