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Socio-hydrological approach to the evaluation of global fertilizer substitution by sustainable struvite precipitants from wastewater

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Together with water, soil phosphorus deficiency is recognized as one of the major biophysical constraints affecting African agriculture . Despite Africa controlling the vast majority of the global phosphate reserves (Morocco & Western Sahara), it also faces the greatest food shortages . Using those reserves for fertilization would be a simple solution if not so many farmers lacked access to the fertilizer market. Another possible, less geographically concentrated, source of phosphorus is that coming from the waste and wastewater generated by urban areas and livestock sectors. This source remains unexploited resulting in a loss of phosphorus through the discharge of un-/partially treated wastewater. Analysing the potential phosphorus production of these two growing sectors in meeting the partial demand of the agricultural sector will be an important tool in Africa's transitioning to a circular economy, thereby reducing the use of unrenewable sources of phosphorus, the phosphorus related pollution of water sources and the current agricultural yield gap. In this study, a global overview is provided where a selection of P-production nodes and P-consumption nodes have been determined using global spatial data. Distances, investment costs and associated carbon footprints are then considered in modelling a simple, alternative trade network of struvite precipitant, phosphorus flows. Preliminary results have revealed that there exists a global anthropogenic production potential of 3.3 MtP for 2005. Very crudely, but in accordance to results by Milhelcic et al. (2011) who reported 22%, approximately 20% of the reported global fertilizer consumption could then be satisfied by recovering urban phosphorus alone. The network reveals potential for increasing the phosphorus security of particularly Egypt, Ethiopia, Rwanda, Burundi, Tanzania, Uganda, Malawi, South Africa, Nigeria, Benin, Togo, Ghana, and Cote d'Ivoire through phosphorus recycling. Given Africa's process of rapid urbanization, phosphorus recovery from wastewater for secondary utilization will prove an important step in creating sustainable communities, protecting the environment while improving food security.