Lotta alla Desertificazione ed all' effetto serra in Togo, Sierra Leone e Ghana

prof. Alessandro Peressotti

BeBi

Agricultural and environmental Benefits from Biochar use in ACP Countries

ACP Science and Technology Programme

Africa Centrale: cooperazione e opportunità di collaborazione per il FVG

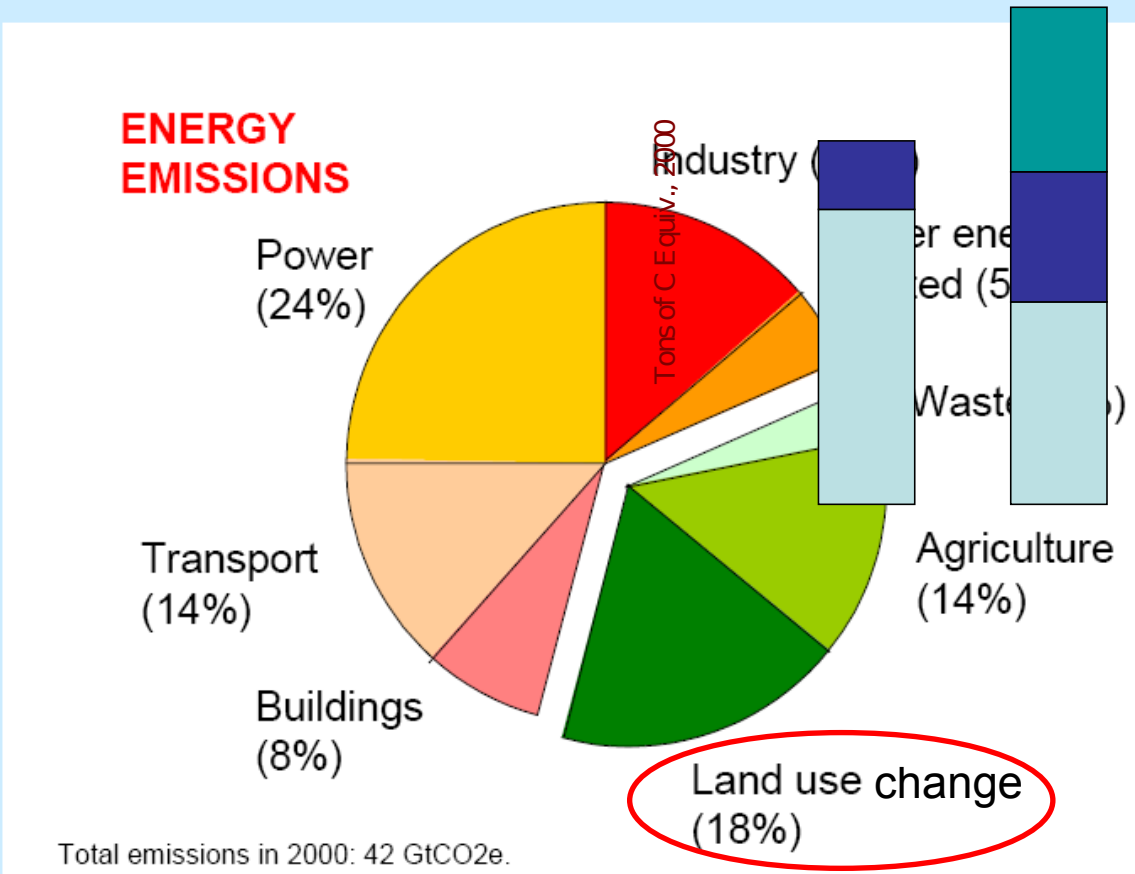
Udine, 27 Settembre 2010

Outline

- GHG emissions and climate change
- Desertification
- Indoor Air Pollution
- The Bebi project
  - Pyrolytic stoves
  - Biochar
- Conclusions

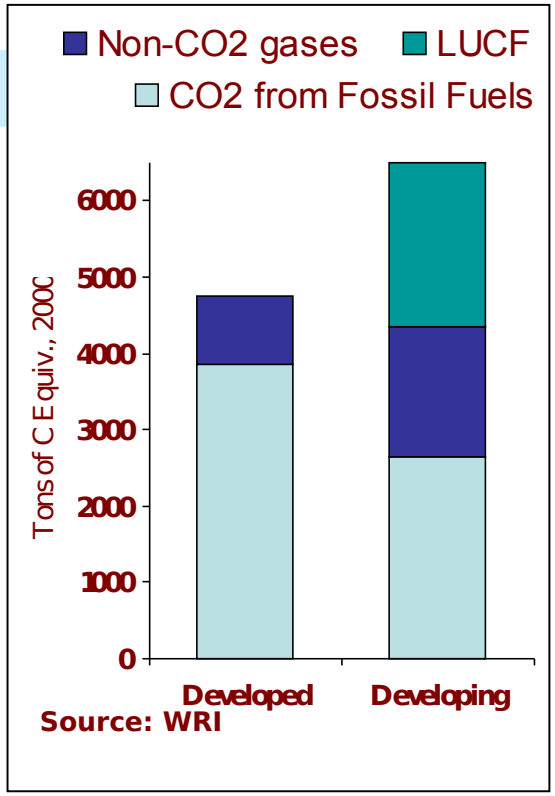
Green house gas emissions

Figure 1 Greenhouse-gas emissions in 2000, by source



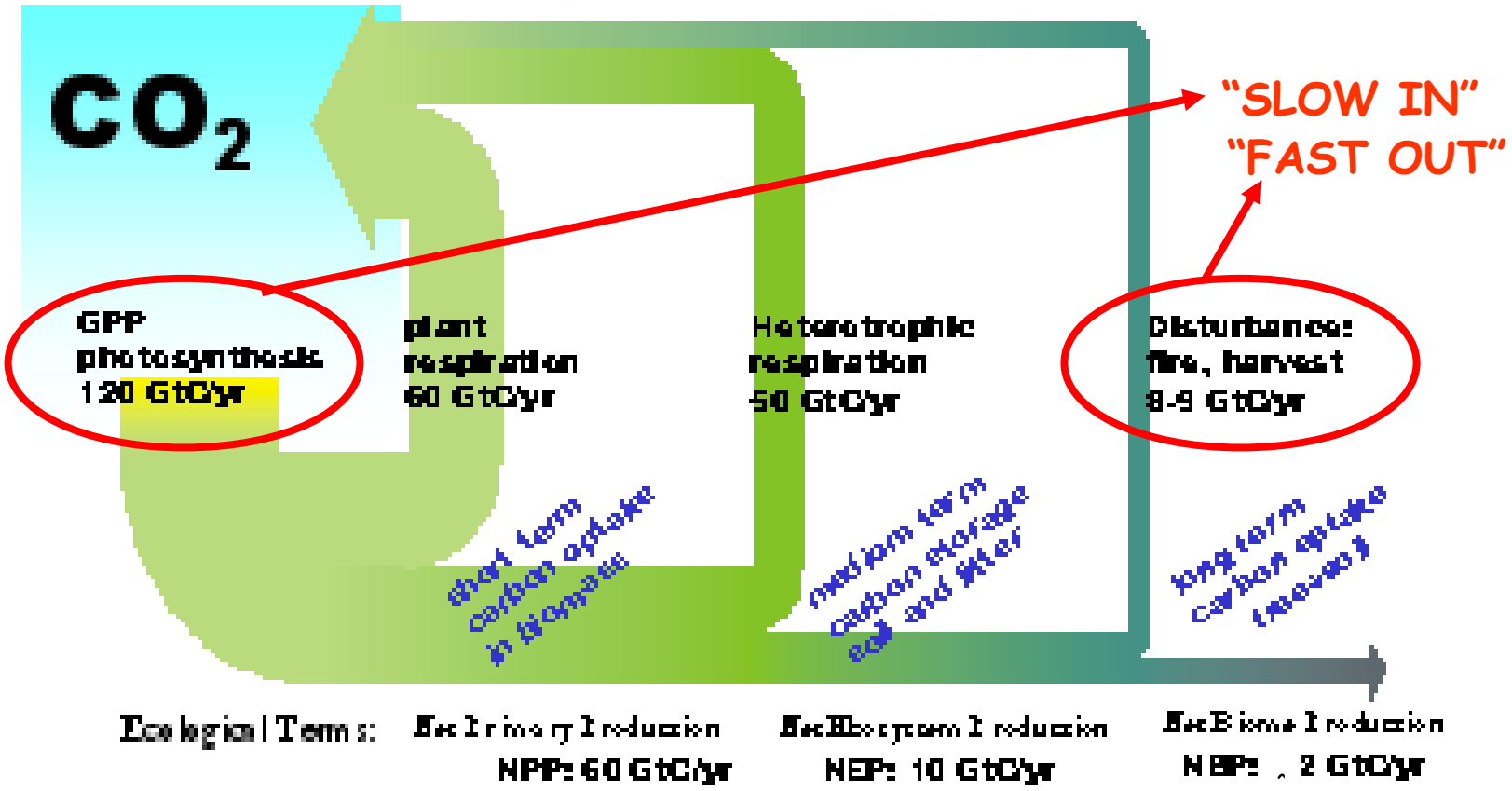
Total emissions in 2000: 42 GtCO2e.

Energy emissions are mostly CO_2 (some non-CO_2 in industry and other energy related).
Non-energy emissions are CO_2 (land use) and non-CO_2 (agriculture and waste).

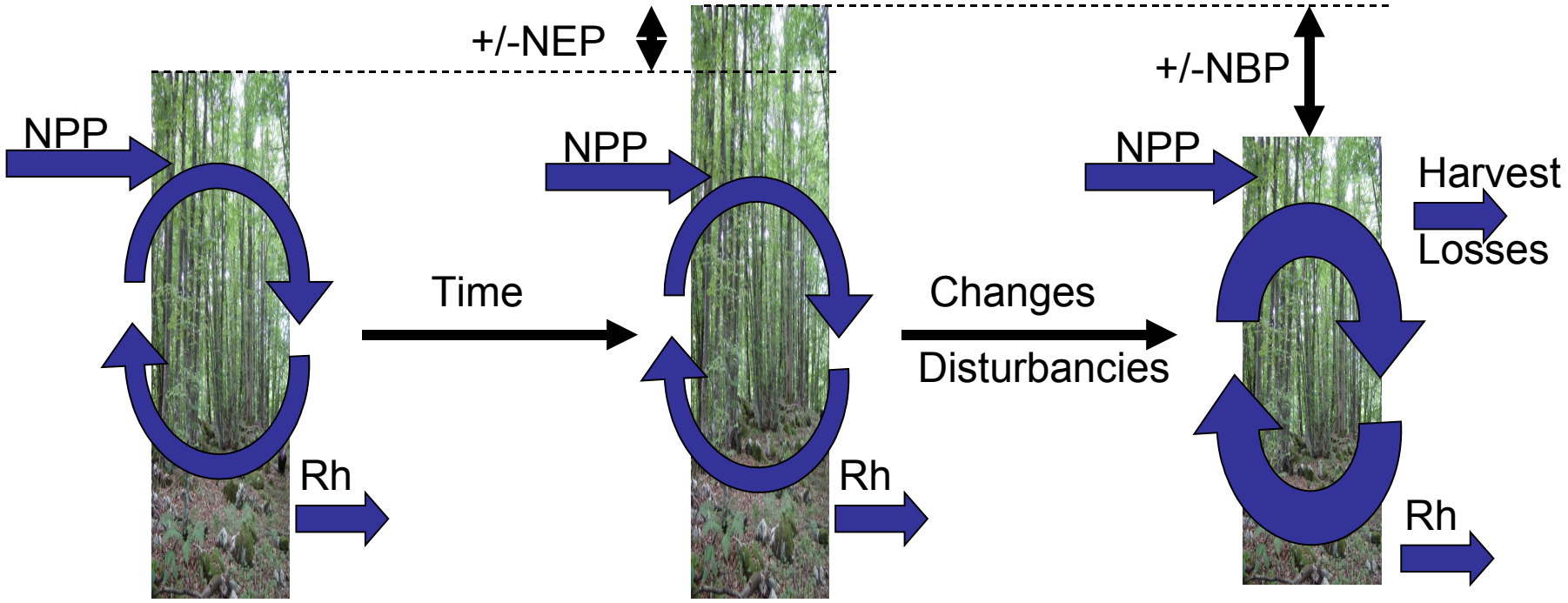


Source: Prepared by Stern Review, from data drawn from World Resources Institute

The atmospheric Carbon cycle



How carbon moves into ecosystems and how we can measure or manage it



Desertification

NBP<0 Carbon losses>Carbon Gains

Traditional fuels in the world

- 2.5 billion people rely on traditional fuels for cooking and heating : wood, charcoal, dung, crop residues (UNDP, 2007).

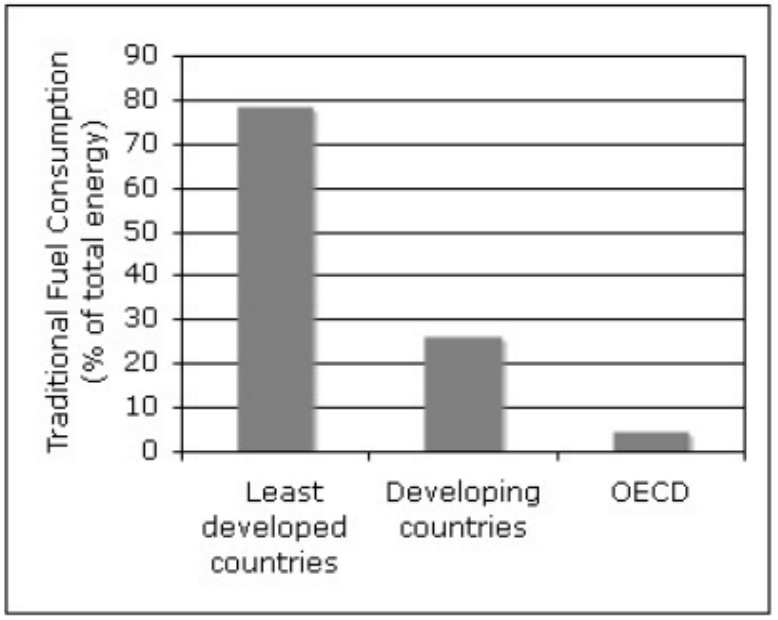
- Inefficient combustion:
  - Deforestation
  - Global warming

- Incomplete combustion indoor and absence of chimney :
  - Indoor air pollution

- Time of exposition :
  - 3–17 hours daily (WHO, 2000 (22)

- People exposed :
  - mainly women and children

Figure 2. People relying on traditional fuels as a percentage of total energy



Source: *UNDP Human Development Report 2006*

Indoor pollutants concentration

Pollutant
Particules (small particles less than 10 microns, and particularly less than 2.5 microns aerodynamic diameter)
Carbon monoxide
Polycyclic aromatic hydrocarbons, e.g. benzo[*a*]pyrene
Nitrogen dioxide
Sulphur dioxide
Biomass smoke condensates including polycyclic aromatics and metal ions

- 24-hour mean PM10 levels typically : 300–3000 µg/m3
- during cooking 30 000 µg/m3 (WHO, 2000)
- > WHO guidelines : 50 µg/m3 (WHO, 2005)

- 24-hour mean CO levels typically : 2–50 ppm;
- during cooking : 10–500 ppm
- > US Environmental Protection Agency's : 9ppm

Health effects

Indoor air pollution kills 1.3 million people per year, mostly women and children > than malaria, and almost = tuberculosis and AIDS (WHO, 2006)

It is the most important cause of death among children under 5 years of age in developing countries (WHO, 2000).

Project outline

BeBi

Agricultural and environmental Benefits from Biochar use in ACP Countries

Conceptual framework

BeBi

Health

Deforestation

Desertification

Climate change

Sustainable development

Pyrolytic Stoves

more efficient (use less biomass)

Less air pollution (burn gas)

Produced locally (economic development)

Biochar

Produced by pyrolytic stoves

soil amending (against desertification)

C sequestration (climate change)

BeBi

Agricultural and environmental Benefits from Biochar use in ACP Countries

Partners

University of Udine
Italy

Ibimet
ISTITUTO DI BIOMETEOROLOGIA

CNR

Florence Italy

WorldStove
Italy

Starter
Italy

University of Lomé
Togo

Njala University
Sierra Leon

Sauve Flore
Togo

CORD SL
Sierra Leon

ASA Initiative
Ghana

University of Cape Coast
Ghana

BeBi Key figures

Grant	FED/2009/221814
Title	**Agricultural and environmental benefits from biochar use in ACP Countries (BeBi)**
Co-ordinator	**Prof. Alessandro Peressotti Università degli Studi di Udine, Italy**
Project duration	36 months From 10/11/2009 to 09/11/2012
EC co-funding	EUR 839,738.15
Total budget	EUR 987,927.24
ACP countries and regions involved	Western Africa – Ghana, Sierra Leone, Togo Europe - Italy
Programme theme(s)	Agriculture and agro-industry Environmental research
Sector(s)	Agricultural education/training; Rural development
Keywords	Biochar, soil fertility and conservation, health risks

What is a pyrolytic stove ?






TLUD gasifier cookstoves. [Clockwise from upper-left corner.]

1. Reed Campstove *#6
2. BP Oorja *#7
3. Reddy Magh-CM1
4. Anderson Juntos B
5. Drummond-Cedar
6. Flanagan Biochar
7. A&W Servals PP-Plus
8. Wendelbo Peko Pe *#10
9. Anderson Champion *#5
10. ARTI Agni (based on Champion)
11. Karve Sampada Charcoal Maker *#8
12. Daxu (China)

1 – 5 have Forced Air. 6, 9, 12 have a chimney.
1, 2, 7, 8, 10, 11, 12 have or had commercial production.
*#__ indicates emissions data in table/graph (some models vary).



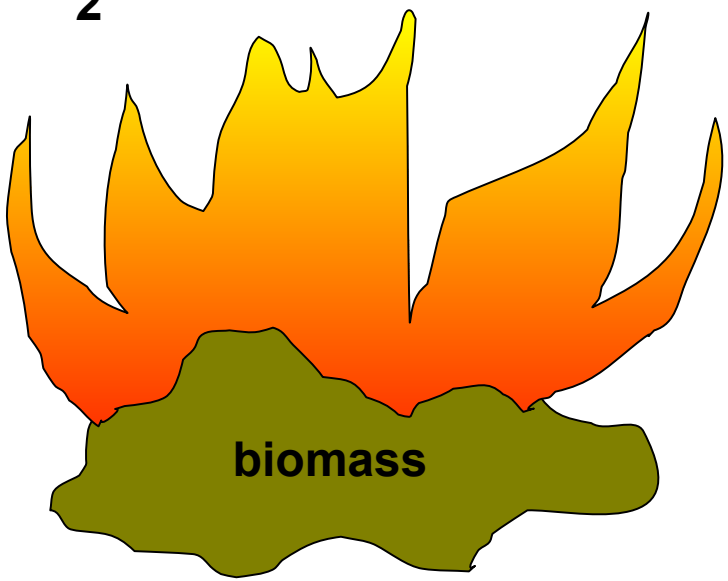




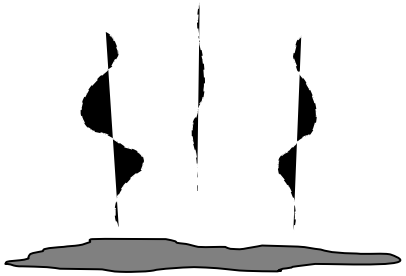
LUCIASTOVE, N. Mulcahy

O_2

Combustion



+ Heat

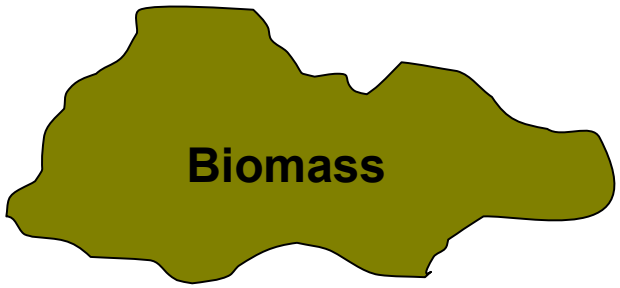


Ash

High particulate and dioxins amospheric emissions

~~O_2~~

Pyrolisis



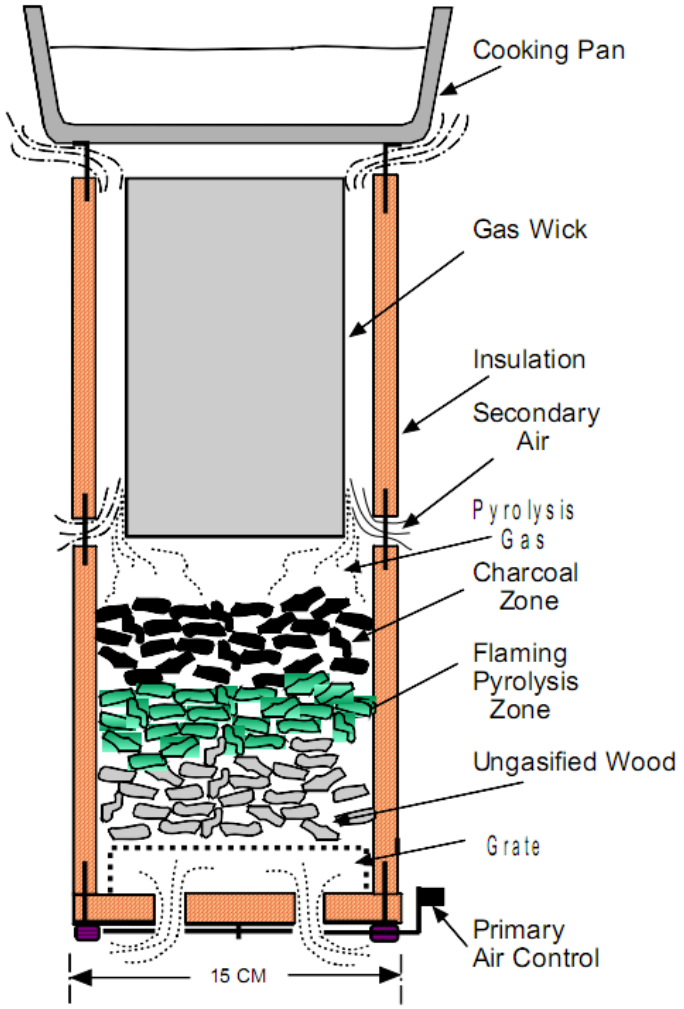
Heating

+ Gas → **Heat or Energy**

Biochar

Low particulate and dioxins amospheric emissions

The stove


Cooking Pan
Gas Wick
Insulation
Secondary Air
Pyrolysis Gas
Charcoal Zone
Flaming Pyrolysis Zone
Ungasified Wood
Grate
Primary Air Control
15 CM

A 4 piece stove

Stage 1: P
stoves rea
shipment

Stage 3: Stove ready for distribution

WorldStove Corporation
a million sto

Improved stoves : Less fuel used

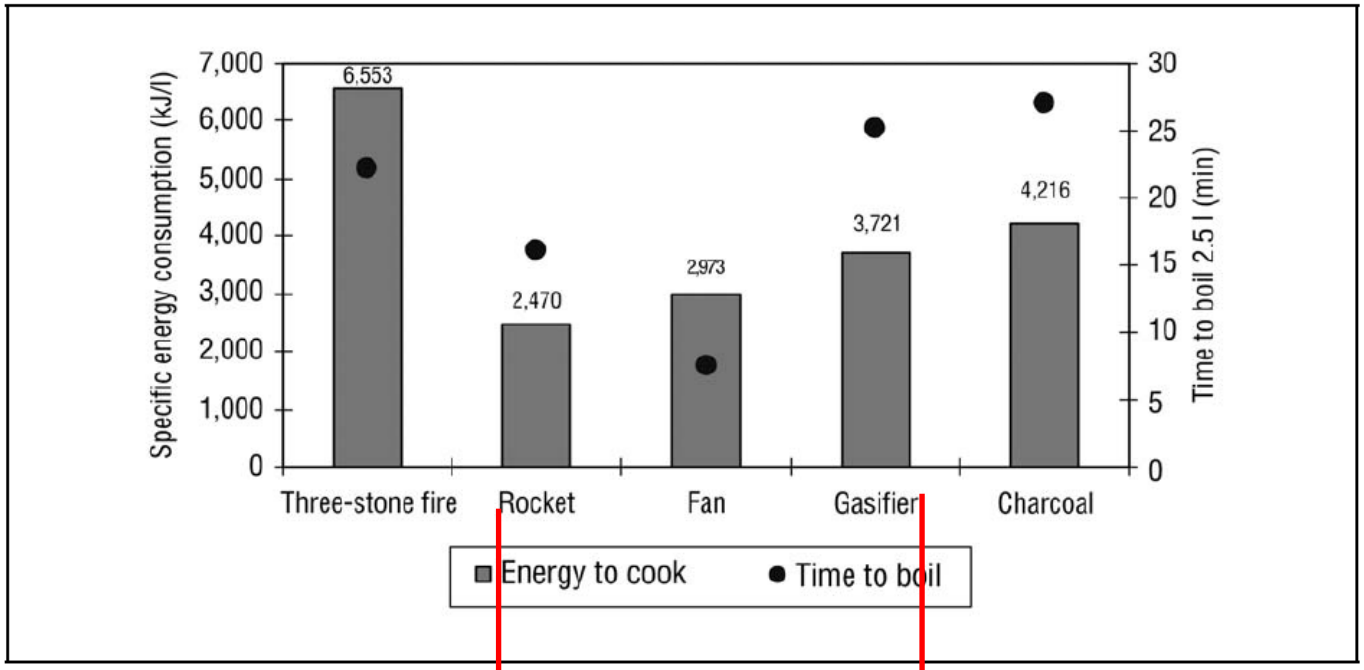


Figure 3. Specific energy consumption (energy consumed to bring to boil 1 l water and then simmer for 30 minutes) and time to boil 2.5 l for the various stoves. Average of three tests. This chart does not include the energy to power the fan, running at 1 W for 37 minutes, or 2.25 kJ of additional energy input. Similarly, the charcoal energy consumption does not consider the energy lost while making the charcoal fuel.

improved stoves

MacCarty et al. 2008

Not only wood

Agricultural residues

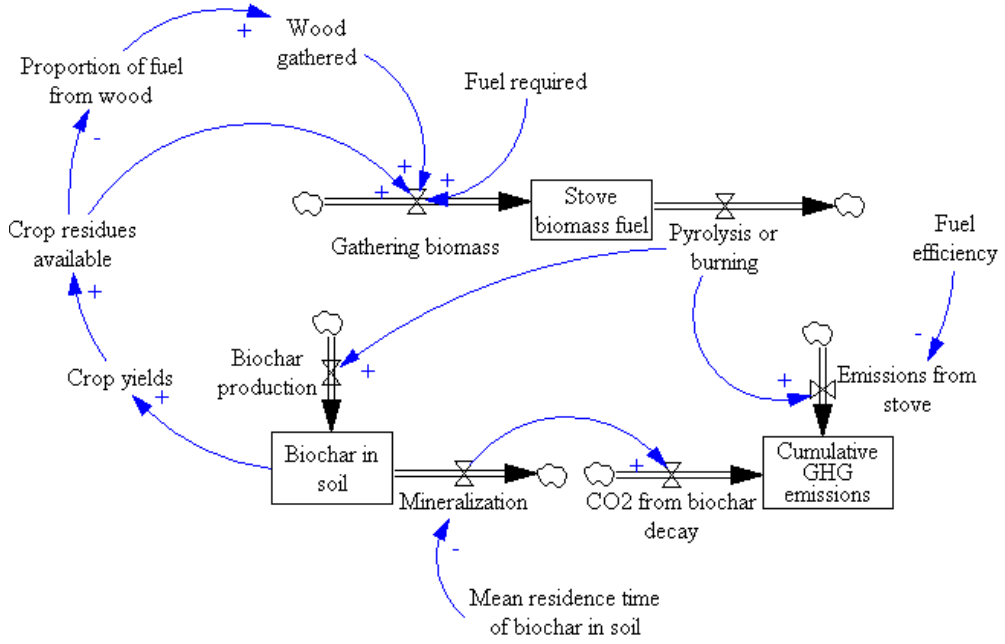
(corn, peanut cocoa shells, palm residues,…

Grasses

Dry animal dung

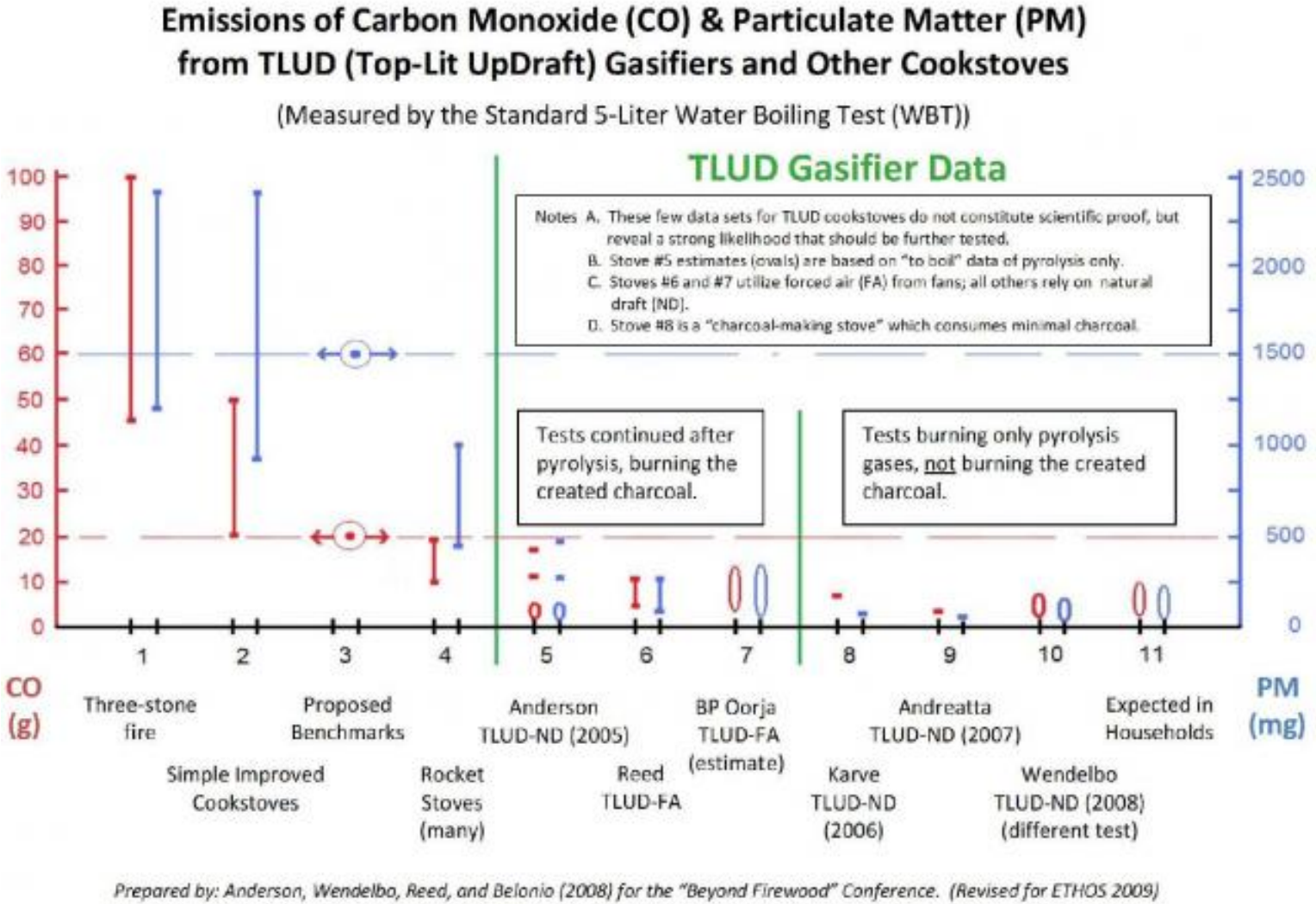
Bebi Project tasks

- Adapt stove to cooking habits
- Consider the complete carbon cycle (biomass availability)



Produce stoves locally

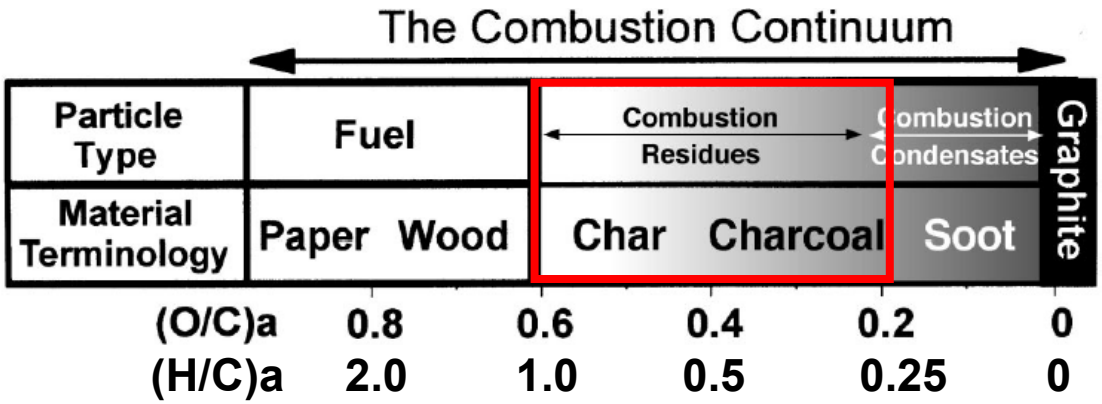
Further benefits: indoor air quality improvement



Prepared by: Anderson, Wendelbo, Reed, and Belonio (2008) for the "Beyond Firewood" Conference. (Revised for ETHOS 2009)

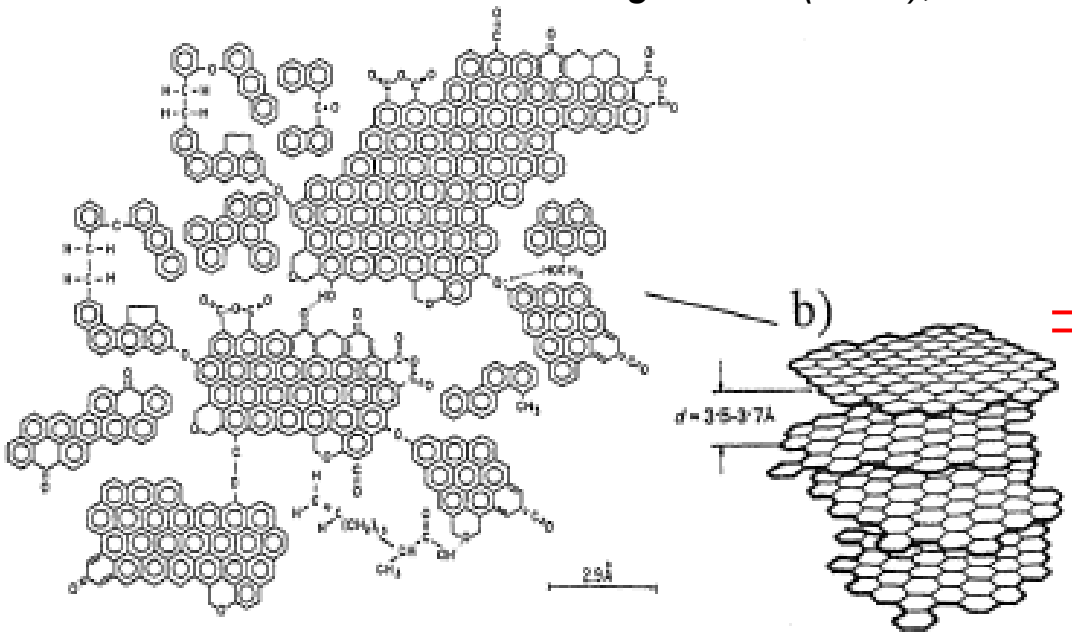
Air quality monitoring

What is Biochar ???



Hedges et al (2000), modified)

⇒ ***Origin:***
Incomplete combustion of organic matter

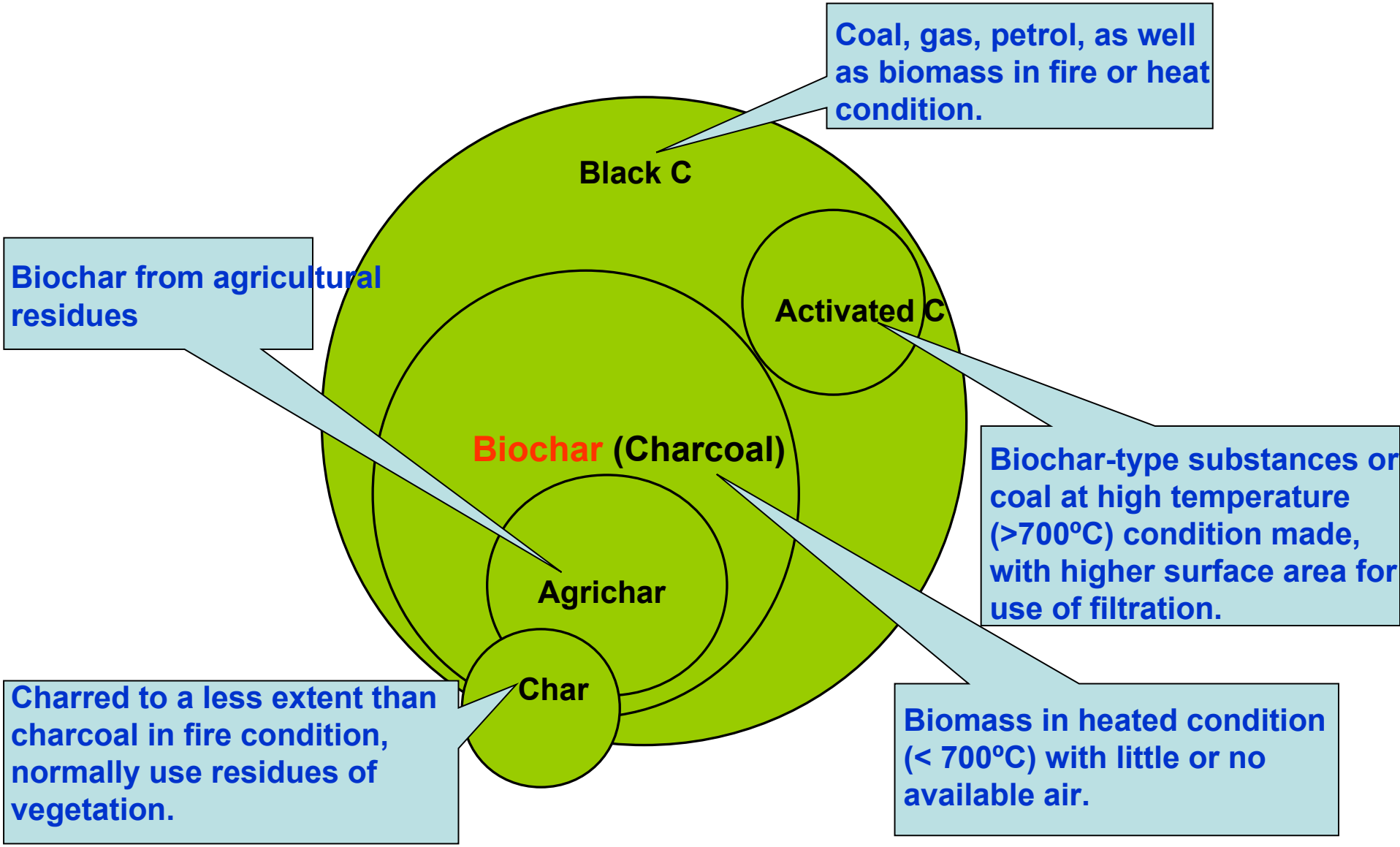


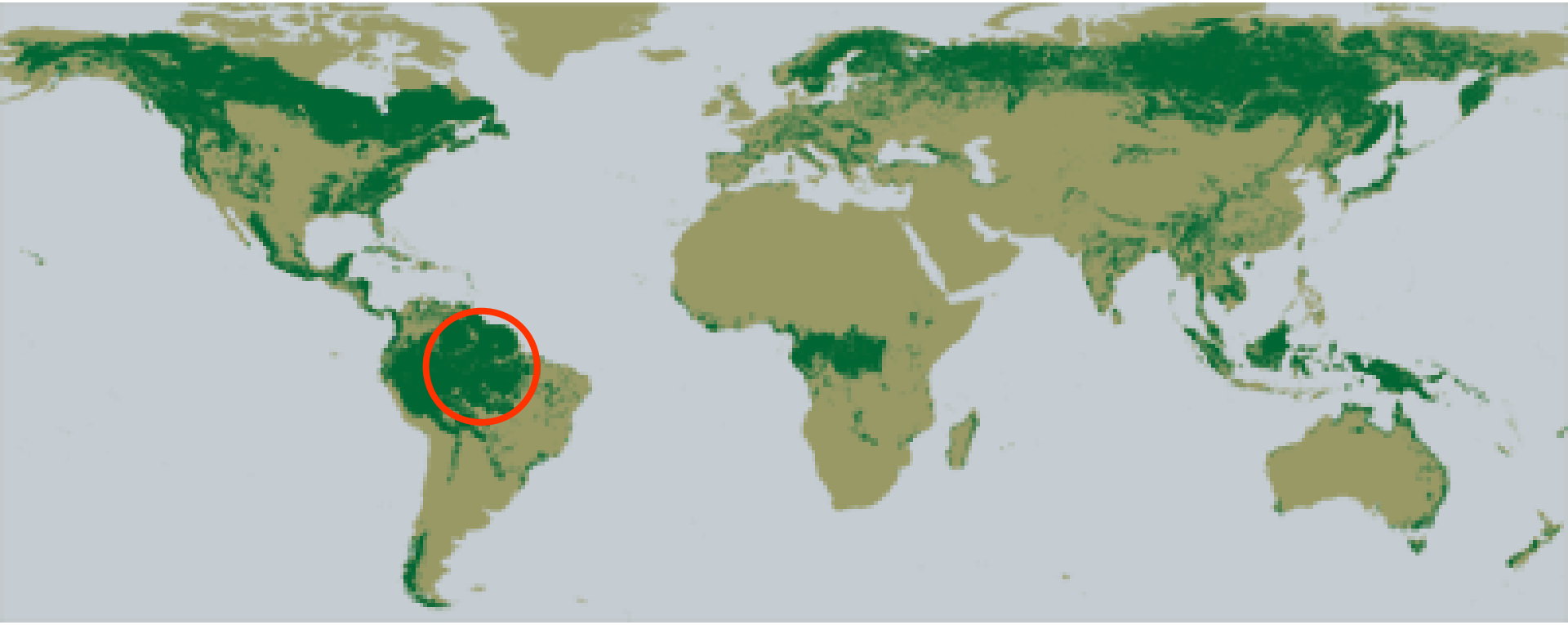
Schmidt and Noack (2000)

⇒ ***Properties***:
Condensed aromatics
Functional groups

Biochar = carbone vegetale

Several kind of chars

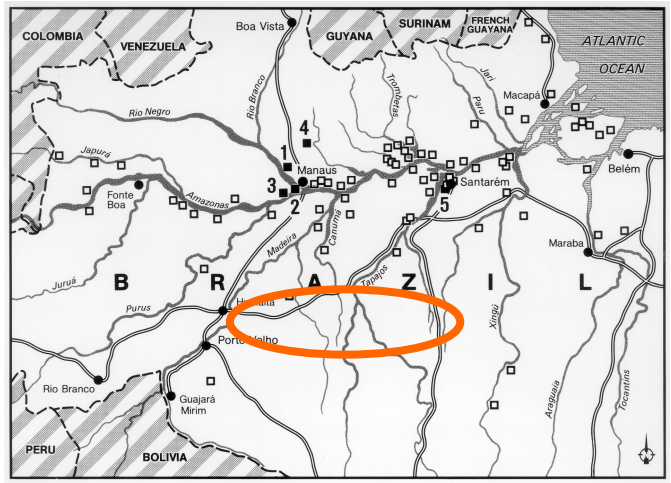




Amazzonia, Manaus Area….

Terra Preta

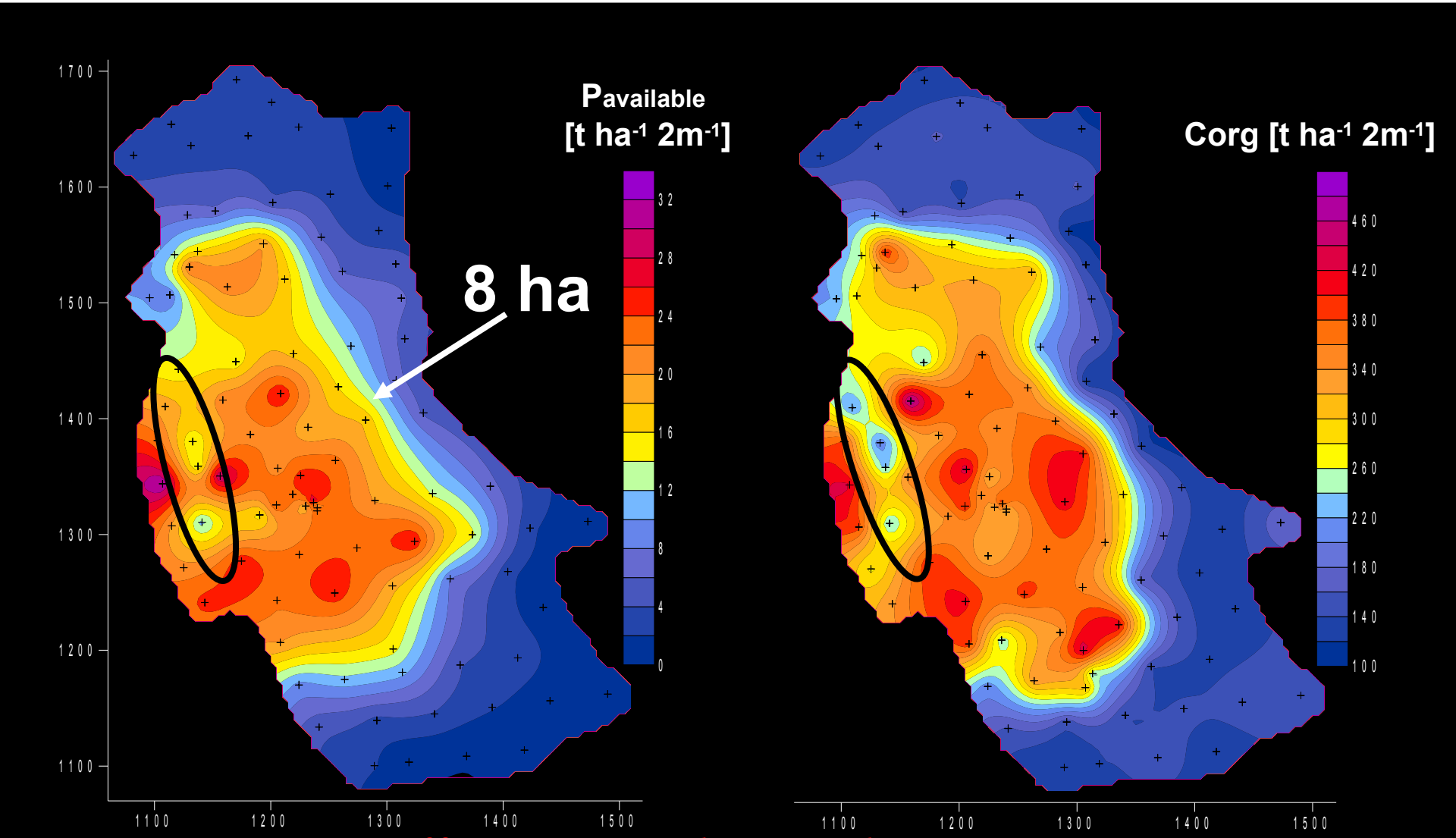
Antropogenic origin



W.G. Sombroek (1934-2003)

Terra preta balck soils were man made about 2000 years ago by adding charcoal and residues to deforested soils

Differences are still very clear



=> Different P and C pools !!!

More fertile soils

2000 years old experiment

Ferralsol

Terra Preta

Mineralogy

- Comparable texture
- Same clay mineralogy
- Rich in Fe and Al oxides

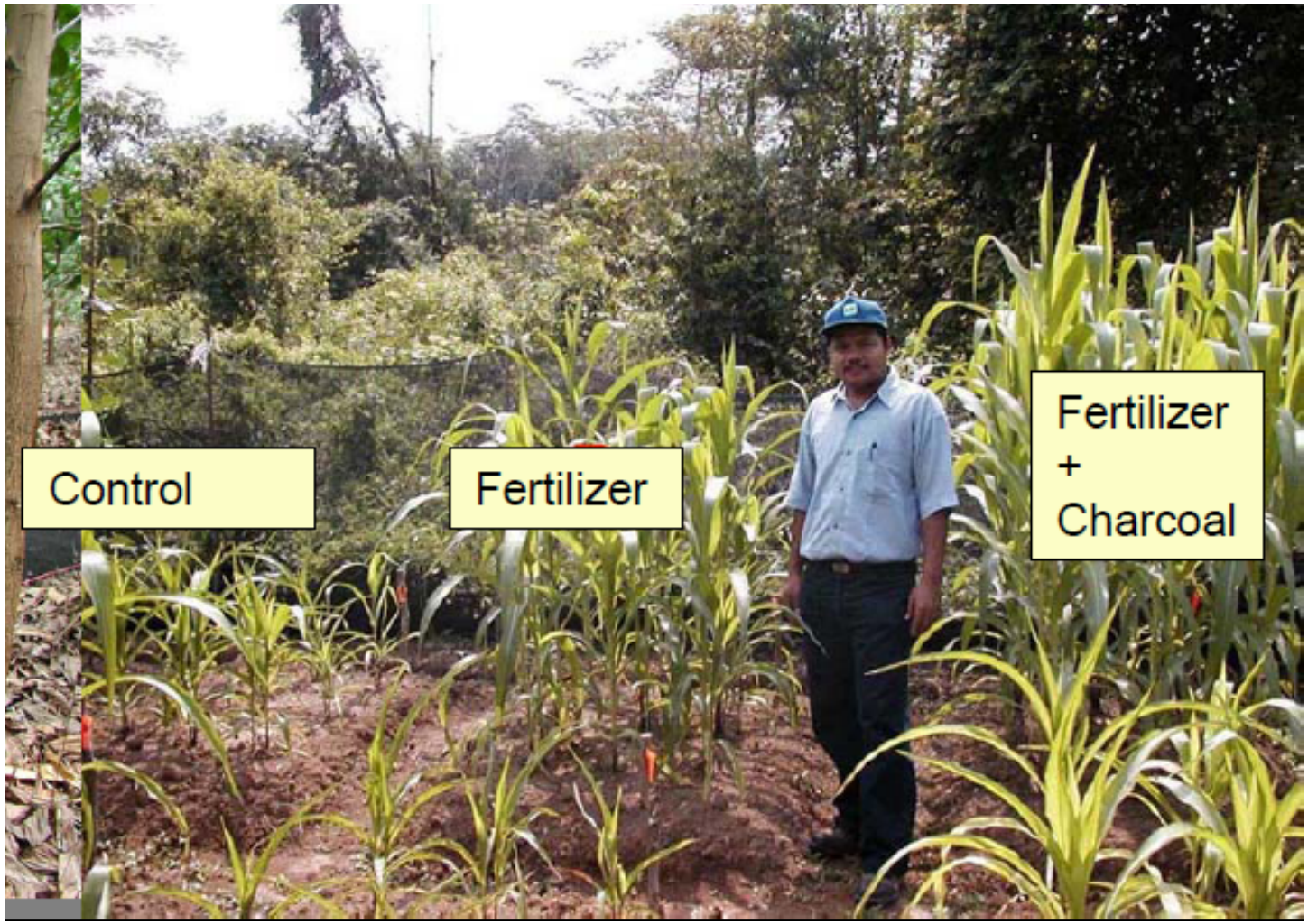
Anthropogenic signs

- Potsherds
- Charcoal (2000 years)

Soil fertility

- Nutrients
- Soil organic matter
- Stable SOM
- Cash crops

not only nutrients



Conclusions: biochar applications

Permanently increases fertility

Add biochar to agricultural soils

Very stable form of organic carbon

Sequester Carbon and reduce Green House Gases

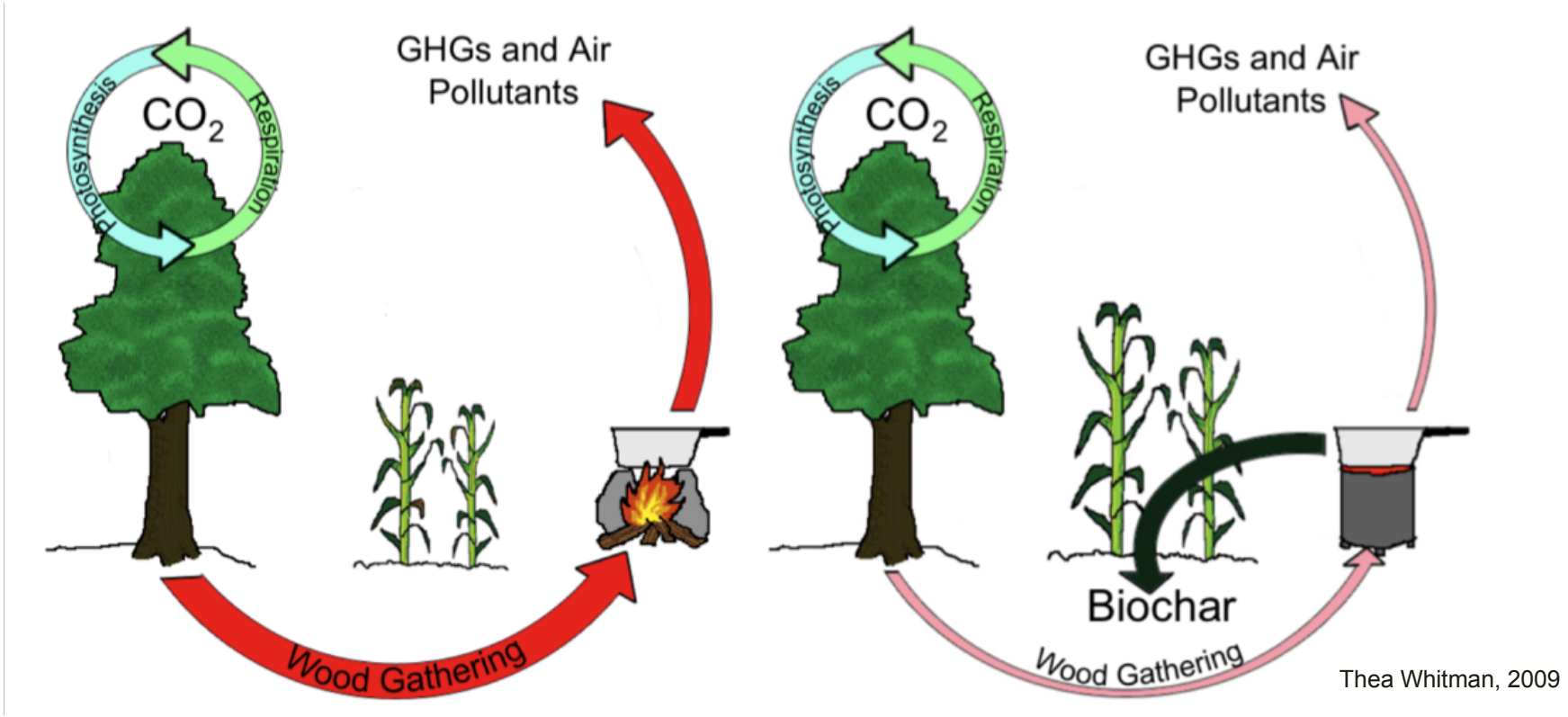
Combat desertification

Pyrolysis generates gas

Use residues or less wood to produce energy

Pollutant emissions are much lower than other technologies

Project syntesys



	local	regional	global
Environmental issues	Indoor air pollution	Land degradation Outdoor air pollution	Climate change
Socio-economical issues	Fuel cost and production	Stove-Energy SME spin – off	Voluntary carbon credits or CDM

Final goal

Fuel producer

Farm or Forest

Carbon Gold

Get fuel

Distribute biochar

Sell Carbon Credits

Small Medium Enterprise

Produce stoves

Test fuel

Get biochar

Sell stoves

Provide fuel

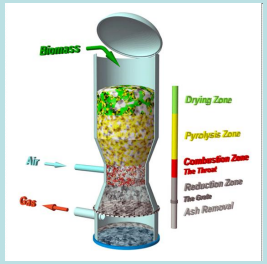
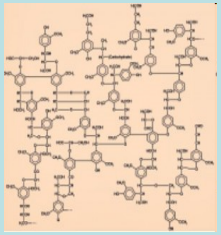
Burn fuel

Final user

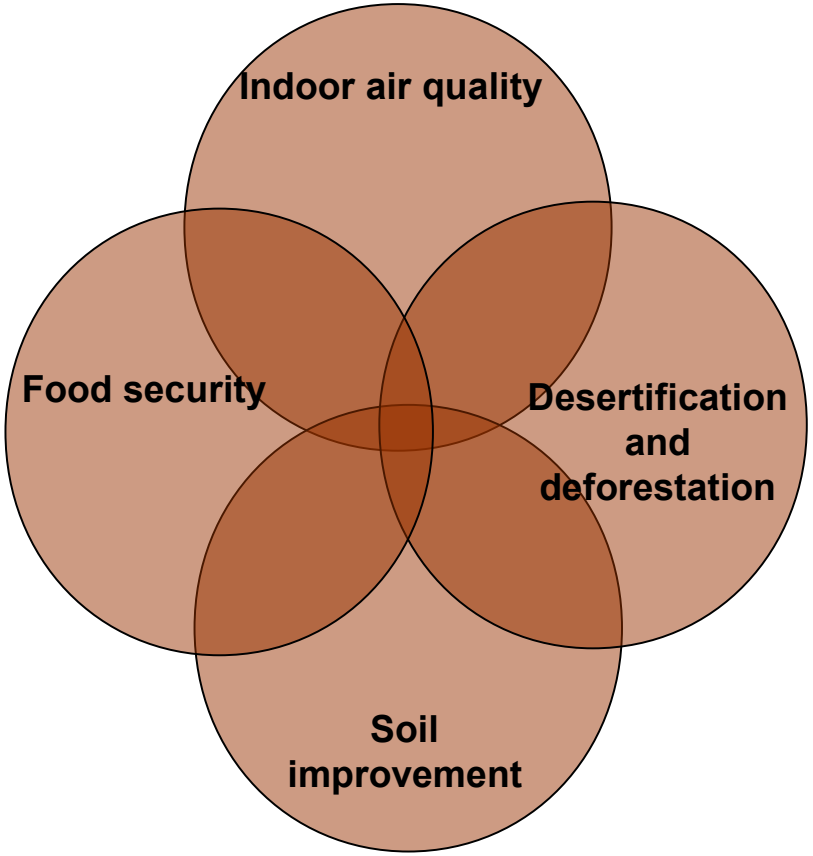
Working streams

Research stream (Universities)

Technology transfer stream (NGO's)

Biochar	Environment	Demonstration
Production 	Indoor air pollution	Stove production use and marketing
Characterization 		
	Environment	Policy and Business
Soil 	GHG mitigation	GHG accounting and marketing

Multiple benefits



ACP Science and Technology Programme

thanks to all project partners

Università degli studi di Udine

DiSA

Dipartimento di Scienze Agrarie e Ambientali

Department of Agriculture and Environmental Sciences

Thanks for your attention !

Prof. Alessandro Peressotti

Dott. Gemini Delle Vedove

Dott. Giorgio Alberti

Dott. Costanza Zavalloni

Dott. Tiziana Pirelli

Dott. Guido Fellet

Phd. Liu Jie

Phd. Giuseppe De Simon

Phd. Elisa Pizzolitto

And wait for pyrolitic stove demonstration at lunch time !

Prof. Alessandro Peressotti

Mail Peressotti@uniud.it

Tel +39 0432558616