Can urban waste become a resource for urban food production?

- ✓ Urban waste streams open up synergies with urban food growing
- ✓ Research is still needed to fully understand how to close the loop
- ✓ Cities should start planning now by carrying out an inventory of current and potential resource streams useful to food growing

Our future cities will need to find ways to recycle and reuse resources, and urban food production is no exception. If urban farming has to be scaled up, how can this be done in the most resource-friendly way?

Researchers from the University of Reading (UK), Michigan (USA) and the Technical University of Denmark have reviewed **key urban waste streams and the way they can contribute to urban agriculture**. Indeed, no matter how efficient cities are, there will always be an inevitable amount of waste they can tap into. Their paper provides a good stepping-stone to start thinking about urban agriculture and the circular economy. It also shows that research is still needed before cities can actually close the urban food loop!

So, how could urban waste become a resource for urban agriculture?

Transferring heat?

Cities produce a lot of heat, as a side effect of human activities. Buildings are an obvious source of wasted heat, but one can also mention electricity generation or sewage networks. Such heat could be used for food greenhouses.

Such an idea still faces a few challenges, though:

- First, it is difficult to collect low-grade heat from lots of buildings. Therefore, cities should focus on heat sources that are big enough.
- Second, one should make sure that heat is produced when the greenhouse needs it. This is easier in colder climates, where buildings are heated in winter.

This, of course, should not prevent from renovating buildings in order to prevent heat losses as much as possible.

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Optimizing water sources?

Recent research has showed that developing urban agriculture could put a strain on urban water resources. So the idea of making the most of wastewater seems rather interesting.

Urban wastewater mainly comes from treated water, that itself originates from surface or groundwater. However, questions still remain regarding how to prevent heavy metals and pathogens that are found in urban wastewater from polluting soils. **On water issues, then, more research needs to be done before we can close the loop**. However, researchers suggest to start with water streams that are known as less polluted, such as brewery waste.

Creating new energy?

Food waste is a significant source of potential energy. Indeed, **it can be put to work through anaerobic digestion,** which is a process through which food waste is "digested" by microorganisms in an oxygen-free environment. It turns waste into a gas (called biogas because of its organic origin) made up principally of methane and carbon dioxide. And this can replace natural gas, or be used to produce electricity. Such energy can then heat greenhouses, while waste CO_2 from combustion can fertilise these operations. This process is all the more interesting as it diverts waste from landfills, when, in the USA, another paper from the same team estimated that around 12% of the carbon footprint of food is due to landfills.

For cities, this means diverting food waste from other municipal waste, i.e. having a specific collection process in place. Cities such as Barcelona (Spain) already have developed anaerobic digestion facilities. Micro-scale anaerobic digesters are being tested as part of the European Research Project DECISIVE (http://www.decisive2020.eu/the-project/) in Lyon (France) and Barcelona (Spain).

Tapping into new sources of phosphorus?

Phosphorus is a key macronutrient for agriculture, but it is a non-renewable resource. For that reason, and with global demand growing, it is a strategic one and should be managed sustainability. It was even included in 2014 by the European Union in its list of critical raw materials.

Cities have a role to play to contribute to the long-term supply of phosphorus as it can be found in a variety of waste streams. Urban sources of phosphorus include human biosolids, animal manure, some industrial waste streams and, of course, compost. It also comes from anaerobic digestion: the digestate, i.e. the material that remains after the digestion has occurred, is a very good fertilizer.

Towards the circular city

To make the most of these potential waste streams, **cities can carry out an inventory of current and potential resource streams that can contribute to food growing**. There is room to be creative here! For instance, could municipal solid waste be a source of construction material for urban agriculture projects? Could urban agriculture sites include composting facilities so local residents contribute nutrients to local production?

This also requires planning ahead: what would the city look like if waste flows were optimized? What facilities would need to be co-located? Where should urban agriculture be located to tap into urban resources? What type of urban agriculture (open field, greenhouse…) benefit the most from existing or potential urban waste streams? And, maybe, even more importantly**, what kind of infrastructure needs to be set up to divert resources from being spoiled?** This requires forward thinking, as infrastructure are long-term investments.

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As such, the circular economy lens opens up many new questions, both for researchers and practitioners. How future cities will manage to close the loop is still difficult to imagine. But starting right now with a good understanding of urban waste flows is the best way to make it happen.

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