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Positive Charcoal = Negative Carbon?
Why adding charcoal to the Earth's soils will also address climate change.

Ronal Larson

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We clearly are making progress on global warming education. *Scientific American* magazine's special September-issue theme, "Energy's Future Beyond Carbon," focused on ways to achieve a reduced-carbon future, which experts say is far behind schedule. But like most everything I read on the subject, the articles offered little hope that we can take any of the existing carbon dioxide (CO_2), the major contributor to climate change, *out of* the atmosphere. However, as evidenced by an article in the Aug. 10 issue of *Nature* (www.nature.com/nature/journal/v442/n7103/full/442624a.html), one "negative carbon" possibility seems to be getting another look from scientists: the positive impacts of putting charcoal back into the ground.

In brief, I am talking here of a three-step process: growing biomass material like corn stalks, turning as much of it as possible into charcoal (a heating process called pyrolysis), and mixing the charcoal into the earth's soil. I look at this process as one represented by the acronym "ChAr" and having two *equal* parts: Ch = Climate healing (i.e., "negative carbon") and Ar = Agricultural recovery (i.e., "positive charcoal"). "Ch" works because charcoal in the soil has a very long life. Those converted carbon atoms starting out as CO_2 molecules will stay in the soil as part of a small grain of charcoal for thousands of years. "Ar" denotes that the charcoal greatly improves the quality of the soil.

How could charcoal, prized worldwide for cooking, find a better use by being buried in the ground? The justification for the "Ar" part of charcoal burial goes back 2,000 years or more in Brazil. Manmade soils at many sites there, known as "terra preta" (Portuguese for "black earth"), are still the most productive of perhaps any on earth. Mixing a few percent charcoal in the top several feet of otherwise awful soil allowed these early Amazonians to avoid slash-and-burn farming. After 500 years, terra preta's productivity apparently remains close to its value in the 1500s. Surprisingly, the effect of roughly doubled crop growth and output was rediscovered only during the last few years — as documented in two volumes, both labeled "Amazonian Dark Earth" ("ADE"; Kluwer Academic, 2003, and Springer, 2004).


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This proven carbon-sequestration process is important to revisit today for several reasons: (1) ChAr can help promote more common forms of renewable energy (RE). Specifically, a concentrating high-temperature solar input to the pyrolysis process could reduce overall costs and provide a greater charcoal output. (2) The more awareness of this opportunity there is, the more likely we will see early R&D funding — and we have no time to spare. (3) We can replace costly natural gas used to make fertilizers, which, like natural gas burning, emit substantial global warming gases. (4) Population and famine pressures require that we find a practical way to get substandard agricultural land into productive use. (5) "Standard" forms of carbon sequestration — such as sequestering carbon emissions in the biosphere or in underground caves — have a high-cost, marginal chance of success and no auxiliary values, while "Ar" will find many welcoming recipients. (6) Much of the material that we can pyrolyze would otherwise enter the atmosphere as methane — a more potent gas than CO_2. (7) We can regain much-needed worldwide goodwill if the United States can lead the way.

The obvious ChAr obstacle is that it may be hard to convince some to bury valuable charcoal, just when we are running out of other fossil fuels for heating. Although the development is preliminary, ADE soil scientists are predicting that ChAr will actually lead to more, not less, biomass for energy uses — both above and below the surface.

Secondly, the economics may not be attractive enough at first to get large-scale farmer "buy-in." The economics remain to be refined, but probably will need to start with incentives and subsidies. Unfortunately, unless we join the Kyoto protocol, these larger incentives will go to farmers in other countries. My reading is that ChAr will eventually be a least-cost sequestration approach (details at www.eprida.com).

To make the economics work, we will have to prohibit the traditional, highly polluting methods of producing charcoal. The pyrolysis gases can provide a valuable chemical "liquor" and/or be used for thermal purposes like cooking — the major use of energy for half the world's people.

The ChAr process must depend on agriculture and forestry interests. Many U.S. farmers and foresters are already converting their produce and wastes into energy-based revenues; ChAr provides important added climate and soil-improvement-financial motivations.

Many agriculture/forestry RE strategies to address climate change are already being promoted by the politically astute organization 25x'25 (www.25x25.org), whose mission is to produce 25 percent of U.S. energy supply from the land by 2025. Although very new, by mid-September, 25x'25 had been endorsed by 27 U.S. senators, 20 governors or state legislatures and almost 300 national/state/local groups (including the American Solar Energy Society and three chapters).

To personally support 25x'25, I organized a workshop and a forum at the ASES SOLAR 2006 conference, focusing on the 25x'25 goal — now well known in Colorado. Several SOLAR 2006 plenary speakers also referenced this rapidly growing, rural America side of renewables. ASES Executive Director Brad Collins and I represent ASES in continuing 25x'25 planning meetings. Readers can similarly help by encouraging our ASES chapters and other local renewable energy organizations to be active with 25x'25. Better than any other national group, 25x'25 can help ChAr get the R&D start that is critically needed.

I look forward to hearing from readers on other ways we can "break new ground" with the barely recognized, but, I believe, most promising potential of ChAr. ●

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