Recycling of nutrients is the key to saving the Earth

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Leakages of nutrients necessary for food production – especially nitrogen and phosphorus – cause severe eutrophication to the Earth's aquatic ecosystems and promote climate change. However, this threat also hides an opportunity. An enhancement of the nutrient economy creates new business models and enables developing recycling technology into an export.

More sustainable use of nutrients and new technological innovations connected to the recycling of nutrients have been studied in the NUTS - Transition towards Sustainable Nutrient Economy in Finland project. A globally unique nutrient footprint, which can be used to measure the use of the main nutrients, i.e. nitrogen and phosphorus, has also been developed in the project. This is a shared project of the Lappeenranta University of Technology (LUT) and the Natural Resources Institute Finland (LUKE), and it belongs to the Green Growth - Towards a Sustainable Future programme of Tekes (Finnish Funding Agency for Innovation).

"There are already some nutrient separation and recycling techniques available, but not all of them are presently commercially viable. For example, there is plenty of nitrogen in the atmosphere, but binding it to fertilisers is currently a highly energy-intensive process. When nitrogen is released to the atmosphere, a new input of energy is required to reutilise the released nutrient. This is wastage, and nutrients should be recycled", explains Mirja Mikkilä, the project manager of the NUTS project.

Waste water treatment is the weakest link

The treatment of the waste water of communities is the weakest link of the nutrient cycle. Nutrients can be recovered from waste water, but until now, different processes have primarily been used for the recovery. However, research findings indicate that it is possible to simultaneously remove phosphorus and nitrogen from waste water. The reuse of nutrients is also lacking, the utilisation rate of phosphorus is less than 50 per cent and of nitrogen less than 10 per cent.

It is possible to slow down the eutrophication of the Baltic Sea through fishing and removal of plant biomass. "For example, nutrients can be removed by fishing cyprinid fish, which also improves the populations of other fish consumed as food. Of course, required actions are always dependent on the situation, and sanitation procedures must always be cost-effective before they become commonplace", Mikkilä notes.

According to Mikkilä, thermal processing of waste water sludge can also be used to separate nutrients and heavy metals from each other. Moreover, cultivation of algae in connection with district heating power plants and water treatment plants would be resource effective. Algae are powerful photosynthesizers.

"Combining the production of biogas and fortified recycled nutrients is one of the key technologies for a sustainable nutrient economy. It is officially a matter of waste processing, but one in which organogenic raw material is processed into recycled nutrients used for fertilisation and into raw material for humus and biogas", Mikkilä explains.

The food system must be changed

Historical development of the food system has resulted in the nutrient

economy becoming established in its current, unsustainable state. It is possible to produce enough food for the 9 billion people on Earth in 2050, but this requires a radical change in both the food system and attitudes. There is a need for more vegetarian and seasonal food and for local recycling. Furthermore, food wastage must be contained and side streams of food must be utilised by recycling nutrients back into food production.

"We should be able to perform global division of labour and introduce in vitro meat, grasshoppers and worms into our diets. The global transportation of fresh produce is also ineffective. In the future, dried food will be transported instead of water. All in all, such combinations would make the food selection fairly versatile", Mikkilä considers.

According to Mikkilä, there are bottlenecks based on institutional structures, the market economy and people's set of values that slow down the transition towards the recycling and fair use of nutrients, and she evaluates that changing the system will take 20 to 30 years.

Provided by Lappeenranta University of Technology