



# LOSSES AND EFFICIENCIES OF PHOSPHORUS ON A NATIONAL LEVEL

## A COMPARATIVE STUDY OF EUROPEAN SUBSTANCE FLOW ANALYSES

### INTRODUCTION

In recent years, various substance flow analyses (SFA) of phosphorus (P) have been conducted on a national level in order to identify and quantify P flows and stocks within a country. However, no detailed comparison of national P flows has been carried out so far.

We present a blueprint for the analysis of national P flows, which allows a standardised procedure and facilitates comparability between countries with regard to the sustainability of their national P systems.

### OBJECTIVES

- To derive a blueprint for SFA of P on a national level from seven European SFAs (Austria, France, Germany, Netherlands, Sweden, Switzerland, UK).
- To conduct a comparative analysis of these SFAs (i) using indicators for assessing losses, efficiencies and potentials of secondary P and (ii) applying cluster analysis as a method for a comprehensive comparison of whole systems.

### COMPARISON OF SUBSTANCE FLOW ANALYSES

Sustainable P management comprises the reduction of P losses and of P imports, the increase of P use efficiency and the development of a circular flow economy based on P reuse, recovery and recycling. The following table shows selected indicators based on these principles:

Agriculture	P-Nutrient use efficiency* (%)		Food	Net-food P use efficiency* (%)	
	Rank	Country		Rank	Country
	1	Switzerland	1	Sweden	29
	2	Austria	2	Switzerland	27
	3	UK	3	Austria	19
	4	Germany	4	UK	19
	5	France	5	France	16
	6	Sweden	6	Netherlands	16
	7	Netherlands	7	Germany	14

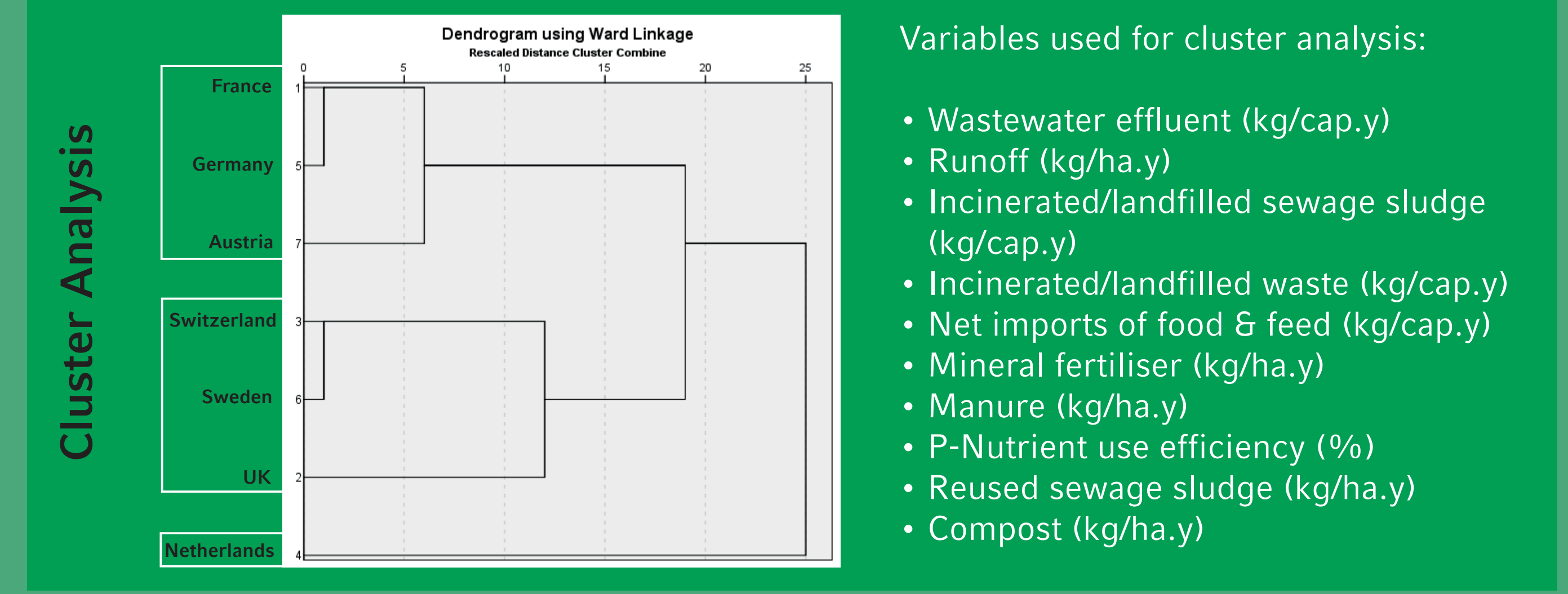
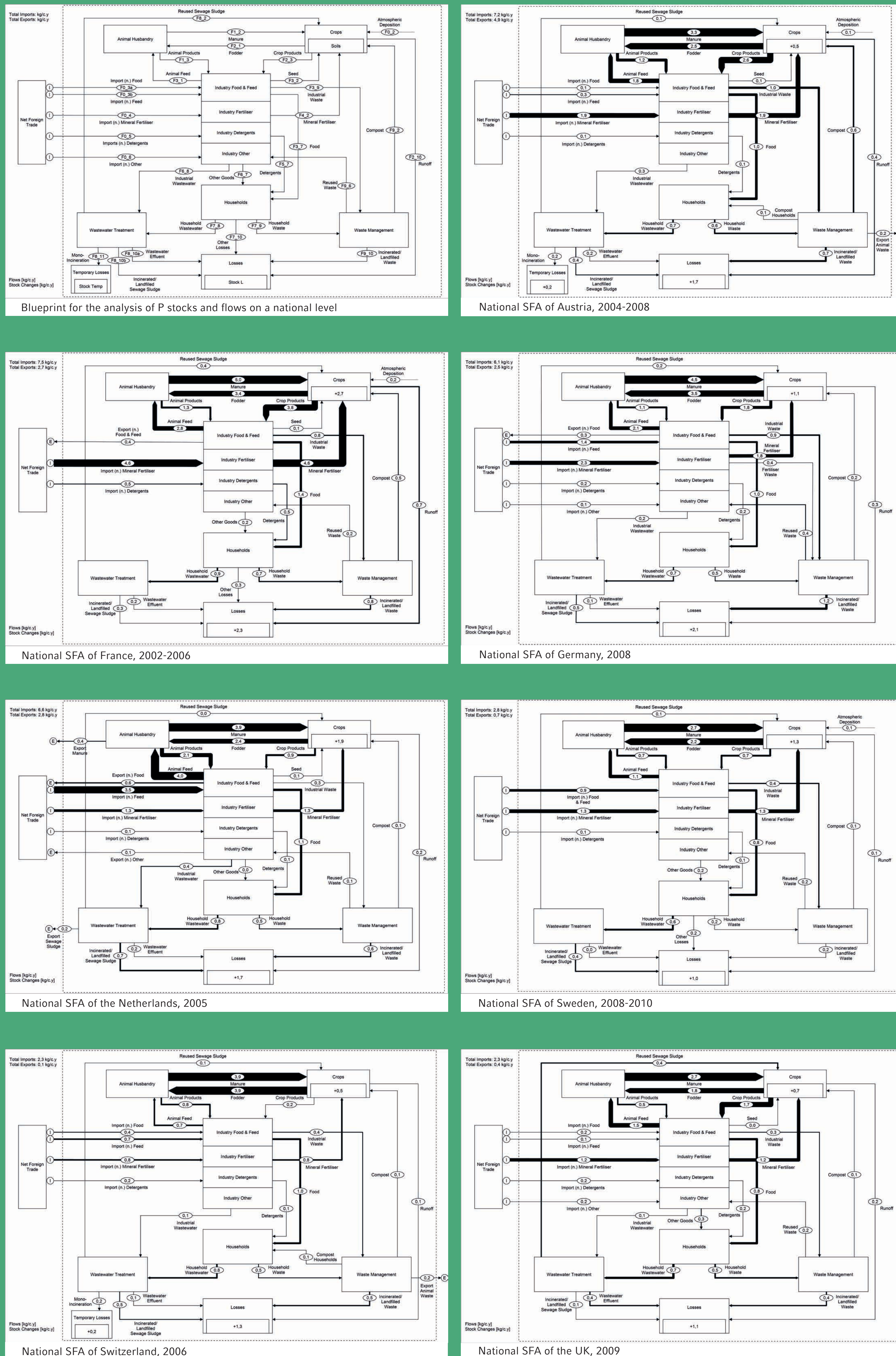
\* ratio between P in crop products & fodder and total P crop inputs

Secondary P	Share of secondary P (manure, compost, sewage sludge*) in total P crop inputs (%)		Potential	Potential for substituting mineral fertiliser assuming a 50% recycling rate of P in WW* (%)	
	Rank	Country		Rank	Country
	1	Switzerland	1	Switzerland	58
	2	Netherlands	2	Netherlands	46
	3	Germany	3	UK	37
	4	UK	4	Sweden	25
	5	Sweden	5	Austria	25
	6	Austria	6	Germany	24
	7	France	7	France	10

\* including mono-incineration ashes as future secondary P

\* wastewater

### BLUEPRINT FOR SFA OF P AND ITS APPLICATION FOR SEVEN EUROPEAN COUNTRIES



### METHODOLOGICAL CONCLUSIONS

- Blueprint provides a basic summary of national P systems.
- More detailed inquiry is possible by analysing subprocesses, e.g. of wastewater.
- The comparative study uses a descriptive approach.
- The reliability of the comparative study depends on the quality of the individual SFAs.
- Standardized approaches for uncertainty assessments and monitoring are needed to increase reliability and comparability of SFAs.

### CONCLUSIONS

- Total annual P losses range from 1.0 kg (Sweden) to 2.3 kg P/cap (France).
- In spite of its high amount of manure application, the Netherlands has both the highest mineral fertiliser input and total P input per hectare (four times the amount of Sweden).
- The Netherlands has by far the highest annual P accumulation in soils (16.5 kg/ha; France: 5.7 kg; Germany: 4.7 kg; Sweden: 4.1 kg; Switzerland: 3.5 kg; UK: 3.5 kg; Austria: 1.4 kg).
- Assuming a 50% recovery rate of P from wastewater for fertilisation, Switzerland shows the highest (58%) and France (10%) the lowest potential for substituting mineral fertiliser use.
- Switzerland shows a relatively high use of secondary P due to its closed fodder-manure cycle.
- The cluster analysis revealed three clusters comprising (i) France, Germany, Austria; (ii) Switzerland, Sweden, UK; and (iii) the Netherlands.

Flow values of „0.0“ comprise flows smaller than 0,05 kg/c.y  
\* Due to reasons of visualisation „Industrial Wastewater“ comprises the wastewater of all four industries

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