Phosphorus flows and balances at country scale: a case study for France

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1. Introduction

Phosphorus (P) is a non-renewable resource and its availability is becoming obscure for future generations. Currently 19.4 Mt of P is being mined every year and 90% of it is used for food production (Smil, 2000) The demand for P is predicted to increase by 50-100% by 2050 with increased global demand for food and changing diets (Steen, 1998). With the current rate of P mining the available phosphorus resources will be utilised in another 50 to 200 years (Sibbesen and Runge-Metzger, 1995; Smil, 2000).

In this study, we identified and quantified the country scale P fluxes in agriculture and other sectors such as domestic, industry, trade and losses to environment (Fig 1). France is a typical western country with intensive agriculture and trade relationships which augments the P fluxes through heavy P consumption and depletion. Quantifying the P flows and balances at country scale will be useful for efficient management of available P resources by identifying the largely P consuming processes and recycling opportunities.

2. Objectives

1. To identify and quantify the P flows, stocks and balances across and within different sectors in France
2. To understand how closed are the P flows in France and what are the opportunities for improvement?

3. Methodology

The method used is Material / Substance Flow Analysis. The data on quantity of material flow were collected from European databases such as EUROSTAT and FAO and also from French national databases such as AGRESTE, UNIFA and ADEME. The data were collected for the year 1990 to 2006 (only 2006 data used for this presentation). The P concentrations of all the flow materials were collected from existing literature and were expressed in percentage. The quantity of P flow in each material was calculated by multiplying the quantity of material with their respective P concentrations.

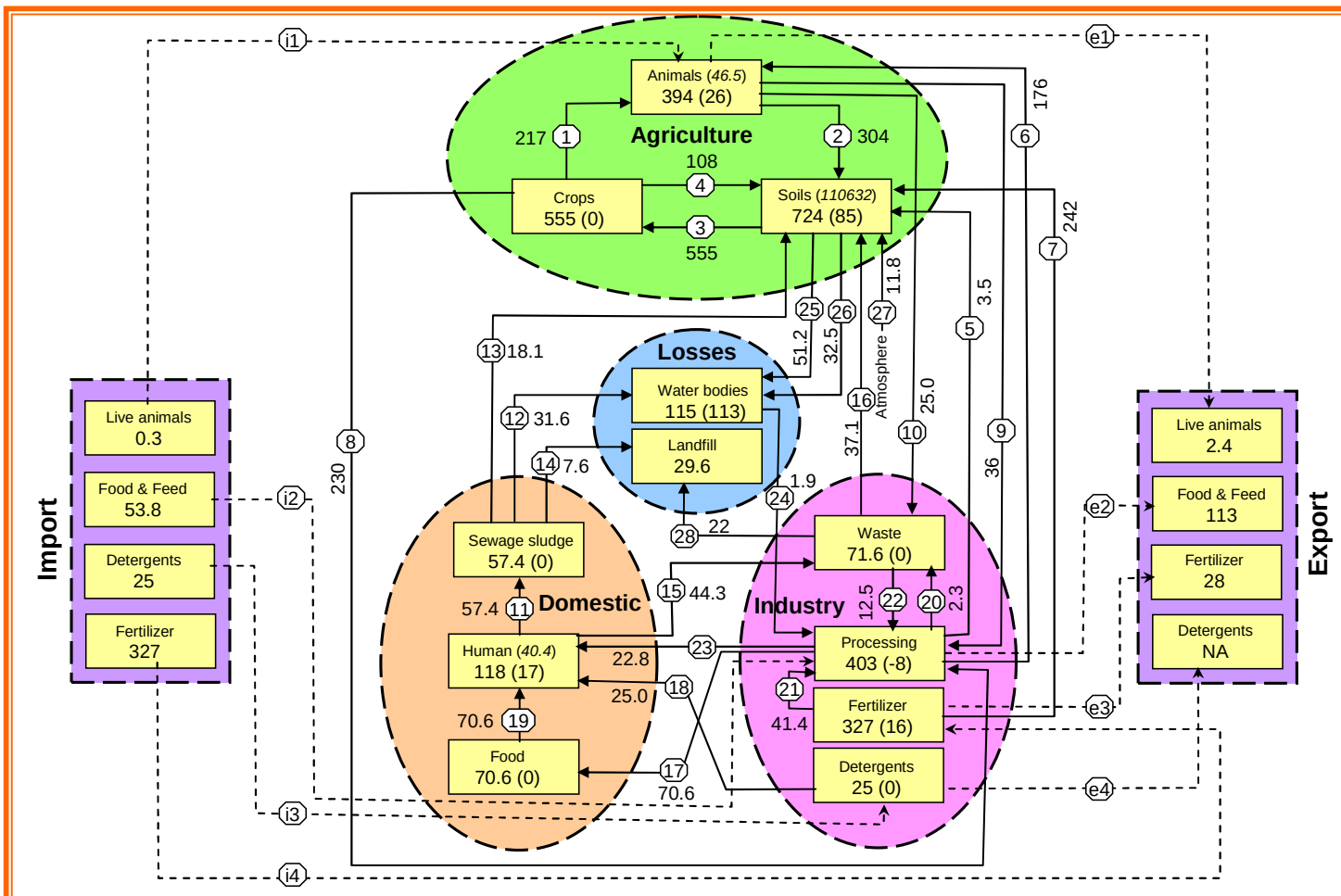

Fig. 1. P stocks (values in italics), flows and balances (values in parenthesis) at a country scale for France. All values of flows and balances are presented in Kt yr^{-1} for the year 2006 (Preliminary results).

4. Results

Agriculture is the largest contributor of P fluxes (sum of all inflows and internal flows) with 1672 Kt yr^{-1} followed by industry (826 Kt yr^{-1}) and domestic sector (246 Kt yr^{-1}) in France.

Animal production used large quantities of P (394 Kt yr^{-1}), however, only 10% of P flew through animal food production. The remaining P flew through animal excretion (80%) and slaughter house waste (10%).

P losses to environment was 145 Kt yr^{-1} mainly through soil erosion, leaching and disposal of municipal and human waste.

Over all country scale P balance (import – export) was positive (262 Kt yr^{-1}), however, this positive P balance was reduced to 119 Kt yr^{-1} due to the P losses to the environment.

5. Conclusions

- Identifying and quantifying the P flows helped to understand the degree of P fluxes in different sectors at country scale.
- The causes for P losses to environment are attributed to soil erosion, leaching, waste water disposal and land filling of municipal and human waste.
- Opportunities exist to close the P flows by reducing erosion and leaching losses and complete recycling of municipal and human waste.

References

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