Applying compost to landfills could have environmental benefits

December 14 2020

Credit: North Carolina State University

Many people think of composting organic matter as a way of keeping solid waste out of landfills, but a new study from North Carolina State University finds there can be significant environmental benefits associated with using compost at landfills.

"There are an increasing number of composting programs out there, and

many of them are required to use the resulting compost 'beneficially,'" says James Levis, corresponding author of the study and a research assistant professor of civil, construction and environmental engineering at NC State. "A lot of state and local regulations don't recognize 'alternative daily cover' as a beneficial use. But our work shows that using compost as alternative daily cover at landfills is competitive, and often superior, to the use of compost as a soil amendment in terms of its environmental benefits."

Landfills apply a layer of daily cover each day in order to reduce odors, reduce wind-blown debris and keep vermin out of the landfilled waste. Federal regulations currently require six inches of soil as a daily cover.

Meanwhile, while most of the nation's yard waste is already turned into compost, a small and rapidly growing percentage of its food waste is also being composted. However, compost from food waste often contains broken glass and other contaminants, making it unsuitable for most soil amendments, such as use in gardens or agricultural fields. There are technologies available to remove contaminants, but these increase the cost of composting. In addition, there is not always a sufficient local market for all of the available compost.

Levis and his collaborators wanted to determine how environmentally beneficial it would be to use compost as alternative daily cover on landfills, and whether those benefits were comparable to the benefits of using compost to amend soil.

To that end, the researchers developed a complex computational model to predict the overall environmental impact of two defined cases: the use of compost to amend soil (e.g., in your garden) and the use of compost as a daily cover in landfills. The model ran simulations evaluating the entire life cycle of each case. For example, they not only looked at greenhouse gases released by compost, but at greenhouse gas emissions

from the equipment that applies compost at landfill facilities. The simulations also accounted for decreases in emissions, such as reduced emissions related to fertilizer use when growers use compost in their soil instead of conventional fertilizers.

Specifically, the model looked at five environmental impacts:

- Global warming potential, or the cumulative warming effect of any greenhouse gases released by the two cases.
- Acidification, or the extent to which each case contributes to acidification of the hydrological system (e.g., acid rain).
- Eutrophication: the amount of nutrients released to ground and surface water by each case.
- Cumulative energy demand, or the amount of fossil fuel resources needed for each case, as well as the amount of fossil fuel use that each case offsets.
- Abiotic resource depletion potential, or the amount of any non-biological, non-renewable resource (e.g., phosphorus) needed to perform each case, as well as the amount of those resources that each case offsets (e.g., the phosphorus in compost used to amend soil in gardens and crop lands reduces the need for mined phosphorus in fertilizers).

The researchers ran a range of simulations in order to account for both uncertainty and the wide variety of different circumstances under which the two cases might take place.

The researchers found that using compost as daily cover outperformed its use as a soil amendment in almost 100% of the simulations evaluated when it comes to eutrophication. Daily cover also did more to reduce acidification in 77% of simulations and reduced global warming potential 63% of the time. On the other hand, soil amendment was better at limiting abiotic resource depletion potential in 96% of the simulations,

and was better in terms of cumulative energy demand about 94% of the time, primarily due to the reduction of peat use.

"Our work also highlights the circumstances that make one process more environmentally attractive than the other," says Mojtaba Sardarmehni, first author of the study and a Ph.D. student at NC State. "For example, our work shows which variables are relevant when determining whether using compost as daily cover in a landfill will reduce global warming potential, as compared to using compost to amend soil."

"We are not suggesting that compost should necessarily be used as alternative daily cover instead of to amend soil," Levis says. "But we think this work highlights the fact that there are environmental benefits associated with using compost as daily cover at landfills—and we need decision-makers to consider that."

More information: Mojtaba Sardarmehni et al, What Is the Best End Use for Compost Derived from the Organic Fraction of Municipal Solid Waste?, *Environmental Science & Technology* (2020). DOI: 10.1021/acs.est.0c04997

Provided by North Carolina State University