OPPORTUNITIES AND CHALLENGES IN SEQUESTERING ATMOSPHERIC CO_2 THROUGH RESTORATION OF DEGRADED AND DESERTIFIED LANDS

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Land degradation implies regressive evolution of soil leading to reduction in humus quantity and composition, decline in soil structure, and adverse impacts on soil quality and ecosystem services. Desertification refers to degradation of land in arid and semi-arid regions with attendant decline in ecosystem services especially loss of biodiversity, decline in net primary productivity (NPP) and failure or disruption of ecological succession processes. Soil degradation, diminution in its current and potential capacity to provide ecosystem functions, can be physical, chemical or biological. Land area affected by desertification is estimated at 35.00 X 10^6 km^2 or 23.5% of Earth's total land area, and total population affected is 1.54 billion or 23.9% of the total population. Degraded soils are severely depleted of their soil organic carbon (SOC) and nutrient pools, have poor soil structure and tilth, and are prone to drought stress because of low plant available water capacity. Desertified soils and ecosystems are adversely affected by meteorological, hydrological and pedological drought, and are source of atmospheric CO_2 at the rate of 210 to 260 Tg (1 Tg = teragram = 10^{12} g = 1 million ton) C/yr. Risks of soil degradation increase with increase in population density, and with increase in climatic aridity. In addition to biophysical factors, degradation of soils and environments is also related to the human dimensions such as poverty and desperateness, poor planning, short sightedness and human greed.

Degraded soils and desertified lands can be restored by creating positive C and nutrient (N, P, K, S) budgets through water conservation, establishment of vegetation cover, application of bio solids (mulch) and improving soil fertility. Increasing ecosystem and soil C pools are essential to enhancing soil/ecosystem/social resilience. Technical potential of soil C sequestration in dry land ecosystems is 0.4-1.1 Pg C/yr over the next 50 years. Adoption of technologies by low-income farmers and small landholders can be promoted by trading C credits and commoditization of C. Trading C credits creates another income stream for farmers. Increasing soil C pool also enhances other ecosystem services including erosion control, increase in renewable water quantity and quality, increase in biomass/agronomic production, and adaptation/mitigation of climate change. Improvement in soil quality through C sequestration is essential to advancing food security in developing countries in Sub-Saharan Africa, South Asia, Central America and the Caribbeans. Restoration of degraded soils and desertified lands is essential to improving the environment, mitigating climate change, alleviating poverty and eliminating hunger and malnutrition.