A modeling approach to estimate P flows and balance at country scale: a case study for France

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As non-renewable resources, global P reserves are quickly depleting (Cordell et al., 2009; Gilbert, 2009). Agriculture is mostly responsible of such depletion. The determinants of the P consumption may apply at different levels (Schlecht and Hiernaux, 2004). In particular, intensive import/export relationship at country scale may influence P flows and balance. Additionally, the segregation of animal and crop production basins at country scale may impair P recycling opportunities. Finally new sources of P (e.g.: sewage sludge), need to be quantified in term of P availability. Modelling approach may be helpful (i) to quantify P flows within a country, (ii) to evaluate the consequences of import and export and (iii) to identify recycling opportunities. Our work was based on conceptual, and then mathematical, modelling of P flows and compartments within France (Figure 1). Preliminary results showed that soil P content was steadily increasing: crop uptake represented some 675 1000t P/yr whereas the sum of crop residues, animal manure and P fertilisers represented 755 1000t P/yr. This suggests that one third of P fertiliser amount could be saved annually.

Fig. 1. P stocks, flows and balances at a country scale