Carbon Sequestration in Terrestrial Ecosystems

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CSiTE, the Department of Energy's research consortium performs fundamental research in support of new methods to enhance carbon sequestration in terrestrial ecosystems in an environmentally acceptable manner. The goal of CSiTE is to discover and characterize links between critical pathways and mechanisms across scales from the molecular to the landscape for creating larger, longer-lasting carbon pools in terrestrial ecosystems. This paper will present results relevant to increasing the biophysical potential of terrestrial C sequestration, but in addition will illustrate the importance of an integrative analysis in assessing this technological option (as well as all sequestration options). Our integrative approach involves six steps: (1) Identify promising technologies, (2) Understand controls on basic mechanisms at the site scale, (3) Perform sensitivity analyses over the range of applicable conditions (model, lab or field experiments), (4) Full C and greenhouse gas accounting, (5) Environmental impacts, and (6) Economic analysis including rate of adoption and cost tradeoffs. Many estimates of the potential contributions of sequestration by terrestrial ecosystems to the control of rising atmospheric carbon dioxide concentration have been rather modest. Indeed, there are many uncertainties and ancillary issues (permanence, land availability, water supply, etc) that must be considered. However, terrestrial ecosystems have not been viewed to-date as a "technology" to be implemented. Rather, the emphasis has been on the promotion of practices that are likely to be implemented for other benefits. It may be possible to use the attributes of terrestrial ecosystems to a greater extent in sequestering carbon. In this paper, we will discuss how a technology view of terrestrial ecosystems may alter the estimated contributions. Examples to be addressed include changing land use, shifting agricultural methods, manipulating soil properties, and altering soil microbial systems.