
Realizing an equitable circular bionutrient economy in the United States

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Recovering nutrients from human and livestock waste can substantially reduce synthetic fertilizer use and associated environmental pressures. Here we quantify the potential of waste-derivable nutrients to meet agricultural demand and assess spatial (mis)alignment between nutrient supply and crop needs across the USA. We find that 8.56 Tg of nitrogen (N) and 2.80 Tg of phosphorus (P), valued at US\$5.71 billion, could supply 102% of N and 50% of P demands. However, nutrient surpluses concentrate in population-dense and livestock-intensive regions, while deficits persist in major crop-producing areas across the Midwest and southern Great Plains, highlighting the need for local use and targeted redistribution. About 37% of waste-derivable N and 46% of P can be used locally, and an additional 61% of surplus N and 56% of P can be economically reallocated to regions with nutrient deficits. Realizing this potential requires coordinated processing, logistics and governance to advance an equitable circular bionutrient economy.