

## Soil as a Nexus Tool

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### Abstract

Soil is the medium for plant growth, and the substrate for all biogeochemical and biogeophysical processes. Soil's unique and immense complexity is attributed to its matrix comprising of primary and secondary particles, inorganic and organic materials, and solids and voids which form a habitat for billions of diverse micro, meso, and macrofauna and flora and is the basis of numerous ecosystem services essential to human wellbeing and nature conservancy. Gaseous exchange between soil and the atmosphere moderates atmospheric chemistry. Soil hydrological processes, movement and retention of water within the soil solum, is the formative soil-water nexus that supports numerous ecosystem services including nutrient transformation and availability; water quality and renewability; denaturing and transport of pollutants; and fluctuations in the groundwater table. Hydrological processes in the entire vadose zone, part of the earth between the soil surface and the phreatic zone, are affected by soil profile characteristics. Soil processes in the upper solum moderate hydrologic processes within the vadose zone, especially properties of hydrosequences (catena). Restoration of contaminated soils, for maintaining their homeostasis, is achieved through plant-microbe-pollutant nexus within the soil solum. There are 66,000 polluted sites in the U.S. which can be restored through phytoremediation with numerous co-benefits (e.g., soil carbon sequestration, phytomass production, soil health improvement, water purification). The soil-water-plant-energy nexus is moderated by precipitation of water which replenishes the green-water supply for plants and soil

biota, produces biomass as a source of food, feed, fiber, and biofuel feedstock. Indeed, soil is a very large reservoir for water and carbon with strong influences on local, regional and global climate. The energy link is also connected with the climate change through soil-water-food-energy nexus because of numerous interlinked pathways including gaseous emissions, energy and food production and recycling of nutrients and water at regional, national and global scales. Through provisioning of numerous ecosystem services, the soil-water-food-energy-climate nexus is interwoven with the ecosystem security and functioning of planet's four ecospheres (i.e., atmosphere, hydrosphere, lithosphere and the biosphere). As Barry Commoner (1972) stated, "everything is connected to everything else," and the connectivity is facilitated through the pedosphere processes which determine soil health and its functions. The health of soil, plants, animals, people and ecosystems is one and indivisible. This interconnectivity is also the basis of the "4 per Thousand" initiative adopted by the COP21, the Climate Summit of 2015 in Paris.