Understanding Tropical Soils: Part 3

This article is continued from Understanding Tropical Soils: Parts 1 and 2.

by Dexter B. Dombro

With the discovery of *Terra Preta*, many people want to implement biochar programs. This can be especially difficult on a large scale, but solutions are being developed all over the planet. Some of the examples given here are based on the methodology being developed at the ***Amazonia Reforestation*** and ***CO2 Tropical Trees*** La Pedregoza plantations in the Orinoco River basin of Vichada, Colombia, together with designs and solutions that have been developed by biochar enthusiasts worldwide. For more information I highly recommend checking out the ***International Biochar Initiative***, of which I am a member.

Tree pruning produces a lot of biomass.

At La Pedregoza we have noticed that when pruning *Acacia mangium* cultivations, there are approximately 5 KG of branches and twigs being removed per tree. Since there are around 1,200 trees per hectare in an *Acacia mangium* plantation, this means that there is approximately 6 metric tons of woody biomass available per hectare (2.47 acres). Biomass from pruning at present has no ready markets, so this is a boon to planters, as the pruned material can be gathered and converted into biochar. Other tree species produce similar results, and as mentioned before charcoal can be made from just about any vegetal matter.

As trees mature in cultivations, the ones that are performing poorly are often culled to allow better growing trees to expand and to receive more light. Culling is also a way to better aerate a plantation, especially in wet tropical conditions. This culled woody biomass may have some economic value (fence posts, wood pellets, small boards etc.), but a lot of it can also be converted to biochar. Needless to say, biochar can also be sold to neighbours and others as a processed product. In hardware and garden centers around the world biochar packages for home gardeners can fetch significant prices, which help to support farmers and plantation owners. The point is that tree plantations and agricultural projects generally speaking have sufficient biomass available to implement biochar programs.

Biomass of culled trees.

Pruned biomass on forest floor decomposes slowly and releases greenhouse gases.

It should be mentioned that if the culled or pruned material is simply left to decompose on the ground, there may be some limited benefit to the soil. However, consider this: it takes many years for a large pruned branch to decompose. All the methane and co2 locked in the decomposing wood is released into the atmosphere, adding to greenhouse gases. While the biomass slowly converts into organic material, it does not become a retention agent, improving the soil's CEC. This is why collecting it and converting it to biochar makes more economic and environmental sense.

Once the benefits of biochar were identified, people quickly realized that traditional methods of making charcoal are not really desirable. Traditional charcoal making involved pits filled with biomass or wood piles being burned and then doused at some point before all biomass is consumed. Unfortunately, this method has two large drawbacks. The first is that all greenhouse gases in the biomass are released into the atmosphere, which is completely undesirable. The second is that on average this method has a very poor 10 to 1 conversion rate, with one ton of biomass producing only 100 kg of charcoal. This makes it economically inefficient and wasteful. Unfortunately, it is the prevalent method of making charcoal in much of the developing world, and in some countries a leading cause of deforestation.

Traditional charcoal making is inefficient and not very environmentally friendly.

Photo courtesy of Chris Adam.
This is an example of an environmentally friendly Adam Retort for making biochar in Senegal.

The best way of making biochar is to construct retort ovens that rely on pyrolysis or low oxygen burning to convert the biomass to charcoal. Retorts are basically sealed chambers inside ovens that allow the operator to control the pyrolysis burn in a low oxygen environment. The retort is packed with biomass and sealed so that very little oxygen can enter. Some biomass is placed inside the oven area and lit, so that it can start to heat up the retort. As the biomass inside the retort gets hot, it starts to release the greenhouse and volatile gases in the biomass, which are gathered and piped or ducted back down into the oven area, where they burn off while continuing to heat the retort. The biomass inside the retort chamber turns to charcoal. These ovens are environmentally friendly, can be built fairly cheaply using locally available resources and supplies, and have a much better conversion rate of 10 to 3.5, meaning for every 1 ton of biomass one can produce around 350 kg of charcoal.

At La Pedregoza we are in the process of constructing 3 large ***Adam Retorts***, based on a design development by a German Ph.D. by the name of Chris Adam. Our goal is to produce on average 1 metric ton of charcoal per day and to then charge it with organic material so that we will have substantial biochar with which to improve our soils (*see the soil sample in Part 1*). In Part 4 of this series we will discuss the charging of the biochar and its application to the soil, as well as how best to use wood ashes, which are another by-product from making charcoal.