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Perlette Totoson, Marilys Pradel, Pierre Thiriet, Lynda Aissani

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Contextualized phosphorus recycling: potential diminution of phosphorus criticality at territory scale - Application to agricultural LCA

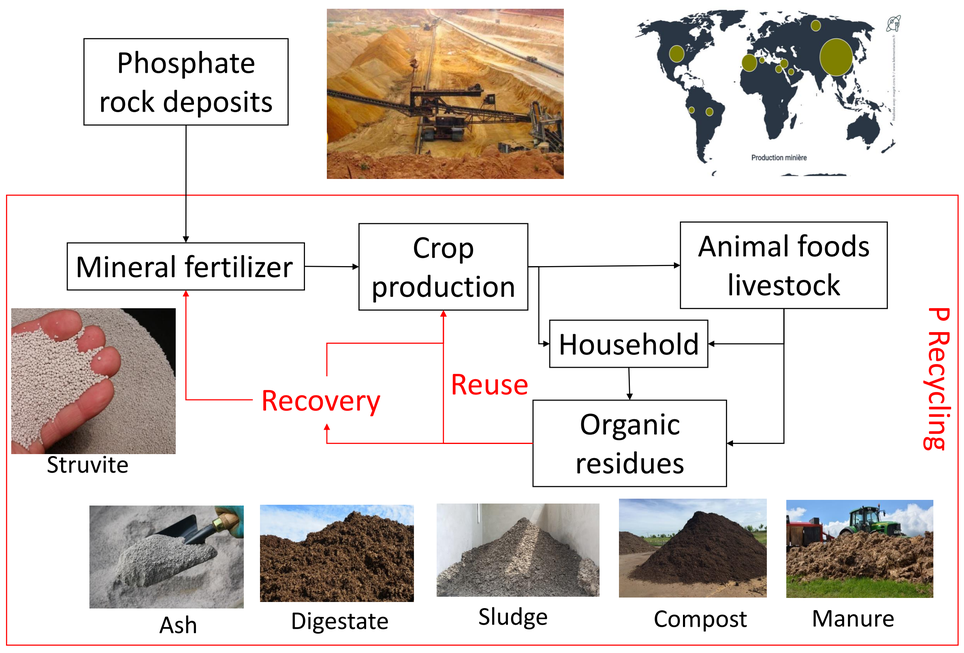
Perlette TOTOSON[1] | Marilys PRADEL[1] | Pierre THIRIET[2] | Lynda AISSANI[2]
[1] Université Clermont Auvergne, INRAE Clermont-Ferrand-Auvergne-Rhône-Alpes, UR TSCF, France
[2] INRAE Centre Bretagne-Normandie, UR OPAALE, France

Context

Phosphate rock is **a critical raw material** for European Union's (EU) economy. It is mainly **used for phosphate mineral fertilizer manufacturing** (86% in EU). **Phosphate rock** is the **main source of phosphorus** (P), an **essential element for crop nutrition**. In the agricultural sector, providing **P from recycling sources** is currently the only way **to mitigate phosphate rock criticality**.

Phosphorus recycling refers to the **reuse in agriculture of collected** (i.e. organic effluent) or **recovered phosphorus** (i.e. struvite) which is contained in organic residues (OR) as digestate, manure, sludge… It depends on the **geographical scale studied** and its **context** (regulatory, social, economic, agronomic,...). **The context and geographical scale are not taken into account in the evaluation of the recycling rate indicators used in the raw material criticality assessmen**t (EOL-RR, EOL-RIR,…).

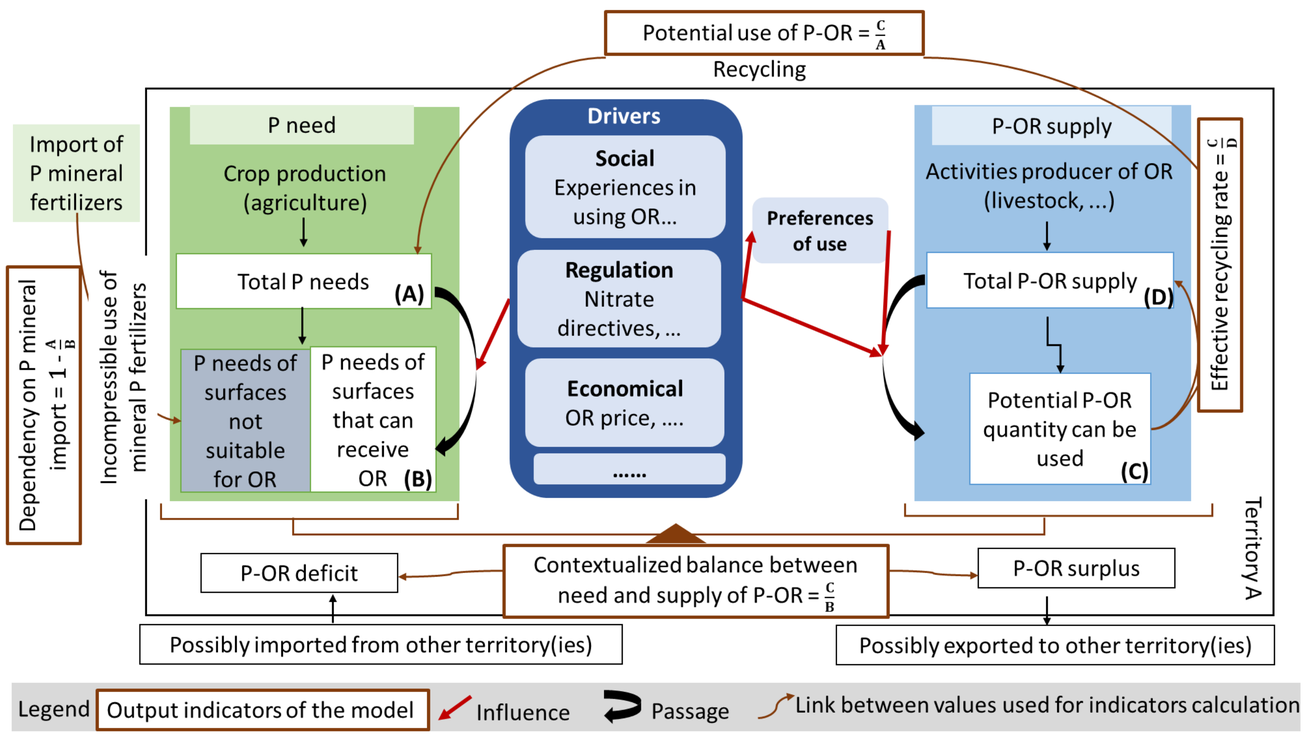
➡ To better assessing the impact of recycling in phosphorus criticality, there is **a need to contextualize P recycling at the local scale.**



Phosphorus recycling

Conceptual model for contextualized phosphorus recycling

The conceptual model aims to put P recycling back into its context to assess the **maximum recoverable and recyclable potential** of phosphorus from organic residues deposits in the studied territory.



To build the model, four set of parameters are identified:

► **P-OR supply**

$$P-ORsupply = \sum_{i=1}^{n} (Total\ supply\ of\ OR_i \times P\ content\ of\ OR_i \times VFP\ of\ OR_i)$$

VFP = P agronomic efficiency,
OR_i = Organic Residues i

► **P needs: COMIFER method + SIG (to identify $SAUPE_j$)**

$$P\ need = \sum_{j=1}^{n} (MCj\ x\ Yj\ x\ TPjx\ SAUPEj)$$

j : culture, MC : multiplying coefficient, Y : yields,
TP : P content in exportation, SAUPE : agricultural area that can receive OR

► **Drivers**, i.e. any factors that can influence the use of P from OR by farmers

► **Preferences of use by farmers**

Drivers and factors influencing farmers' preferences of OR use

26 farmers surveyed

Studied territory in France

► Quality production specifications
► Public opinion
► Economic aspects: transport cost, site cost, OR cost
► Disponibility and accessibility (transport distance)
► Distribution ability
► Soil compaction problems

► Content of metallic and biological contaminants and the confidence in these values
► Presence of weed seeds
► Agronomic value
► OR odor
► Knowledge about the organic residues …..

Preferences of use by farmers

Most preferred

- Manures
- Compost of manures
- Digestate
- Wood ash
- Sludges

Least preferred

➡ Which factors do **arbitrate the farmer's preferences** of organic residues use?

Conclusion

- The proposed model will help to provide **an effective recycling rate consistent with local context**.
- This promotes a **better integration of the characteristics of phosphorus recycling into criticality assessment**.
- The model gives a methodology advancement, which **would improve or be a complement of the LCA tool to assess territorialized phosphorus recycling scenarii**.

40 RTE DE CHAZEUIL, DOMAINE DES PALAQUINS
03150 MONTOLDRE
Tél. : + 33 (0)6 52 05 83 85
Contact mail : perlette.totoson@inrae.fr