BENEFITING LOWER WATERSHED HEALTH THROUGH UPPER WATERSHED WILDFIRE RISK REDUCTION PROJECTS: Forest2Farm Biochar Concept

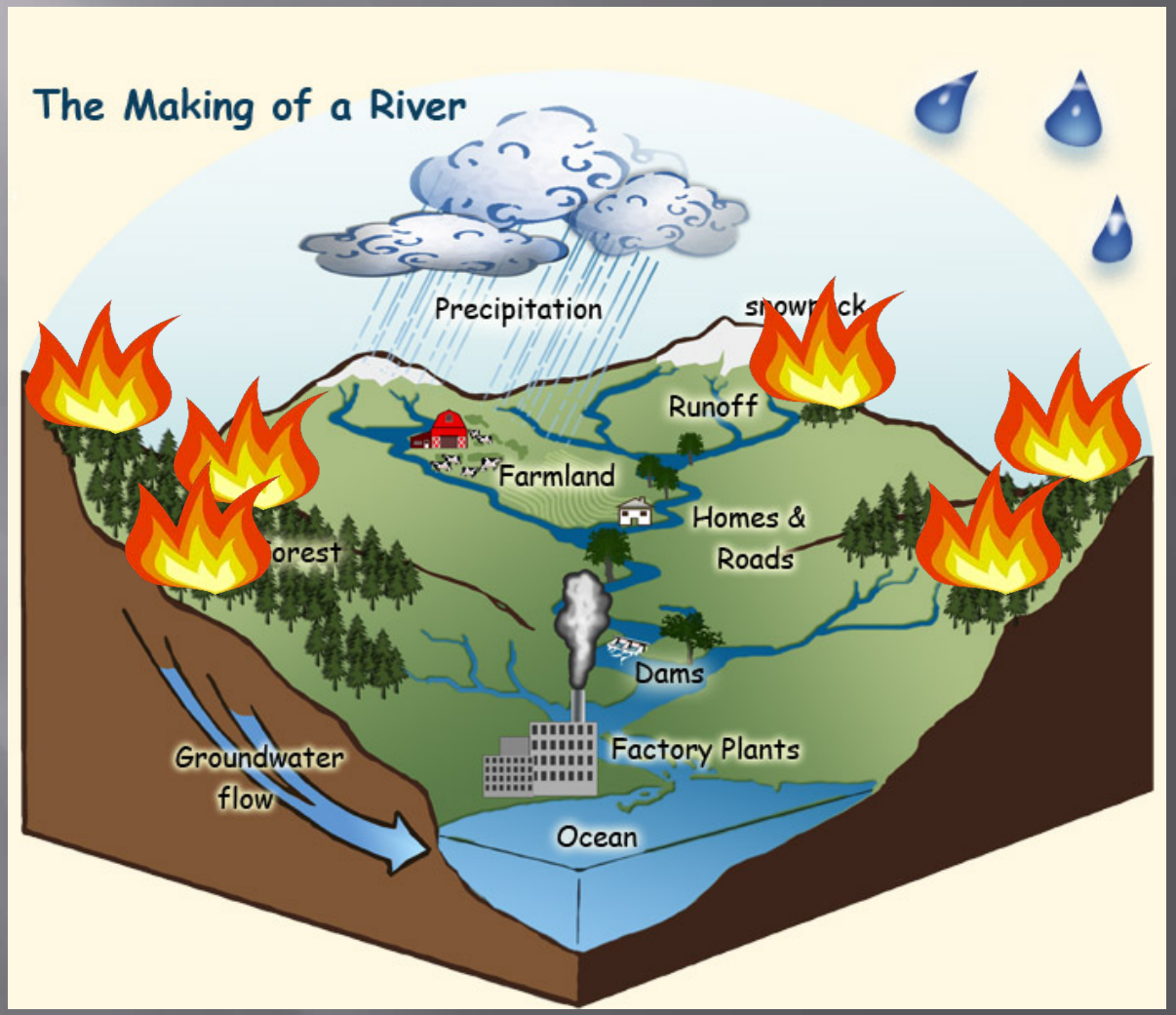
Jim Archuleta
Region 6 Biomass Coordinator

Charcoal In the Soil

Schmidt & Noack (2000) Black Carbon in Soils and Sediments

- Charcoal is ubiquitous in soils and sediments since Devonian times.
- On land, Black Carbon (charcoal) seems to be abundant in dark-colored soils, affected by frequent vegetation burning

Watershed View



Adapted from A.Vicente, U.S.Forest Service.

Charcoal laden sediment debris flow

1990 Pine Springs wildfire Malheur NF

Credit :James David, FS Forest Soil Scientist

Charcoal in the forest

- Upper watershed charcoal production :
  - Incidental wildfire or Managed controlled fire.
- Deluca & Applet (2008) - Charcoal is formed by 1-10% of total biomass consumed by a fire.
- Stable charcoal (Biochar) produced by wildfire is a low
- Low intensity/short duration fire creates the most stable charcoal.
- Manufacture of charcoal for Biochar can produce around at least 10-15% of biomass consumed by fire.
  - Depending upon method used.
- Fire return interval in natural charcoal production can be sporadic and may not occur where needed.

Upper Watershed (UW) Problem

- 2017 – of the Forest Service Budget ($4.9 billion)
  - 193 million acres of land management.
  - ~50% (~$2.4 billion) was used for fire suppression in 2017.

UW Problem

- Material creating the greatest risk of wildfire is 100 hr. fuels (<3" diameter)
  - This material is assumed to be without value.
- Fuels Management is different from timber management, which focus on material ~>6" diameter for saw log and pulp production.
  - Fuels treatments costs can vary between $200-$1200 ac depending upon locations
- Landscape management activities are needed on a scale beyond the scope of timber sales, to deal Wildfire risk and spread.
- Biochar, may offer a way to pay for some measure of that needed land treatment

FS Charcoal Production Historical

Very little charcoal is made today in sod-covered pits. This operation was photographed in New Jersey in 1928.

SHORT LIST UW TREATMENTS
THAT CONCENTRATED BIOMASS FOR BIOCHAR

1. Timber sales
    1. (timber production or wildlife habitat objectives)
2. WUI Fuels reductions
    1. Wildland Urban Interface (city/forest)
3. Road work (Fed Hwys, FS)
4. Power Transmission Line (NF Easements)
5. Stream restoration or realignments

Low Watershed Problem

- Loss of SOM in the farm environment. Partly from the environment and partly from farm practices.
- Dr. Machado (OSU CBARC), Some farmers in the Columbia Basin have lost as much as 50% SOM.
  - In this dry-land farm area SOM is important to water management.
  - Some of these farmers have also begun to consider Lime applications, attributed to low SOM.
- Lal 2010, most agricultural soils have lost 25% to 75% of their original soil organic carbon (SOC) pool.

Feedstocks Carbon to Nitrogen Ratios

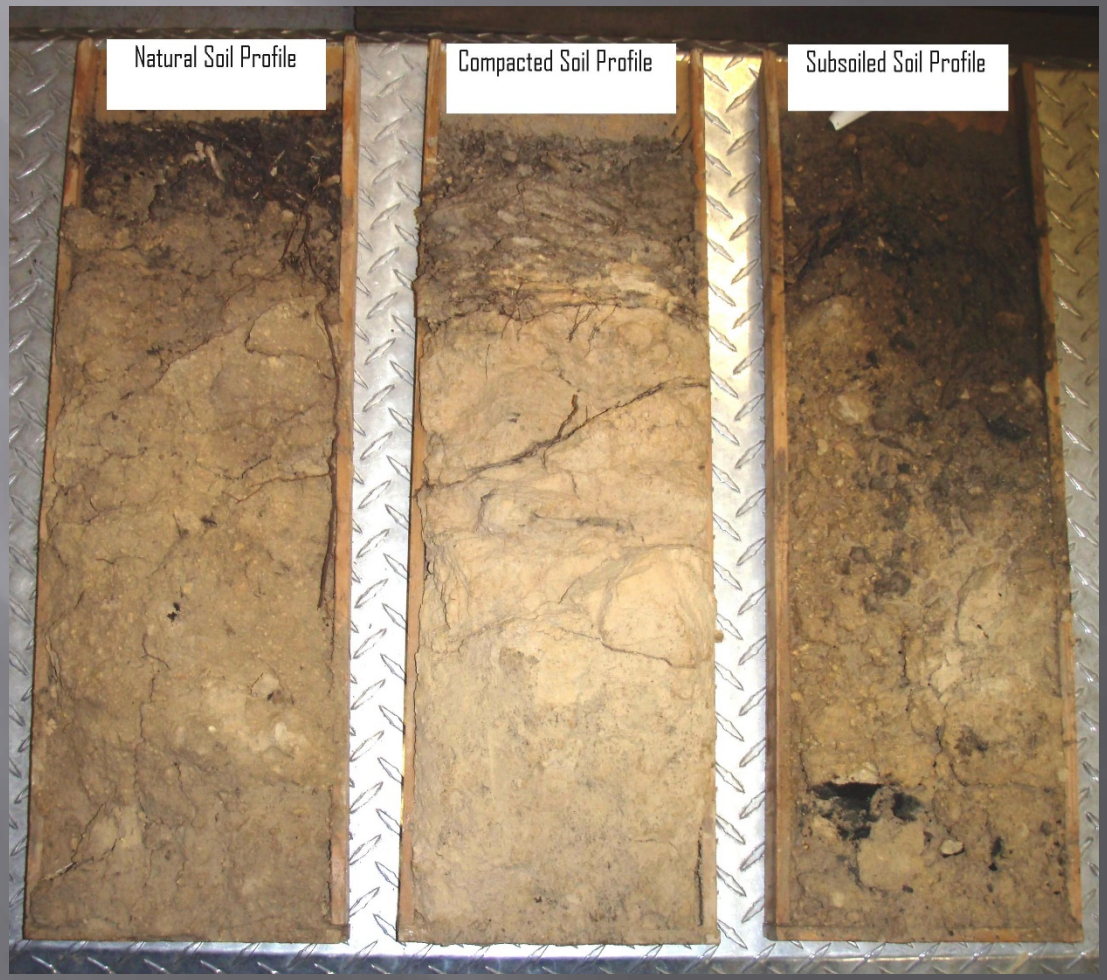
Material	Carbon to Nitrogen Ratio (C:N)
Grass Clippings	17:1
Nut Shells	35:1
Corn Stalks	60:1
Straw, Hay	90:1
Saw Dust	500:1
Woody Chips & Twigs	700:1

Biochar to supplement SOM/SOC losses

- Some traditional forms of soil organic augmentation
  - Manures
  - Cover Crops
- When is Biochar a good option for soil augmentation
  - Available manures are limited or close to 303d listing
    - Adding biochar manure increases volume and may limit any nutrient leachate
  - Cover Crops in some dry environments may limit water availability when desired crops are grown.
    - Biochar with Cover Crops to build SOM and water capacity
  - Inherently low SOM or reclamation objectives.
    - Using biochar to bring more acres into ag production

Soil Monoliths example of SOM loss

Nat, Altered, Restored



Maple Cr. Forage plots Umpqua NF

Benefits of carbon in recent literature & practice

- Charcoal can influence N Cycling in P Pine - Forest
  - Deluca. et al. 2006
- Retains nutrients for higher crop yields - Farm
  - Major. et al 2009.
- Reduce the mobility of soluble contaminants - Variable
  - Beesley. et al 2010.
- Carbon Band Seeding in Willamette Valley - Farm
  - Lee 1973- Willamette Valley Grass Production
- 25,000g/ac for every 1% increase in SOM.
  - NRCS claim

Biochar Implications to Both Watershed Positions (Upper & Lower)

- Improvements in the Watershed
  - Climate change mitigation
    - Drought buffering in the forest and cropland
  - Water holding capacity & Infiltration
    - Reduced runoff
    - Sustained summer stream flows (T&E Species)
  - CEC – Improving plant available nutrients/Decreasing Soluble nutrients
  - Empirical Carbon Sequestration Accounting
    - Other methods are relying on assumed vegetation growth and yield.

Proposed method

- FS is currently exploring methods to make biochar in the woods. This manufacturing scenario is expected to
  - Reduce the cost of transport of raw materials
  - Eliminate some of the existing logistical hurtles of biomass transport.
  - Forest treatments that previously only produced acres treated may have a means to produce a marketable product.
- While this project is not the only way to make biochar, it may offer a new way to treat acres and benefit the entire watershed.

Does Biochar Soil Augmentation have any drawbacks?

- Maybe to Yes - Issues are either site or soil dependent
  - Unaged Biochar may initially tied up nutrients as they fill surface bonding sites
  - If applied to a histic soil, Biochar could initiate or speed decomposition . Wardle, et al 2008
    - Salem, OR Don't use at Lake Labish (Salem OR, peat soils) until more is known
  - If moisture retention is changed on unstable moist slopes; the soils angle of repose could be further altered
    - With the variation in precipitation from Climate Change, Biochar Rx should be done judiciously above 35% slope.

Questions

??????????

jgarchuleta@fs.fed.us