Biochar and Food, Water and Energy NEXUS

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OUTLINE

- Problem Highlight
- The History
- Biochar technology
- Biochar technology performance and uses
  - Energy
- Biochar and Food; Biochar/biofertilizer nutrient and water NEXUS
- International recognition
Situation
- Land degradation and poor soil fertility due to deforestation and climate change;
- Drought /Irregular rainfall/Poor or no harvest;

Challenge
- Food insecurity;
- Inefficient Energy Access;

Effect
- Climate change related poverty;
- Migration.

Problem?
THE HISTORY

- The ELSA (biochar) burner was developed for Africa through scientific cooperation between ASA Initiative, ECREEE, Starter and European/African Universities under EU/ACP S&T Programme.
BIOCHAR TECHNOLOGY

- Slow pyrolysis, low-temperature plant/cooking stove
- Uses biomass - agro and agro-industrial residues/waste for pellet as fuel; and
- raw biomass such as empty palm bunches, various types of nuts shells and corn cobs etc.

- Pyrolysis process, syngas released from feedstock, is burnt cleanly with negligible emissions of CO$_2$, CO, NO$_x$ and PM, improving indoor/outdoor air quality over wood & charcoal stoves.
Pelletizing or fuel processing
Turning Waste into Fuel

Corn cob - Agrowaste

Pellets for cooking = more efficient burning time
Biochar burner - One aspect of the Technology

Efficient quality biochar

- Produces heat for cooking and releases by-product - Biochar

Biochar from Biomass
Performance of Technology

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<th>Energy - Performance</th>
<th>Biochar-Output and quality</th>
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<tr>
<td>• 0.6-1.5kg of fuel produced energy for cooking for 1-2hrs depending on fuel quality and air conditions with fire power of 2.7kw;</td>
<td>• 100% of biomass input results into 25-30% biochar;</td>
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<td>• Used to cook for 2-12 household members.</td>
<td>• High level biochar;</td>
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<td>• Up to an hour for industrial cooking with solid biomass;</td>
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<td>• High thermal efficiency 20 - 25%</td>
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ELSA BIOCHAR TECHNOLOGY-USES

❖ The energy produced is **Green**; carbon stored in the biomass (70%-90%) converted to gas (10% to 30%) turned to black char (**biochar**)

❖ It could be used for cooking & produce biochar simultaneously **or** to produce only biochar **or**

❖ converted to generate bio-electricity.
1. Domestic use = Household cooking
2. Industrial use = Oil processing etc
Effect of Energy access:

• by 17,576 resident families would cause a decrease in deforestation rates of 0.12\% year\(^{-1}\)(=25,530 t of wood year\(^{-1}\)) with fuel substitution of waste coffee husk, corn cob etc.

Capable of producing fire power of 187,068 MJ year\(^{-1}\)

• Carbon stored in fuel (biomas) =1/2 is converted to gas and 1/2 remains in the created char. (Source: adapted from Wilson (2013), based on Biochar Solutions Inc. (2011), printed in Roth (2014))
Large plant Pyro-Gasifiers

100% Biomass as input

- Large Plant for factory/off grid power
- 90% of Biomass converted to

Bioelectricity Production/Off grid energy access

Biomass source or a central point where biomass can be easily accessed.

Biofertilizer for application to farm land
Biofertilizer for Soil Amendment

- Biochar/Biofertilizer

- Biochar fields
Output of Maize farm with Biochar Treatment

- Resistant to drought;
- Resistant to army worm infections.

- Healthy and sturdy growth;
- Maize on every part of the cob.
- More biomass generated.

Double Output
Maize from Non Biochar treated farm

Maize Farm with no biochar = Same maize variety = less biomass

Maize Output with no biochar treatment
Biochar helped produce healthy food by preventing the crop from absorbing toxic elements like weedicide and other heavy metals from mining activities;

Improved weed management; (soft weeds)

Biochar facilitated water and nutrients retention of the crop land over long period and make it available to the plants;

Application of biofertilizer changed the soil structure by improving soil fertility;
Biochar prevents certain soil and plant diseases.
Biofertilizer removes soil-borne diseases such as Nematodes.
Biochar and water retention

Two farms with the same boundary, Pawpaw variety, planting time. **Biochar** retains water and nutrient over long period of time and make it available to the plant.
INTERNATIONAL RECOGNITION

- Evaluated (Dec 2016) by FAO-Rome as the best IFES for Africa
Thank You

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