Human wastewater valuable to global agriculture, economics, study finds

16 August 2018, by Lois Yoksoulian

Credit: CC0 Public Domain

It may seem off-putting to some, but human waste is full of nutrients that can be recycled into valuable products that could promote agricultural sustainability and better economic independence for some developing countries.

Cities produce and must manage huge quantities of wastewater. Researchers at the University of Illinois at Urbana-Champaign have developed a model to clarify what parts of the world may benefit most from re-circulation of human-waste-derived nitrogen, potassium and phosphorus from cities and back into farm fields. They report their findings in the journal *Nature Sustainability*.

"We grow our crops in the field, apply nutrient-rich fertilizers, eat the crops, excrete all of the nitrogen, phosphorus and potassium and then those nutrients end up at the wastewater treatment plant," said Jeremy Guest, a civil and environmental engineering professor and study co-author. "It is a very linear, one-directional flow of resources. Engineering a more circular nutrient cycle would create opportunities that could benefit the environment, economy and agriculture."

The team's exploratory exercise examined 56 of the largest cities across six continents to assess the feasibility of human-waste-derived nutrient recirculation. They looked at factors like transport distance, population and cropland density, crop nutrient requirements and what types of products would do best where.

"In some cases, wastewater that has been treated for safety can be used to simultaneously irrigate and fertilize crops," said John Trimmer, an Illinois graduate student and lead author on the study.

Treated wastewater is an option for places where crops grow close to cities, such as many parts of Africa, Asia and Europe. However, water is challenging to transport because of its weight and relatively low nutrient content, so it is not a good option when nutrients must travel longer distances to reach farmland, the researchers said.

"In some cities, we would need to use more advanced technology to recover a more concentrated product suitable for longer transport distances," Guest said. "These are similar to the crystalized fertilizers that we are accustomed to and, in most cases, the technology to produce these from human waste is well established."

The study shows that a variety of cities throughout the world could benefit from this proposed sustainability approach – not only for helping grow crops, but also for their economic independence.

"We found, for example, that in Cairo, Egypt, if all of the nitrogen resources from wastewater were utilized, the city could cut Egypt's nitrogen fertilizer imports by roughly half," Trimmer said. "This type of approach could also help smallholder farmers in places like Sub-Saharan Africa gain better access to fertilizer than what is currently available."

The study also identifies parts of the world where nutrient recirculation may have less impact.

"Most of the population centers we looked at throughout the U.S. don't appear to be the best candidates," Trimmer said. "For example, places like New York and Boston are too far from intense agriculture areas. However, the Midwest – Chicago in particular – did a bit better in our analysis."

The team acknowledges that there are limitations to this type of exercise.

"Because this was developed as a global analysis, the method does not allow us to examine specifics for each city, like the driving routes to haul nutrients or locations of wastewater plants, among other details," Guest said. "The results of this exercise should be taken as estimates of nutrient transport distances and are useful for identifying broad trends and locations that may warrant further investigation into reuse strategies."

More information: John T. Trimmer et al. Recirculation of human-derived nutrients from cities to agriculture across six continents, *Nature Sustainability* (2018). DOI: 10.1038/s41893-018-0118-9

Provided by University of Illinois at Urbana-Champaign