DESERTIFICATION AND GLOBAL CARBON CYCLE

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Abstract

Four main reservoirs regulate carbon cycle on earth. These are fossil carbon ($6000x10^{15}$ g C), the oceans ($39000x10^{15}$ g C), the atmosphere ($750x10^{15}$ g C), and terrestrial systems including soils and biomass ($2000x10^{15}$ g C). Of the total C of $760x10^{15}$ g held by world drylands at the first 1.0 meter, $300\text{-}369x10^{15}$ g are organic C, and $473\text{-}546x10^{15}$ g are carbonate C. 80% of it is at soil depths between 0-40 cm, which is subjected to miniralization and erosion as a result of climate and land use changes. C stored in deeper profiles of the soil by drought-tolerant species has limited importance in gaseous exchanges with atmosphere.

The biomass productivity and the soil organic C reserves of significant parts of world drylands are decreasing due to conversion of rangelands to croplands and land degradation. Intensive grazing and tree cutting coincided with periods of droughts to promote desertification (mainly wind and water erosion). Desertification modifies the fundamental structure and function of dryland ecosystems and disrupts climatic control on production and decomposition accelerating the release of C from the soil. Mean loss of soil C after conversion of drylands to agricultural lands are 46% for tropical drylands and 28% for temperate. Estimates of the peri-agricultural and present land distributions show that out of the 16.4 billion ha of current cropland, 9.4 billion ha came from drylands. Currently, about 70% of world drylands (5.2 billion ha) are undergoing various forms of land degradation. Emphasis on economic rather than ecological sustainability in drylands has generally led to a decline in soil organic C. In addition to *in situ* oxidation of soil organic C, accelerated erosion increases soil organic C loss from the site by selectively removing the C-rich surface horizons. Soil erosion in most of dryland ecosystems is frequently a major avenue of C loss. In wind and water erosion, organic matter is among the first soil constituents removed due to its weight. Topsoil lost annually to agricultural lands through wind and water erosion in dryland regions is estimated at about 15 billion tonnes. Such erosion material is about 5 times richer in organic matter than in the residual soil material.

Soil management strategies in dryland regions have great impact on soil C storage. Combating desertification by establishing agro forestry systems or restoring natural woodlands could contribute to sequestering C and reducing C emissions. Drylands though of low biotic potential (1/4 to 1/3 of that of tropical rainforests) but have an area of 5.2 billion ha capable of supporting some form of agricultural production. Estimates show that sustainable management of grassland and dryland ecosystems can preserve or sequester about $0.5\text{-}1.0x10^{15}$ g C yr^{-1} at a cost of US$ 10-18 per sequestered tonne of C. Cultivation of halophytes in coastal areas and inland wastelands can sequester another $0.5x10^{15}$ g C ha^{-1} yr^{-1} at similar above cost.

Key-words: soil carbon, soil erosion, , carbon fluxes, atmospheric carbon, carbon sequestration.