Nitrogen footprint calculator for Germany

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Nitrogen Footprint Calculator

Tools to calculate personal footprints can help assess and communicate the impact of lifestyle and consumption choices to individuals. In comparison to carbon footprints however, nitrogen footprints are less well-known to the public. A Nitrogen footprint Calculator has previously existed for Germany based on the work of Leach et al. (2012). With the help of this online tool, the user could estimate their consumption for different categories and see how that relates to nitrogen losses. However while the sectors housing, transportation and goods and services were adapted to German conditions, the food sector was broadly based on US values.

Since the food sector is the biggest driver of nitrogen losses and production conditions differ significantly between countries, this work was needed to bridge that research gap and provide more accurate results for Germany.

Results

N losses vary considerably between products. The N footprint of plant-based products on average amounted to 3,4 g N loss per kg product. In-contrast, N footprints for animal-based products were calculated to be around 12 times higher at 40,5 g N per kg product. The overall N footprint for the German consumer was calculated to be at 9,94 kg N per capita and year. This corresponds to a national N footprint of about 825,000 t N per year for the population of Germany, of which 84% relate to the consumption of animal-based products.
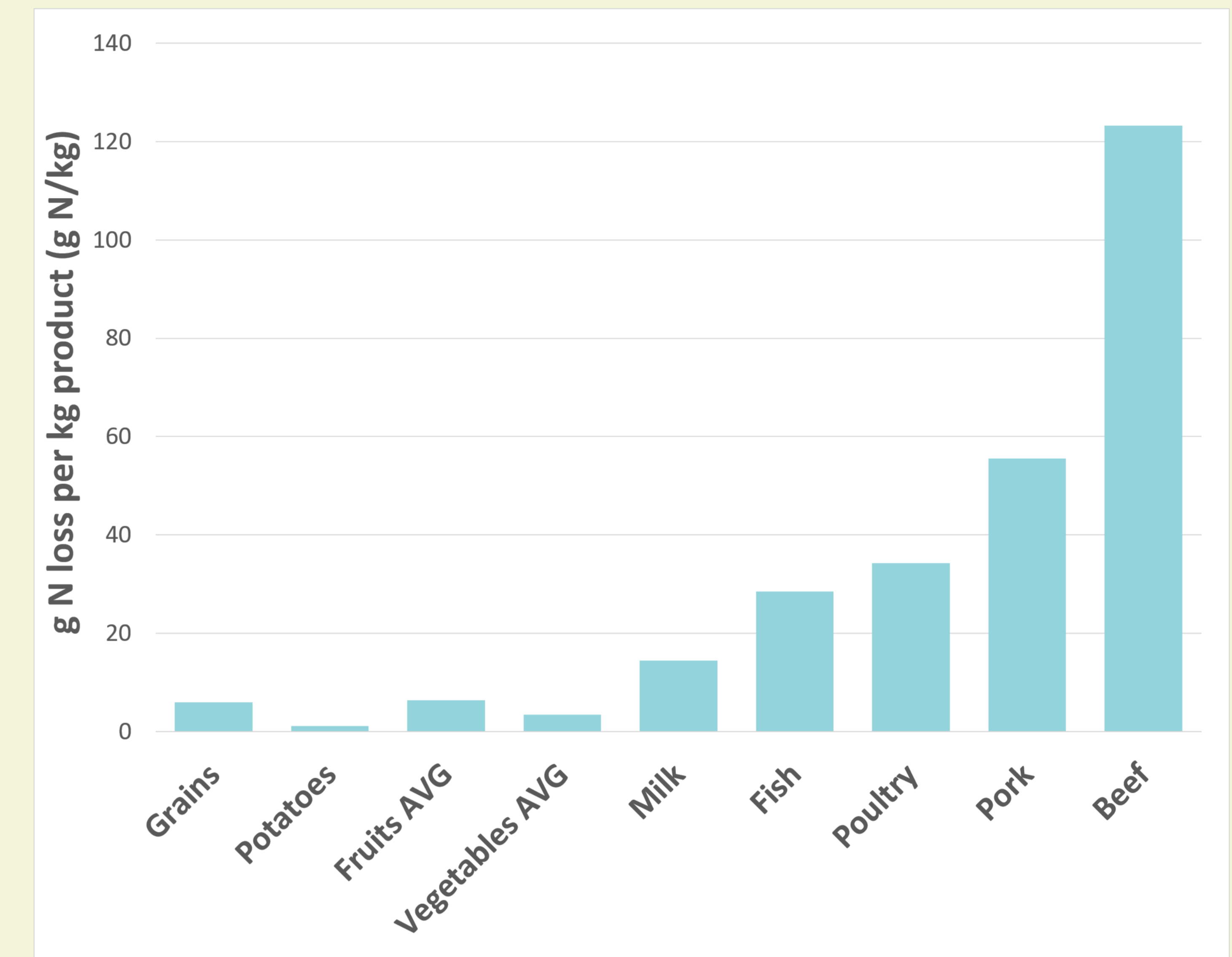

Fig. 1: Comparison of the N footprint [g N per kg product] for different food categories for Germany

Methods

Losses were calculated for 20 plant-based products, 17 feed materials, 18 compound feeds and 14 animal-based products.
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For every category, all nitrogen inputs that were added during production (e.g. with fertilization, biological fixation or feed intake) were summed. From this, the contained N in main products (e.g. flour, milk, beef) as well as by-products (e.g. bran, calves born during dairy production, slaughter waste) were deducted to calculate the N losses (e.g. non-recyclable waste, spillage and spoilage).

National N budgets

Results were scaled up to the national German agricultural sector by multiplying the N losses with national statistical data for production amounts. These values were compared to the agricultural budget reporting, mainly Häußermann et al. 2019. While the N footprint results were 12% higher for plant-based products, both approaches were in agreement for animal-based products with a deviation of only 2%.

Possible Future Improvements

Estimation of consumption patterns and portion sizes can be difficult. In order to make this more approachable for the user, the inclusion of more food categories and processed food like pizza and burgers could improve user estimates. Since consumption averages differ by gender for the different categories, it would also be helpful to provide the user more detailed average consumption data based on gender to be used as guidance.

References
Leach et al. (2012). *A nitrogen footprint model to help consumers understand their role in nitrogen losses to the environment*. Environmental Development 1(1) 40-66.
Häußermann et al (2019) *Stickstoff-Flächenbilanzen für Deutschland mit Regionalgliederung Bundesländer und Kreise – Jahre 1995 bis 2016. Methodik, Ergebnisse und Minderungsmaßnahmen*. UBA-Texte 131/2019.
Klement et al. (2021) *Calculation of a food consumption nitrogen footprint for Germany* [Manuscript submitted for publication], University of Gießen.