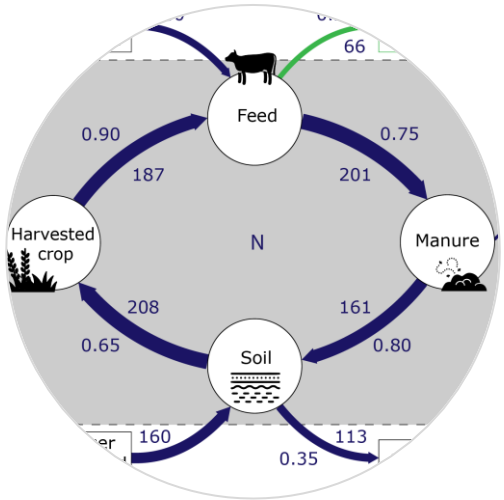
BENCHMARKING NUTRIENT CIRCULARITY AT DIFFERENT SCALES: USING A FOOD SYSTEMS PERSPECTIVE

Friday 15 September 2023

Marloes van Loon, Wytse Vonk, Renske Hijbeek, Jouke Oenema, Wim van Dijk, Sjaak Conijn, Marc Spiller, Enrico Roets, Anastasia Papangelou, Martin van Ittersum



WAGENINGEN UNIVERSITY & RESEARCH

University of Antwerp

Introduction

- Efficient production is key for sustainable agri-food systems in a increasingly populated world
- Increased circularity proposed as primary solution in Europe
- Robust circularity indicators are needed to monitor progress and benchmark management practices of agro-food systems

Objectives

- Develop circularity indicators
- Benchmark Dutch dairy farms to assess cycling potential and assess implications interventions

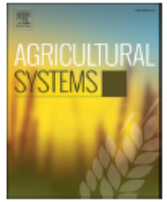
The basis

Agricultural Systems 207 (2023) 103610

Contents lists available at ScienceDirect

Agricultural Systems

journal homepage: www.elsevier.com/locate/agsy

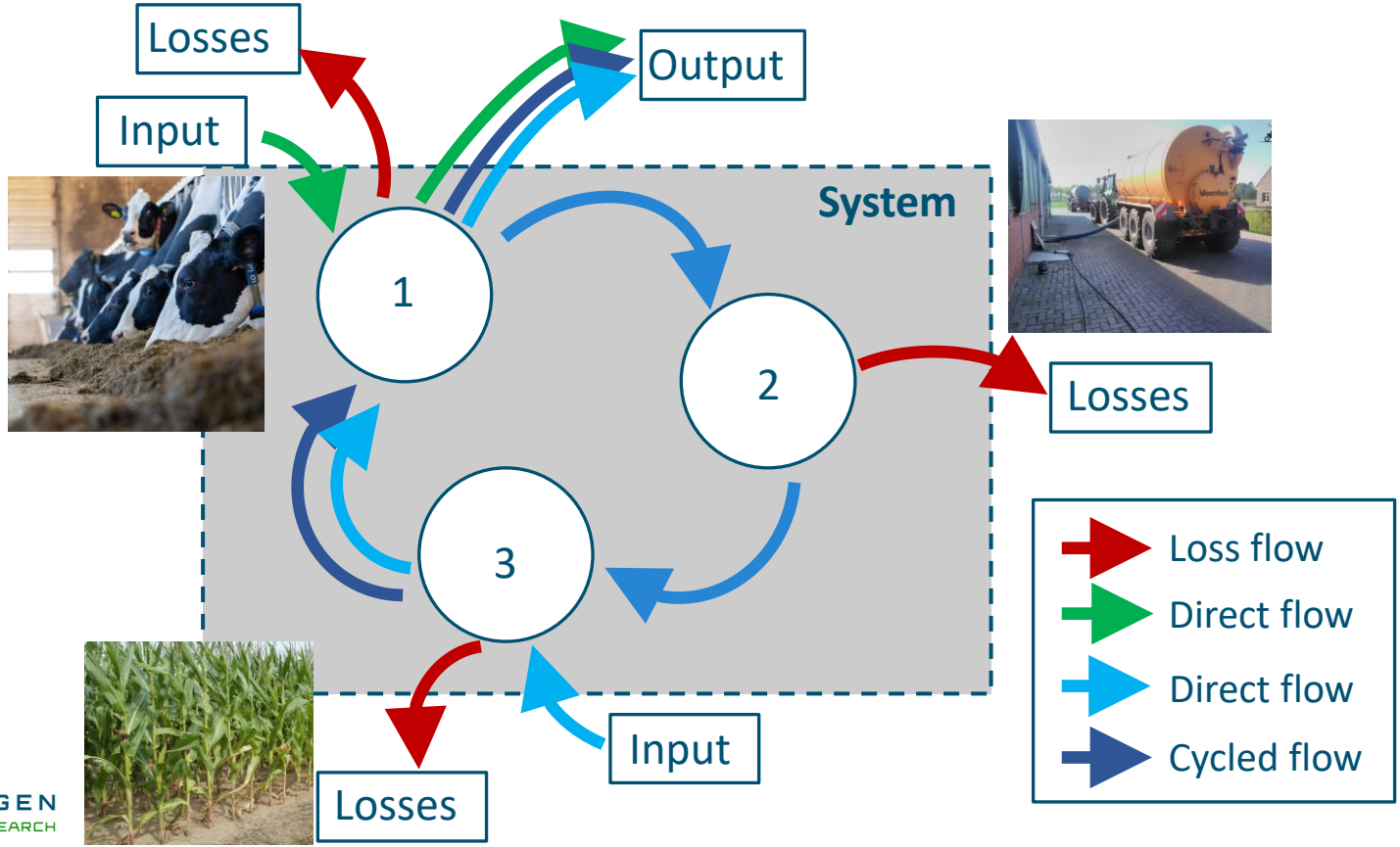


Circularity indicators and their relation with nutrient use efficiency in agriculture and food systems

Marloes P. van Loon [a,*], Wytse J. Vonk [a], Renske Hijbeek [a], Martin K. van Ittersum [a], Hein F.M. ten Berge [b]

[a] Plant Production Systems Group, Wageningen University & Research, Wageningen, the Netherlands
[b] Wageningen Plant Research, Wageningen University & Research, Wageningen, the Netherlands

Example circular production system



WAGENINGEN
UNIVERSITY & RESEARCH

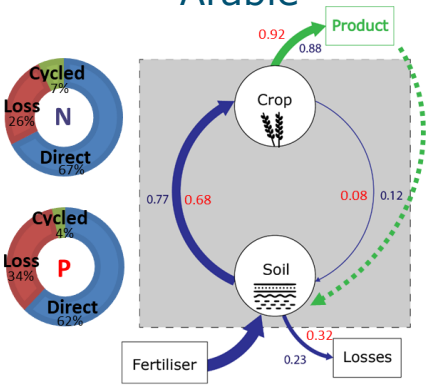
The indicators

- *O*/*I*: product Output / system Input
- Cycle count (*CyCt):* How many times will a single cohort of input, pass through a full cycle before being dissipated
- Use count (*UseCt*): How many times a unit of fresh nutrient input passes, on average, through the ‘use compartment’

Step 1: Test studies

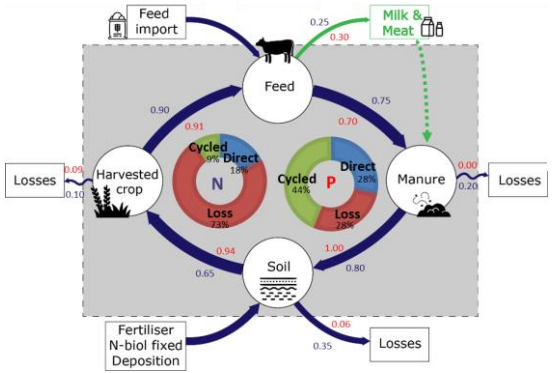
- Van Loon et al. (2023)

Arable



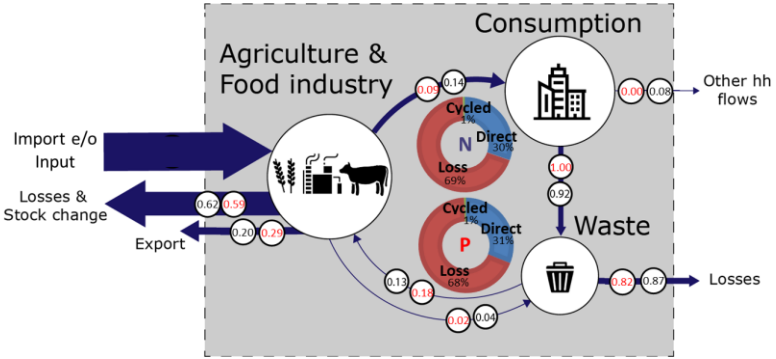
Broadbalk, UK: winter wheat. Data source: Rothamsted Research, 2022

Dairy



De Marke experimental dairy farm Hengelo, the Netherlands. Data source: Oenema (2013) and Aarts (2000)

Agro-food

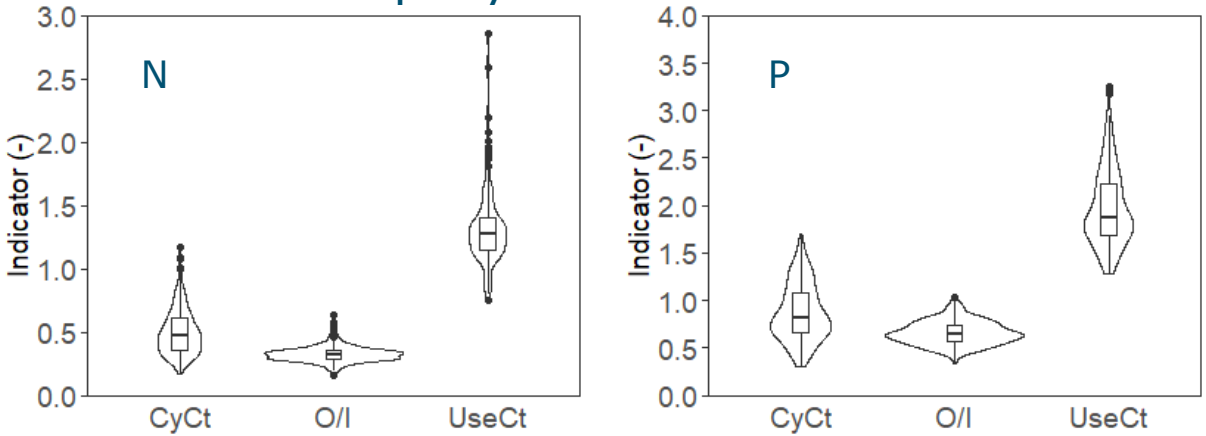


Flanders, Belgium. Data source: Papangelou & Mathijs, 2021

WAGENINGEN
UNIVERSITY & RESEARCH

Step 2: Nutrient cycling Dutch dairy farms

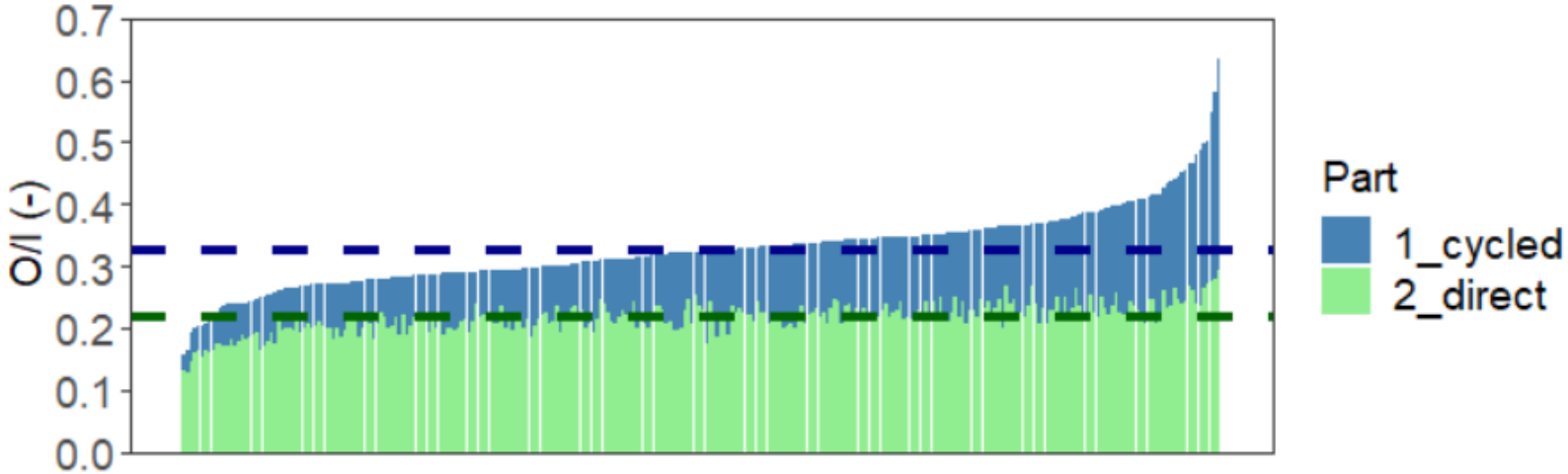
- 27 (front-runner) farms across the Netherlands
- Years 2006 – 2022, some farms have 2 years of data up to 17 years
- In total 284 unique year and farm combinations



WAGENINGEN
UNIVERSITY & RESEARCH

Dutch dairy farms: Nitrogen Output/Input

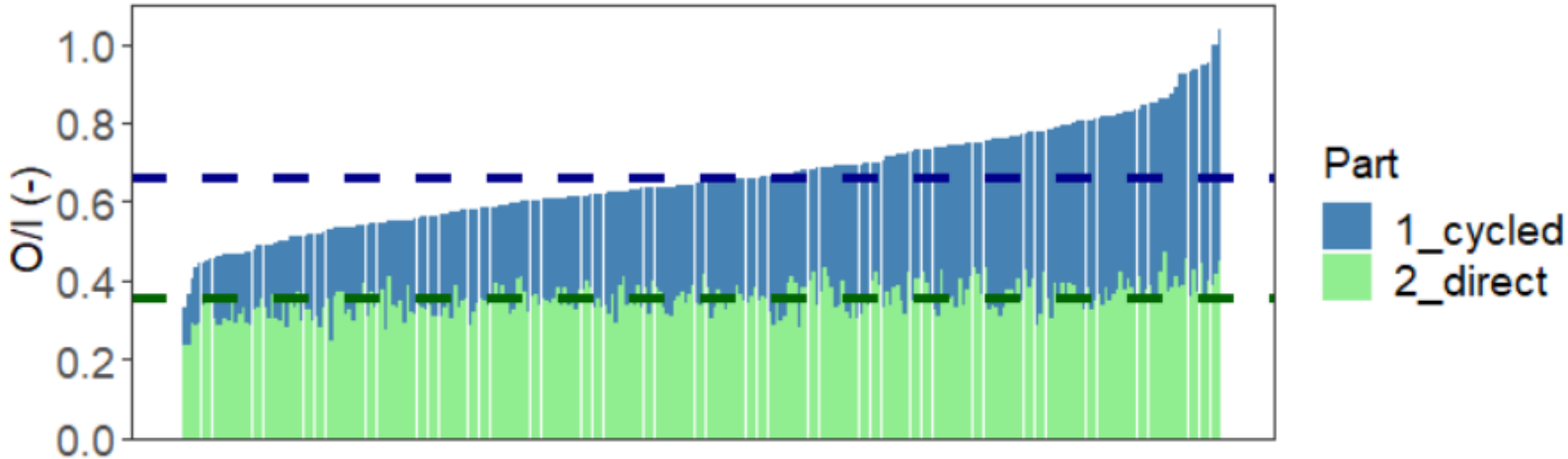
- 32% of *O/I* from cycling
- More variation in cycled flow (42%) compared to direct flow (11%)



Sorted from low to high *O/I* ratio for each farm and year combination.
Dashed line is average

Dutch dairy farms: Phosphorus Output/Input

- 45% of *O/I* from cycling
- More variation in cycled flow (35%) compared to direct flow (11%)



Sorted from low to high *O/I* ratio for each farm and year combination.
Dashed line is average

Next steps

- Assess nutrient cycling, food production and greenhouse gas emissions on farm and agri-food level and the implications of different management practices, technologies and farm configuration interventions
    - Quantify impact of manure processing and feed import on nutrient circularity and GHG emissions at food systems level

Questions?

marloes.vanloon@wur.nl or in the chat