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Quasi-dynamic Material Flow Analysis applied to the Austrian Phosphorus cycle

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Phosphorus (P) is one of the key elements that sustain life on earth and that allow achieving the current high levels of food production worldwide. It is a non-renewable resource, without any existing substitute. Because of its current dissipative use by mankind and to its very slow geochemical cycle, this resource is rapidly depleting and it is strongly connected to the problem of ensuring food security. Moreover P is also associated to important environmental problems. Its extraction often generates hazardous wastes, while its accumulation in water bodies can lead to eutrophication, with consequent severe ecological damages. It is therefore necessary to analyze and understand in detail the system of P, in regard to its use and management, to identify the processes that should be targeted in order to reduce the overall consumption of this resource. This work aims at establishing a generic quasi-dynamic model, which describes the Austrian P-budget and which allows investigating the trends of P use in the past, but also selected future scenarios. Given the importance of P throughout the whole anthropogenic metabolism, the model is based on a comprehensive system that encompasses several economic sectors, from agriculture and animal husbandry to industry, consumption and waste and wastewater treatment. Furthermore it includes the hydrosphere, to assess the losses of P into water bodies, due to the importance of eutrophication problems. The methodology applied is Material Flow Analysis (MFA), which is a systemic approach to assess and balance the stocks and flows of a material within a system defined in space and time. Moreover the model is integrated in the software STAN, a freeware tailor-made for MFA. Particular attention is paid to the characteristics and the quality of the data, in order to include data uncertainty and error propagation in the dynamic balance.