A simple and easy-to-communicate framework for analyzing Nitrogen Use Efficiency (NUE) in agriculture and food systems

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Abstract

We developed an easy-to-use framework for nitrogen use efficiency (NUE), applicable to agriculture and food production–consumption systems. We give examples of application, identify potential pitfalls and provide some perspectives on future best management practices for high NUE throughout the food chain.

1. Introduction

The main resources for global food production (land, soil, water, biodiversity, nutrients) are scarce or even finite. Moreover wasting resources is harmful to society and the environment. The pressure on our natural resources is large, and expected to increase further due to anticipated population growth, increased wealth and changes in food consumption patterns.

Therefore we need to find measures to increase resource use efficiency of nutrients in relation to food production, in particular nitrogen (N), which is a main nutrient element and essential for life. It is needed in relatively large quantities for the sufficient production of food, but excess N application results in pollution, a threat to our health and the environment.

The EU N Expert Panel (www.eunep.com, 2014-) has an ambition to contribute significantly to improving overall N use efficiency in food systems, by developing strong analysis and communication tools.

We have developed a simple and easy-to-use framework for 'nitrogen use efficiency' (NUE), applicable to agriculture and food production–consumption systems. It is based on the mass balance principle, and we have deloped a graphical tool to interpret and communicate the results (EUNEP, 2015).

We will present the concept, some examples of application and identify potential pitfall's. Finally, we provide some perspectives on future best N management practices for high NUE throughout the food chain.

2. The NUE framework

For estimating NUE and communicating the results, data are required about (i) the nature of the system (e.g. farm, crop system, livestock system, food processing) and its boundaries, (ii) the total sum of N inputs into a system and the N output in harvested products, (iii) the time span of the analyses, and (iv) possible changes in the stock of N in the system (e.g. in soil, feed or manure stores).

Nitrogen use efficiency is then simply calculated as $NUE = N_{outputs}/N_{inputs}$ and correspondingly N productivity as $N_{prod} = N_{outputs}$ and N surplus as $N_{surplus} = N_{outputs}\text{-}N_{inputs}$.

A simple two-dimensional input–output diagram allows the presentation of NUE, N output and N surplus in a coherent manner, together with possible reference values (Figure 1). This allows to identify an operating space, where NUE, productivity and environmental impacts are all within a desirable range.

Further info in (EUNEP, 2015; 2016; in prep.) and Quemada et al. (2020).

References

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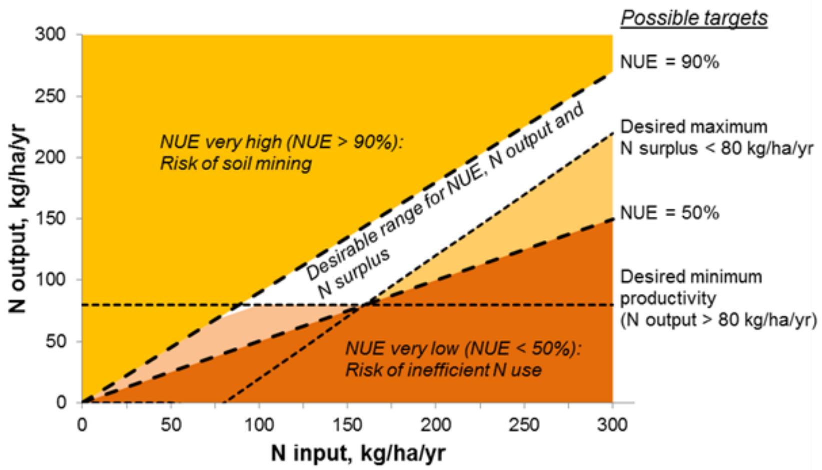

Fig. 1: Framework of the NUE indicator. ***NOTE:*** *Numbers shown are illustrative; will depend on context (farming system, soil, climate, crop).*