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Fertiliser resource limitations: recycling for food security

Global population growth since 1850 has been largely enabled by commercial phosphorus and nitrogen fertilisers. The availability of these nutrients for food production relies upon steadily diminishing resources of natural gas and phosphorus rock. A recent study suggests that to secure a long-term affordable food supply, policy intervention is needed to conserve these essential resources.

Nitrogen and phosphorus are both vital to life. Few cultivated soils can support sustained commercial agriculture without adding these nutrients. Nitrogen fertilisers are made with ammonia manufactured using methane (natural) gas. Phosphorus fertilisers are manufactured from phosphate rock, whose global distribution is very uneven: Finland has the only active rock source in the EU, for example. Access issues or shortages may lead to future conflict. The study suggests that ownership of reserves must be fairly recognised but remain available to all. It is not known exactly how long phosphorus reserves will last given rising demand for food, but the study urges the risk of exhaustion to be faced now. Finite supplies of reserves of phosphate rock are thought to be available for another 300 to 400 years, according to the study.

The study indicates that sustainable resource management will require systemic change, integrated across all sectors and that market mechanisms alone will not suffice. For example, producers and consumers need to ‘reconnect’, with more coherent regulation. Fertiliser use should be optimised by better on-farm management and applied soil science. Industrial-scale food waste prevention and nutrient recovery from waste streams is needed, together with increased energy and water efficiency. Consumers should accept more responsibility for purchasing and dietary habits, says the study, for example, by reducing the amount of food wasted.

For nitrogen, the efficiency of ammonia production using methane is already virtually maximised. Further efficiency gains, both on farm and in recycling, can reduce the net energy input per unit of production. The volume of methane currently ‘flared’ from oil wells is almost the same as required for global nitrogen fertiliser production and sustainability and food security objectives may require methane to be reserved for nitrogen fertiliser production, with the energy deficit made up by other means. Recovery of synthesised nitrogen from waste, including manure, should also be maximised.

Implementing an almost ‘closed’ phosphorus management system is theoretically feasible and, for sustainability, imperative, i.e. no phosphorus is lost. Currently, phosphorus use is managed as an open system - it leaves the land when crops are sent for processing, but much of these crops are destined for landfill as food waste. If phosphorus in waste streams reaches the sea, it is effectively lost forever. Leakages and losses are avoidable if the system were closed: recycling phosphorus from waste water and applying it to agricultural land would help close the system, but the actual EU recovery rate averages 40 per cent, with some countries banning the practice.

Future population growth will be largely urban and future waste management infrastructure must be able to capture and recycle nitrogen and phosphorus resources, changing the waste management mission from collection to recycling. Current regulations regard phosphorus not as recoverable resource, but as a potential pollutant, with emission levels to water set for environmental reasons. The EEA permitted limit for phosphorus discharge to water in many EU Member States exceeds the recommended human intake. The study recommends that revised waste regulations should promote attitudinal and behavioural change focused on recycling and reuse.

Source: Dawson, C.J. & Hilton, J. (2011) Fertiliser availability in a resource-limited world: production and recycling of nitrogen and phosphorus. *Food Policy*. Doi: 10.1016/j.foodpol.2010.11.012.

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