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Soil Erosion and Agricultural Sustainability

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Data drawn from a global compilation of studies support the long articulated contention that erosion rates from conventionally plowed agricultural fields greatly exceed rates of soil production, erosion under native vegetation, and long-term geological erosion. Whereas data compiled from around the world show that soil erosion under conventional agriculture exceeds both rates of soil production and geological erosion rates by up to several orders of magnitude, similar global distributions of soil production and geological erosion rates suggest an approximate balance. Net soil erosion rates in conventionally plowed fields on the order of 1 mm/yr can erode typical hillslope soil profiles over centuries to millennia, time-scales comparable to the longevity of major civilizations. Well-documented episodes of soil loss associated with agricultural activities date back to the introduction of erosive agricultural methods in regions around the world, and stratigraphic records of accelerated anthropogenic soil erosion have been recovered from lake, fluvial, and colluvial stratigraphy, as well as truncation of soil stratigraphy (such as truncated A horizons). A broad convergence in the results from studies based on various approaches employed to study ancient soil loss and rates of downstream sedimentation implies that widespread soil loss has accompanied human agricultural intensification in examples drawn from around the world. While a broad range of factors, including climate variability and society-specific social and economic contexts — such as wars or colonial relationships — all naturally influence the longevity of human societies, the ongoing loss of topsoil inferred from studies of soil erosion rates in conventional agricultural systems has obvious long-term implications for agricultural sustainability. Consequently, modern agriculture — and therefore global society — faces a fundamental question over the upcoming centuries. Can an agricultural system capable of feeding a growing population safeguard both soil fertility and the soil itself? Although the experiences of past societies provide ample historical basis for concern about the long-term prospects for soil conservation, data compiled from recent studies indicate that no-till farming could reduce erosion to levels close to soil production rates. Consequently, agricultural production need not necessarily come at the expense of either soil fertility or the soil itself, even if recent proposals to rely on conventionally grown corn for biofuels exemplify how short-term social and economic trade-offs can de-prioritize soil conservation. Like the issues of climate change and loss of biodiversity, the ongoing global degradation and loss of soil presents a fundamental social challenge in which the slow pace of environmental change counter-intuitively makes solutions all the more difficult to adopt.