Identifying opportunities for sustainable phosphorus management in Northern Ireland with substance flow analysis

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In common with most national agricultural systems, phosphorus (P) inputs are essential for production of crops and livestock in Northern Ireland (NI). However, the negative environmental impacts on their aquatic environments of inappropriate P management both in agriculture and the wider food system are widely acknowledged. Recent gains in reducing P loading to fresh waters through regulatory intervention are now reversing (Northern Ireland Environmental Statistics Report, DAERA 2018) suggesting the need for additional approaches that improve the sustainability of P use in the NI food system. Such approaches should ensure that P entering the food system (e.g. as food, fertilisers and animal feed) is efficiently recycled back into the system to ‘close the P cycle’, and thus reduce the demand for imported P. Furthermore, minimising P losses from different stages of the food system are critical to mitigating negative environmental impacts. To effectively achieve this, the flows, stores and losses of P within the food system must first be understood. Here, we report on a P substance flow analysis (SFA) undertaken for NI for the year 2017, that provided a focus to empower stakeholders to explore options to change P stewardship in the NI food system. Total P import to the NI food system in 2017 as food, feed, fertiliser and chemical P was 19096 t (10.21 kg person⁻¹ yr⁻¹), total P exports were 8097 t (4.33 kg person⁻¹ yr⁻¹) leaving a system surplus of 10999 t (5.88 kg person⁻¹ yr⁻¹). Of this surplus, 923 t of P (0.49 kg person⁻¹ yr⁻¹ or 8%) was consumed in food by the population of NI, 7959 t (72%) accumulated in agricultural soil as excess application, 1528 t (14%) were lost to fresh and coastal waters and 1189 t (11%) were disposed in landfill, demonstrating the current imbalance of P use in NI. This P SFA model created a framework of understanding to engage key stakeholders, in scenario analysis, to explore opportunities for improving the sustainability of P use in the NI food system.