Study identifies way to enhance the sustainability of manufactured soils

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The University of Plymouth is leading the quest to fabricate soils which could ultimately lead to the creation of custom-made, sustainable products. Credit: University of Plymouth

A combination of waste materials supplemented with a product of biomass could help in the search for high quality soils, a new study suggests.

Soil degradation is posing a huge threat to global food security and every year, around 12 million hectares of cropland are lost to soil erosion.

Scientists from the University of Plymouth have demonstrated that adding biochar—a solid, carbon-rich material derived from biomass—to soil constructed from waste materials, reduces the loss of essential nutrients such as nitrogen and carbon.

This, they believe, can improve the sustainability of manufactured soils by enhancing conditions suitable to sustain plant growth, by improving moisture content, nutrient retention and carbon storage capacity.

It will also lower the soil's dependence on intensive fertiliser applications, reducing both cost and the risk of pollution from the excessive leaching of nitrogen.

The study, published in *Science of the Total Environment*, focused on a soil composed of waste materials, which has been deployed to support a variety of plants within natural and artificial environments over an 18-year timescale.

However, its success has relied on regular fertiliser applications to supply the required nutrients so the research objective was to measure the effect of biochar application on the retention of macronutrients over the experimental period.

Postdoctoral Research Fellow Dr. Kate Schofield, who led the research, said: "Manufactured soils are a growing component in the fight for global food security. But for them to be effective and sustainable, they must retain and cycle nutrients without the need for significant fertiliser inputs. This study has shown that, by combining waste material with pyrolysed biomass (charcoal), the amount of nutrients escaping can be significantly reduced. It is a promising first indication that sustainable soils from waste can be generated and something we are now looking to build on through our current research."

Mineral and organic waste materials, derived from a range of industries and activities, have the potential to be reused as components of manufactured soils.

Their uses include the manufacture of topsoils for urban grasslands and as materials for the horticulture, agriculture, amenity and restoration markets.

Through its FABsoil project, the University—in partnership with the world famous Eden Project and businesses in Cornwall, such as the Green waste Company—is leading the quest to fabricate soils which could ultimately lead to the creation of custom-made, sustainable products across a range of locations and markets.

It has received funding from Agri-Tech Cornwall, a three-year £9.6 million initiative part-funded by the European Regional Development Fund, with match-funding from Cornwall Council.

FABsoil project leader Mark Fitzsimons, Professor of Environmental Chemistry, added: "There isn't a community in the world that doesn't rely on soil. But with global population growth and demand we are currently facing the genuine prospect of a soil crisis. The manufacture of high value soils from waste materials offers international opportunities in terms of food security, carbon sequestration and achieving a circular economy. However, it is crucial that whatever soil we create is sustainable in the long-term and that is one of the key ongoing challenges our research aims to meet."

Science Team Manager at the Eden Project Dr. Rachel Warmington, who was not involved with the study but is part of the FABsoil project, added: "Since the Eden Project opened in 2001, we have been successfully growing plants in soils manufactured from waste materials. This research shows how soil 'recipes' can be developed to reduce

fertiliser inputs and will be a vital component of future landscape restoration projects."

More information: H. Kate Schofield et al, Biochar incorporation increased nitrogen and carbon retention in a waste-derived soil, *Science of The Total Environment* (2019). DOI: 10.1016/j.scitotenv.2019.07.116

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