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Engineering Global Soils to Sustain Planet Earth

Steven A. Banwart, Manoj Menon

The Kroto Research Institute, Faculty of Engineering, The University of Sheffield

Abstract

Global soils are under intense pressure from the demographic drivers of increasing human population and wealth. During the next 40 years Earth's human population is project to approach 10 billion with a quadrupling in the global economy, a doubling in the demand for food, a doubling in the demand for fuel, and a more than 50% increase in the demand for clean water. Can Earth's soils keep up? The United Nations Environment Programme estimates that the projected resource demands by 2050 will outstrip the environmental capacity of Earth's productive land by 10-45%; exactly at the time when humans need to mitigate and adapt to climate change and global biodiversity decline. The University of Sheffield plays a leading role in a major international research initiative to tackle these challenges; the study and adaptation of Earth's Critical Zone (CZ) to global change. The CZ is the thin outer layer of our planet that extends from the atmosphere and tree canopy across the soil interface to the deeper rock, water and biota; an integrated environmental engineering system that supplies most life-sustaining resources but is under pressure from the impact of human activities. Critical Zone Observatories (CZOs) are research field sites that provide a focus to draw together the critical mass of multidisciplinary research talent in order to create a step-change in understanding the integrated functioning of the CZ, and apply the resulting new knowledge to solutions that can help adapt human use of the CZ to sustain economic development and the necessary supply of resources for future generations. New results from CZOs show how computational simulation of the integrated functioning of the CZ can help identify the major environmental processes and the mechanistic chain of impact that occurs as change in one part of the CZ propagates through the entire CZ system. These results show where human intervention is needed to help meet resource demands and protect CZ functioning for the future. CZOs are currently funded by around 100 Million US\$ in the USA and Europe, but research is set to expand with interest from China to establish a jointly funded international CZO programme with other countries. What is clear to researchers and to funders, is that the scale and urgency of the global societal challenge of understanding and protecting Earth's CZ requires the very best talent worldwide to be drawn together to develop joint projects and achieve goals.

Keywords Critical Zone; Earth; Soil; Water, Biodiversity; Resources