MENDOCINO COAST TRANSITION TOWNS:

Concerns:

- **People don't know what biochar is (Charles)**

While charcoal has been an integral part of traditional farming practices in many parts of the world, it is true that the use of biochar in agriculture and gardening is a new idea for most people in modern society. Grassroots efforts are expanding across the U.S. to tell the story of biochar and generate interest in both the consumer markets and agricultural sectors.
Locally, the Sonoma Biochar Initiative is conducting outreach and education for biochar and sponsoring field trial studies to learn more about the benefits and potential challenges in this bio-region: www.sonomabiocharinitiative.org
The International Biochar Initiative is a great resource for developments in the scientific, business and grassroots arenas: http://www.biochar-international.org

- **Extracting nutrients depletes forests (Judy)**

This is one of the primary concerns that the Woody Biomass Working Group (WBWG) has heard from the community around biomass removal from forests. The Sierra Institute considers nutrient levels to be one of the key indicators for sustainability of forest biomass removal. The woody part of a plant is made up of mostly carbon, which is not actually a nutrient. It is my personal understanding informed by conversations with Yana Valachovic, a soil scientist with the UCCE in Humboldt, that carbon availability is not a limiting factor in soil health for the regions forests. However, like biochar wood carbon can act as a soil amendment and removing too much carbon could impact forest nutrient cycles indirectly.

Stewart et al. (2010) is a great resource for better understanding this:

"For forest soils in California, nitrogen, phosphorus, potassium, and calcium are the major limiting nutrients for growth (Powers, 1975). Since trees capture carbon from the air rather than from the soil, soil carbon is not considered a direct nutrient but does play a key role in improving the soil quality in terms of water holding capacity, drainage and as a structural anchor for other nutrients." (30)

Stuart et al. aggregates research on nutrient levels in California forests that have undergone harvesting and biomass removal. The study finds that:

"The historic removal of the carbon in the boles of the trees and nitrogen in the foliage does not seem to have left any strong evidence of long term nutrient deficiencies in these soils." (34) The study goes on to say that *" It would appear that soil carbon levels in California are more a function of the climate and underlying geology than of any temporal changes from timber harvesting." (37)*

While this study helps address the concern around forest nutrients and biomass removal, the WBWG in collaboration with the coastal working group have decided that because this is such a key concern of the community we would explore the issue

further. We have developed a project to help define how much biomass should remain in Mendocino County Forests (by forest type) in order to achieve ecological sustainability (nutrient levels being one of the key indicators of ecological sustainability). We are in the beginning phases of the project Greg Guisti, a biologist from U.C. Berkeley will conduct a literature review to help answer this question. We will have a series of outreach events throughout the county to share the results.

The link to the sited study is listed below. The pertinent pages are from 30-37

Stewart, W., R.F. Powers, et al (2010). "Potential Positive and Negative Environmental Impacts of Increased Woody Biomass Use for California." Public Interest Energy Research Program (p 30-37)
http://www.energy.ca.gov/2011publications/CEC-500-2011-036/CEC-500-2011-036.pdf pages 30-37

- **Ph implications in redwood forests (Charles)**

I was not able to locate any studies completed specifically in the area of effects of biochar in redwood forests, however there has been work done on examining naturally occurring char in forests with recurring forest fires that is similar to the redwood forest environment.

"Biochar collected from forests that had been exposed to recent forest fires was found to stimulate net nitrification in soils from low-elevation ponderosa pine forests that otherwise demonstrated little or no nitrification (Deluca et al, 2006). Nitrification activity as measured using an aerated slurry method (Hart et al, 1994), was found to be extremely low in soils collected from sites that had not been exposed to fire for approximately 100 years and relatively high in soils exposed to recurrent fire (DeLuca and Sala, 2006)."

Biochar for Environmental Management – Johannes Lehmann and Stephen Joseph 2009; Page 257.

This finding supports the notion that biochar amended soils in forest environments will likely improve the nitrogen cycle nutrient management but additional careful study should be conducted to test the effect of PH balance before wide-spread applications are implemented.

- **Use dead standing trees, don't take everything for biochar- other uses (Judy)**

From an economic and best use perspective this makes total since. Using the lowest value/ highest hazard wood sources would be ideal for biochar creation. However, there is nothing guaranteeing that each piece of wood removed from a property will

be taken for its best possible use. Other areas have undergone analysis to help define the best use of forest products based on existing infrastructure.

Questions:

- **Why do we see exponential growth in year 4 after the biochar has been applied? (Charles)**

The majority of studies on productivity from soils amended with biochar are relatively short (1-2 years on average). The long-term fertility effects studied are primarily done on existing Terra Preta soils in the Amazon region and naturally occurring char content in prairie soils in the mid-west United States. The strongest indication for the increased fertility over time comes from the increase in the cation exchange capacity (i.e. the electrostatic properties of the carbon atoms to hold on to nitrogen and potassium) and the increased microbial activity. Following is the abstract from the study I referenced:

Maize yield and nutrition during 4 years after biochar application to a Colombian savanna oxisol
Julie Major & Marco Rondon & Diego Molina & Susan J. Riha & Johannes Lehmann

The application of biochar (biomass-derived black carbon) to soil has been shown to improve crop yields, but the reasons for this are often not clearly demonstrated. Here, we studied the effect of a single application of 0, 8 and 20 t ha−1 of biochar to a Colombian savanna Oxisol for 4 years (2003–2006), under a maize-soybean rotation. Soil sampling to 30 cm was carried out after maize harvest in all years but 2005, maize tissue samples were collected and crop biomass was measured at harvest. Maize grain yield did not significantly increase in the first year, but increases in the 20 t ha−1 plots over the control were 28, 30 and 140% for 2004, 2005 and 2006, respectively. The availability of nutrients such as Ca and Mg was greater with biochar, and crop tissue analyses showed that Ca and Mg were limiting in this system. Soil pH increased, and exchangeable acidity showed a decreasing trend with biochar application. We attribute the greater crop yield and nutrient uptake primarily to the 77–320% greater available Ca and Mg in soil where biochar was applied.

- **Analysis of pre-condition of forests- what are we going back towards? (Judy)**
- **What is the optimal forest ecosystem here? (Judy)**

The above two questions are related. It is impossible to define the original state of our forests. Even before industrial logging, Native Americans used forestland in a way that would have altered it from its "original state". Before people, the climate in this region was different likely supporting a different array of species than what we see currently. Ecosystems evolve- however, you can take a snapshot in time and say our forests functioned better then than they do now.

Defining what is optimal from a human perspective is inherently subjective. To one person an optimal forest ecosystem would be park like, while others would seek to maximize certain types of habitat i.e. spotted owl habitat. Generally the WBWG has strayed away of defining what the optimal forest would look like, instead focusing on improving the functionality of currently degraded forestland. This is includes ecological functionality (i.e. erosion control, nutrient cycling, fire risk reduction etc.) and the functionality of forest based economies (sustainable timber harvesting, biomass utilization etc.). In other words it is less about what we are trying to go back towards, and more about improving forest functionality based on what we have today. What this will look like will inevitably be different than what a highly functioning ecosystem looked like 100, 1,000, or a million years ago.

- **Does the market become saturated? (Charles)**
- **What amount could be used locally? Is there a limit? (Charles)**

Both of these questions can be addressed in a similar way. The body of literature on how much biochar can be safely added to topsoil and what amount is optimal is quite varied at the moment. A good point of reference is 1 ton per acre. Given that amount over a good portion of the agricultural land in Mendocino County, it would take many years of operations to reach even one application widely distributed. In most regions, biomass is the more critical limiting factor which is why sustainable production principles are so important to any new proposals.

I am attaching a report that looks at the global potential for carbon offsets utilizing available, sustainable biomass to provide some more detail on how these calculations are done in large systems.