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

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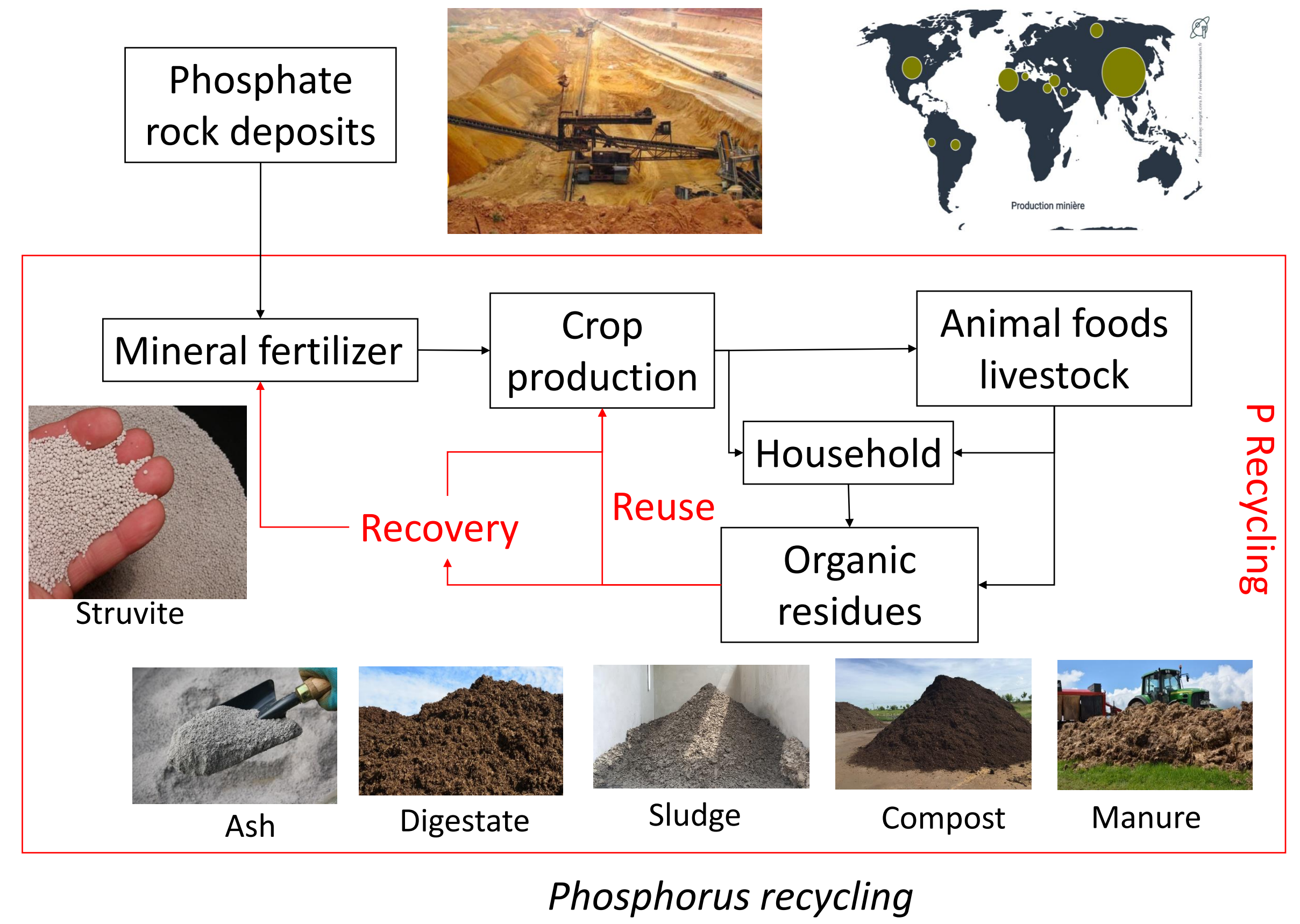
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Context

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**.

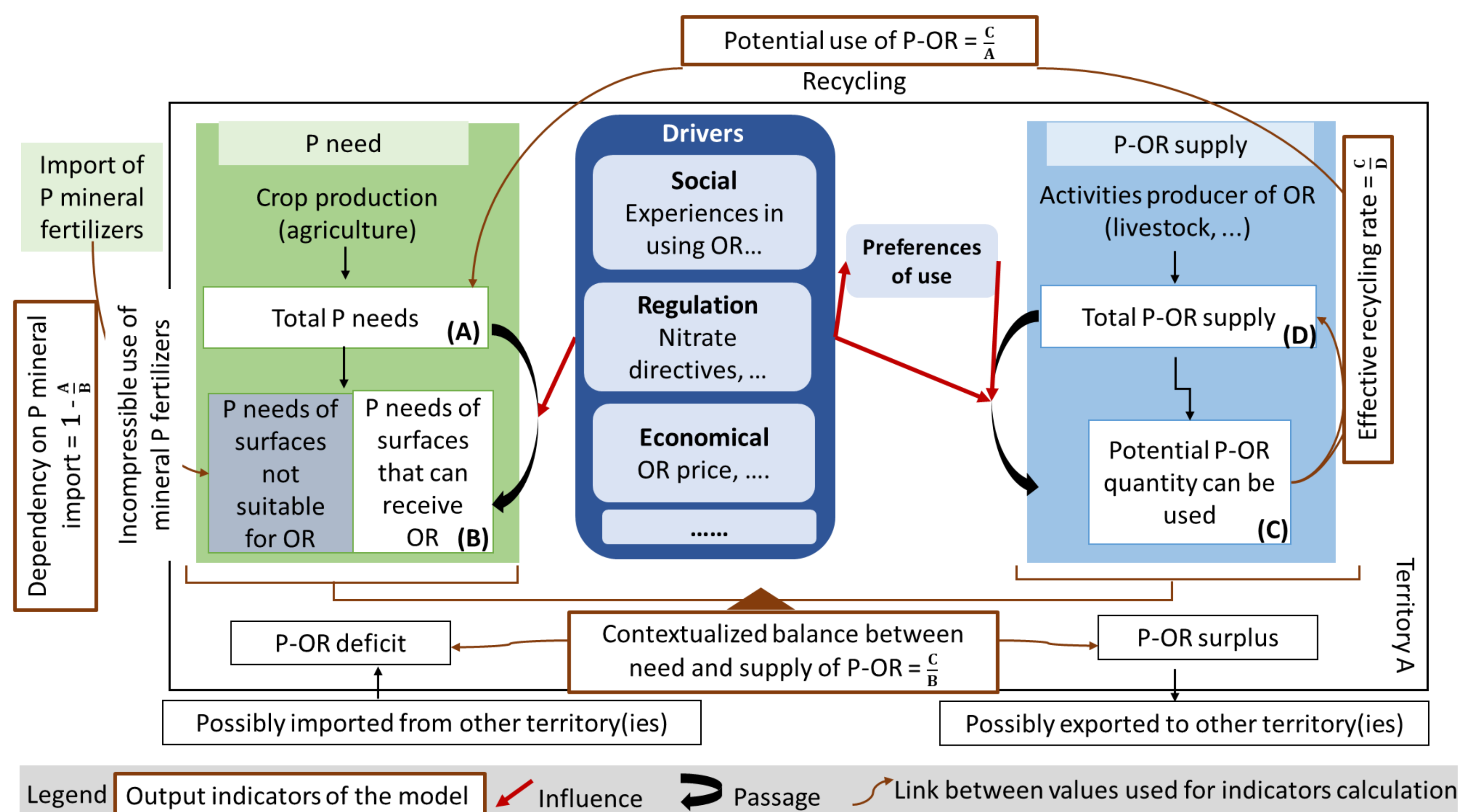
Phosphorus recycling refers to the **reuse in agriculture of collected** (i.e. organic effluent) or **recovered phosphorus** (i.e. struvite) which is contained in organic residues (OR) as digestate, manure, sludge... It depends on the **geographical scale studied** and its **context** (regulatory, social, 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 assessment (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**.



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

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

VFP = P agronomic efficiency,
OR_i = Organic Residues i

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

$$P\ need = \sum_{j=1}^n (MC_j \times Y_j \times TP_j \times SAUPE_j)$$

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**.