Biochar in Conservation Agriculture

Improving Crop Yield and Storing Carbon

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NGI

CFU
CONSERVATION FARMING UNIT

UNIVERSITY OF ZAMBIA

Overview

I. Introduction
II. Performed work in Zambia
III. Future work and outlook

What is biochar?

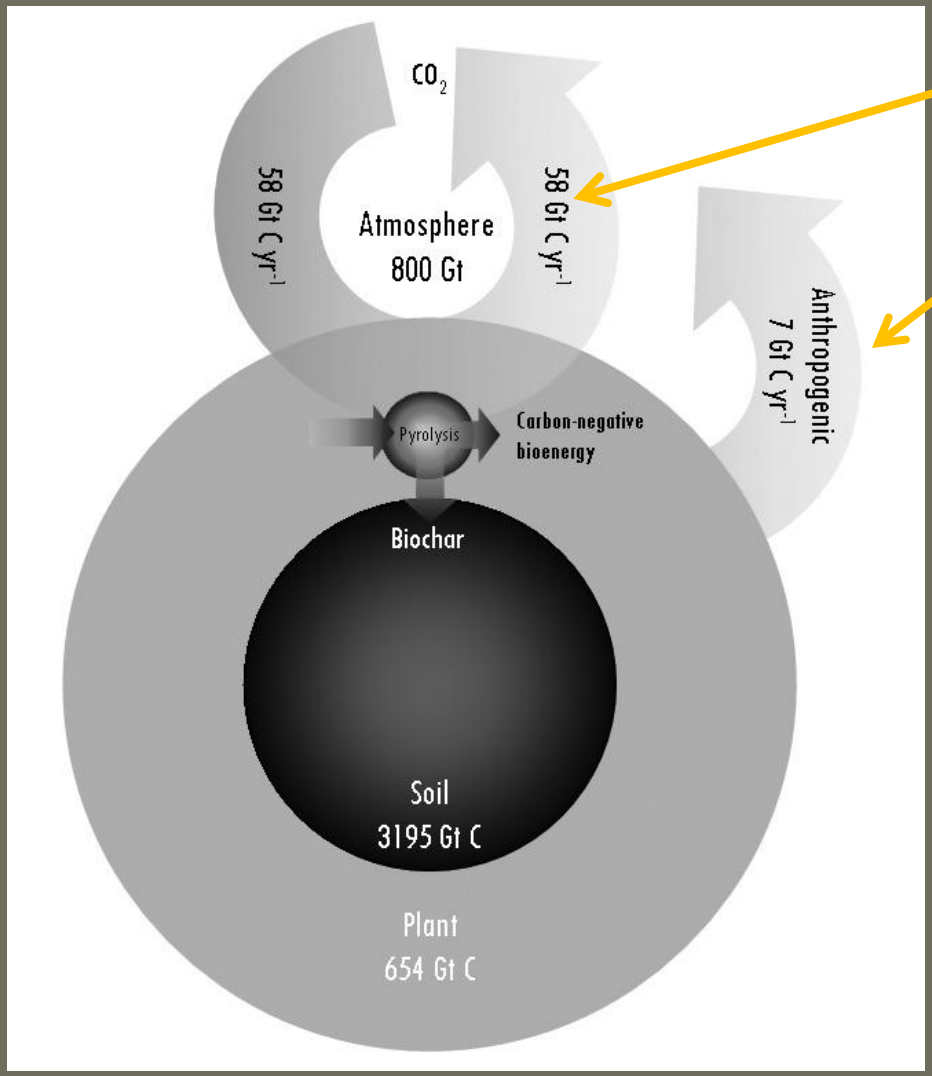
”Engineered” Charcoal:

- Product of airless combustion of organic waste (pyrolysis)
- ”Almost” pure carbon (60-90%)

Open fire charcoal
Low carbon content
Not stable in soil
High ash content

Biochar
High carbon content
Stable in soil
Low ash content

The big question: biochar a serious wedge?



Agricultural waste 9 Gton/yr

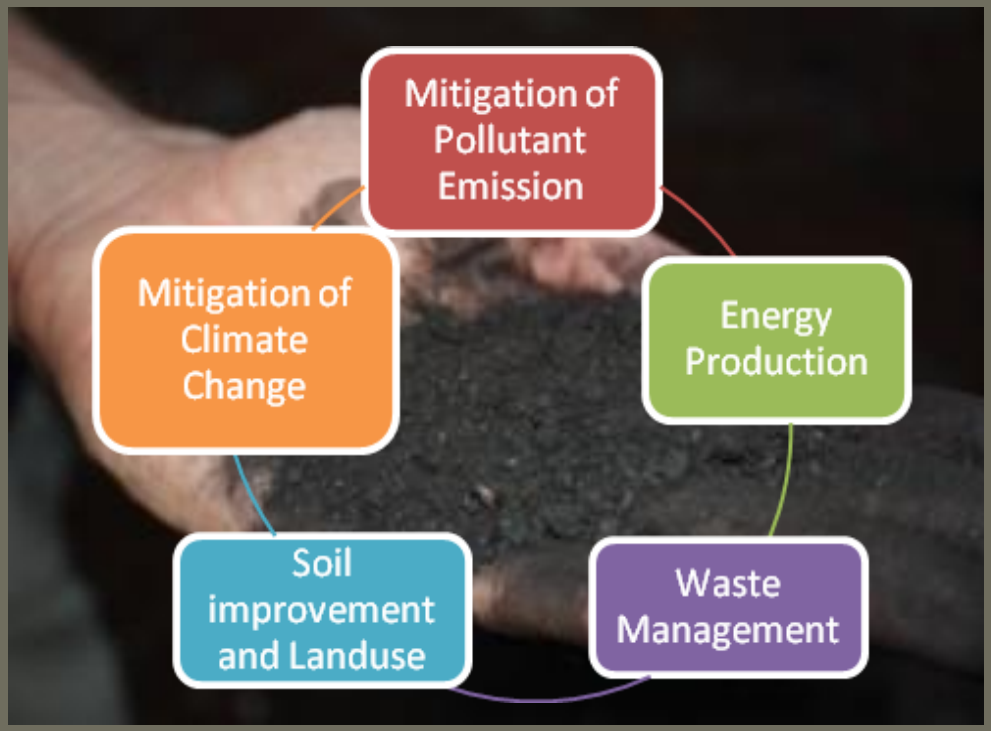
Climate change

20% of annual agricultural waste into biochar:

Carbon emissions reduced by 10%

Based on Lehmann and Joseph, 2009

Multiple advantages of Biochar



Perspective: example for rice waste

Biochar in Indonesia, Malaysia, Zambia, Nepal – Four projects at Norwegian Geotechnical Institute and University of Life Sciences

- Applied and mechanistic biochar research
- Laboratory and field tests
- Combination soil science, socio-economic science, implementation

Kaoma, Zambia

- ✓ Norwegian Embassy / CFU – this project in Zambia, start Oct 2010
- ✓ Norwegian Research Council – ”NorGlobal”, ”FRIMUF”, Indonesia + Malaysia, 2011-2014
- ✓ ”Excellent Researcher Personal Stipend”, Zambia/Nepal/Indonesia, 2012-2017

Indonesia Malaysia Norway biochar consortium

http://biochar.ngi.no

Biochar in Zambia: Perfomed work

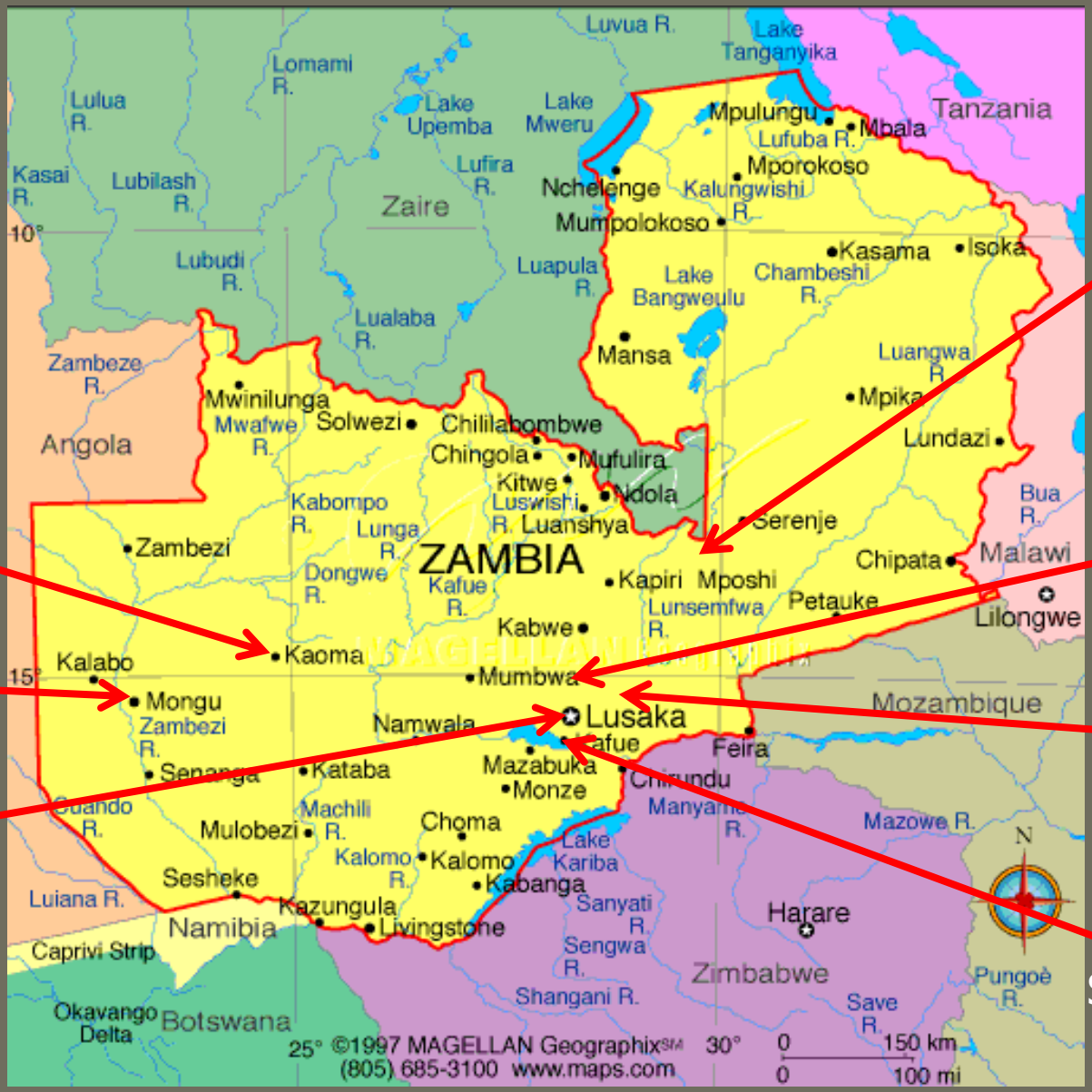
- Pot trials, 5 soils, 2 biochars
- Field trials, 6 stations, 2 biochars
- Biochars: corn cob biochar, charcoal dust, 350-400 C
- Small-scale farmers
- Crop: maize

Biochar and Conservation Farming: a happy couple!

- Conservation Tillage: planting basins, only 10-12% tilled
- Strongly reduces amount of biochar (and fertilizer) needed

http://biochar.ngi.no

Field Sites



Mkushi

GART Chisamba

Kaoma

Mongu (2012)

NRDC

UNZA farm

Shimabala

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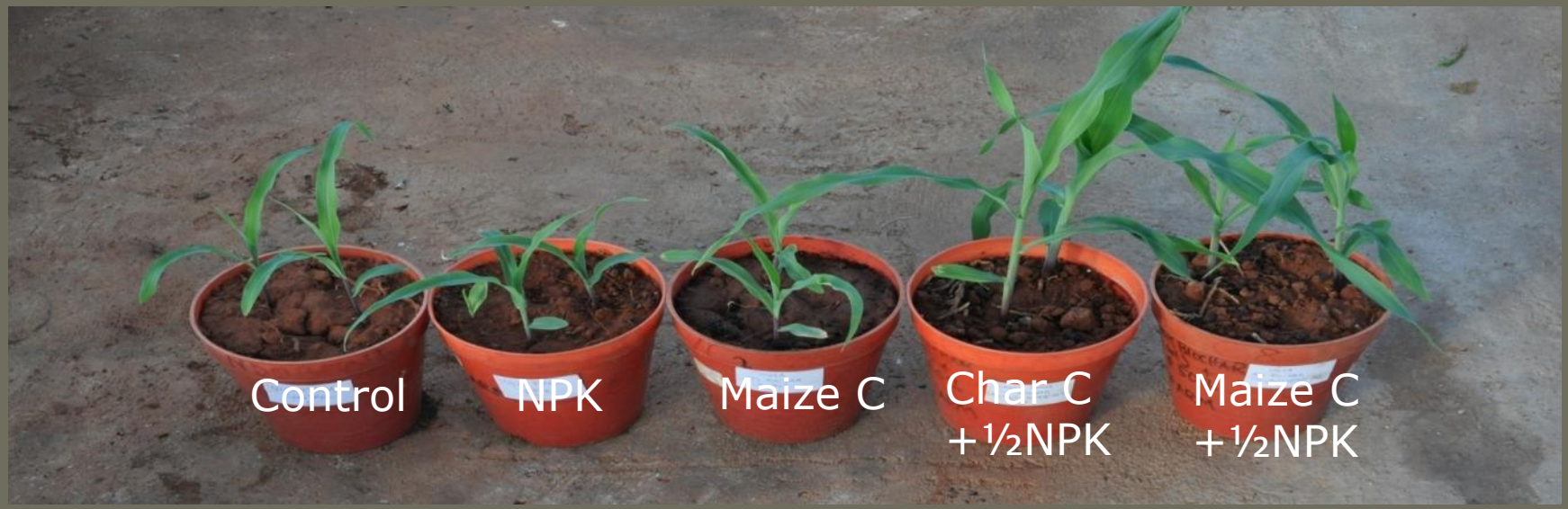
Pot trial University of Zambia (128 pots)

1.	0.5% biochar + full fertilizer	43	g biomass
2.	2% biochar + 50% of fertilizer	34	g biomass
3.	Only fertilizer	27	g biomass
4.	Only 2% biochar	12	g biomass
5.	Control	5	g biomass



Look Biochar Works

NRDC: good soil

(not acidic, good nutrient and water holding capacity)

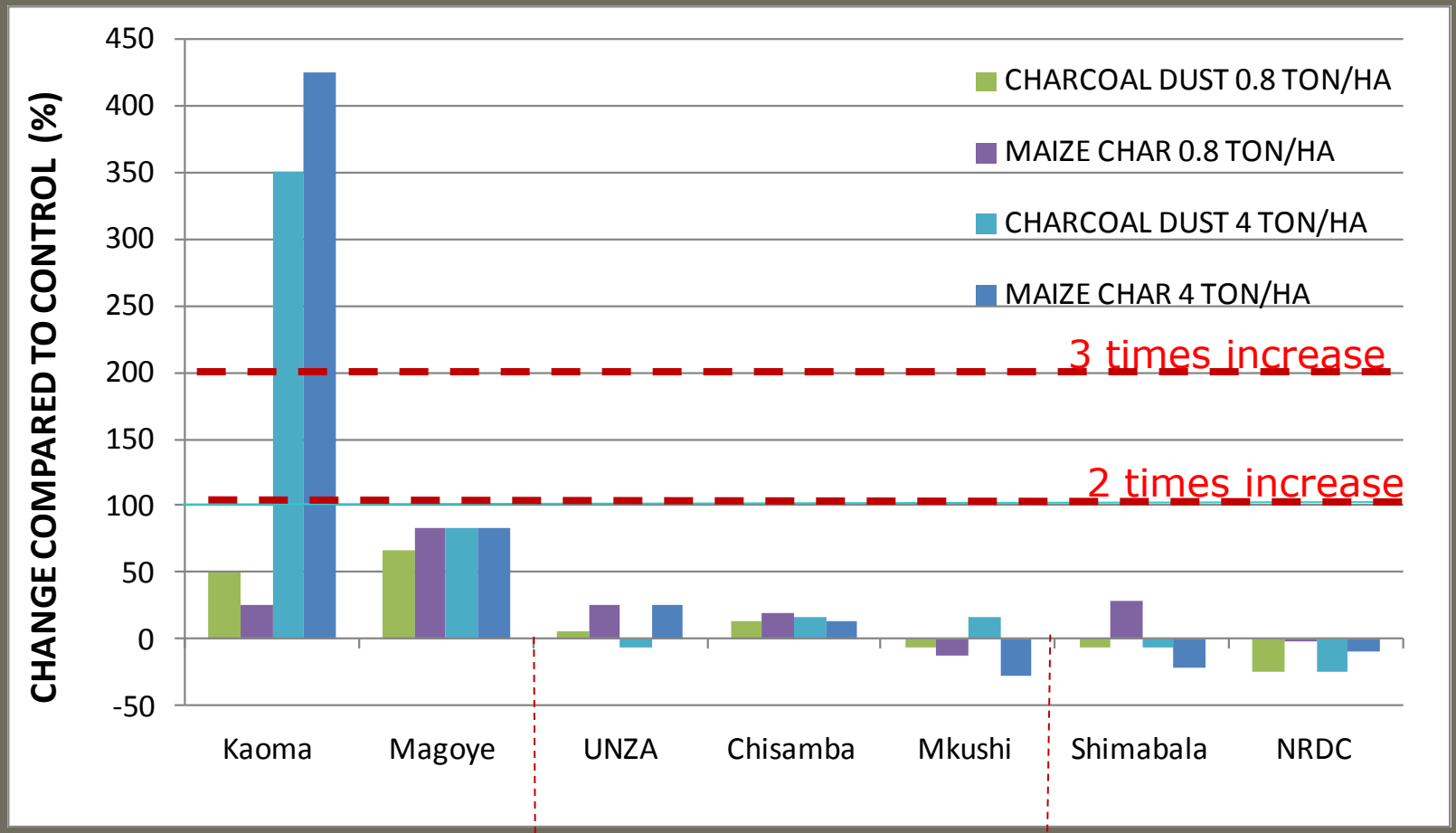
No effect of biochar

Control

Charcoal 4 t/ha

Maize Char 4 t/ha

Harvest relative to control plots



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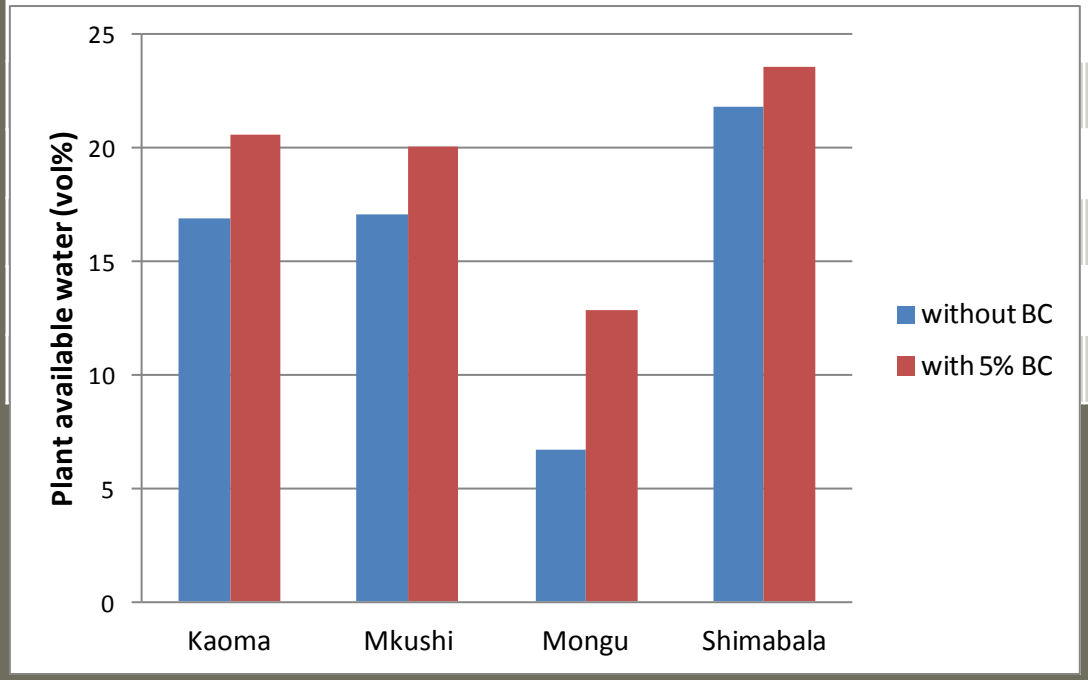
Why is biochar so effective?

- Compensation of acidity

Soil/ char	pH, no biochar	pH, 5% biochar
		6.8
		7.0
		6.2



Next phase 2012-2015

- Expanding field trials to 18 farmers in Kaoma, Mongu and Mkushi
- Exploring the possibility of reducing fertilizers
- Focusing on groundnuts and cotton in addition to maize
- Exploring the feedstock and possibilities for biochar production in a larger scale
- Socio economic evaluations

Generating biochar: traditional versus modern prosesses

Traditional Kiln

High-tech pyrolysis

Small-scale stoves (around US$30-50)

Foundation Miombo joining Zambia project
- Award-winning Peko Pe stove

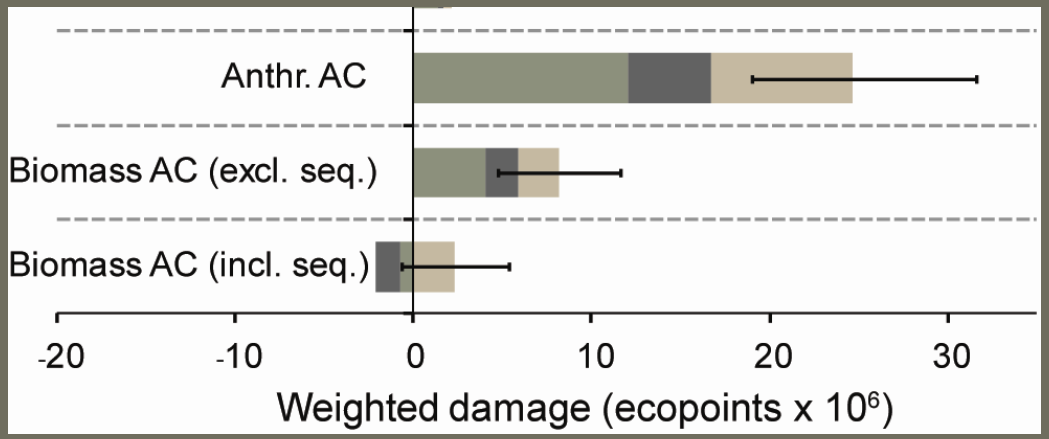
Advantages
- Biochar → Soil Fertility
- Cleaner cooking
- Utilizing corn/rice husk, less need for wood

Other possibilities:
- Medium-scale unit:
  - Energy generation (electricity) and biochar generation combined

Life cycle assessments in a ”nutshell”

- Calculates negative and positive impacts over the whole life cycle
- Compares potential environmental impact between alternatives

Cleaning the Grenlandsfjords

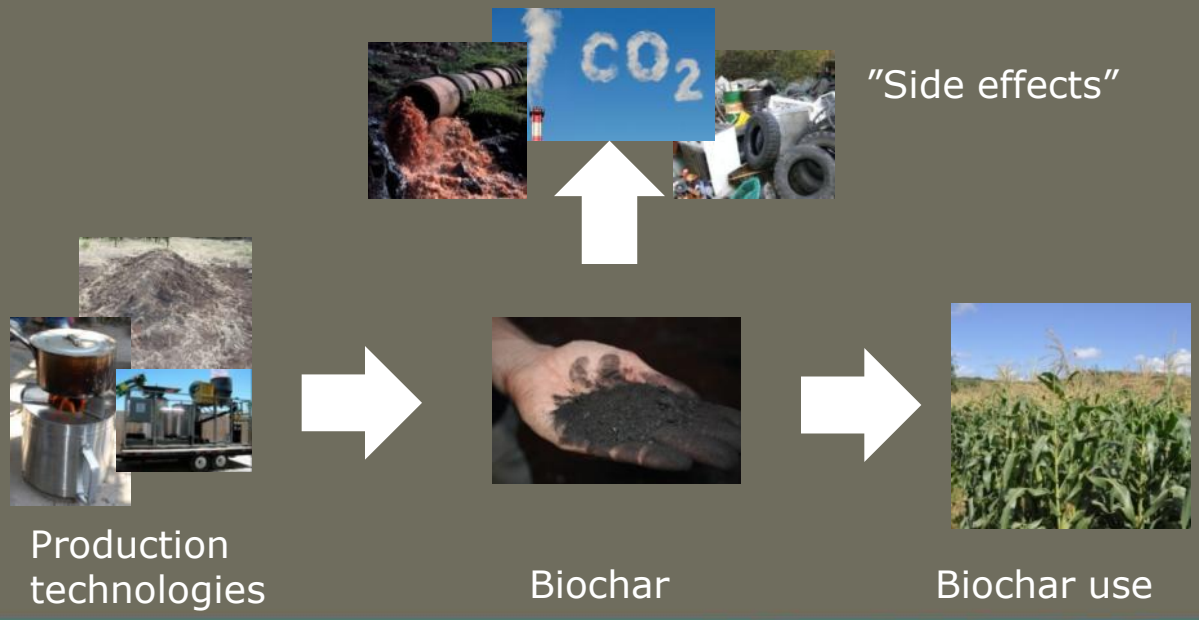


AC = Activated Char

Sparrevik, M.; Saloranta, T.M.; Cornelissen, G.; Eek, E.; Fet, A.; Breedveld, G. D.; Linkov, I. Use of life cycle assessments to evaluate the environmental footprint of contaminated sediment remediation.
Environ. Sci. Technol. **2011**

Socio-economic evaluations of biochar

- LCA for “side effects” of different biochar production techn. and use
- Social acceptance of biochar use in conservation farming
- Cost-benefit evaluations for use in a CFU setting



Advantages in a climate context

Mitigation

- Carbon storage: Biochar in CDM?
- Reduced need for deforestation in farming
- Reduced nitrous oxide emissions

Adaptation

- Drier climate in many parts of Africa: water sponge

Perspective
100.000 small scale farmers (5 ha 1 tonnes pr year) – 50% of all CFU farmers in Zambia

- 2 mill t CO_2 tones pr year - Zambia gets climate neutral or 5% of Norwegian CO_2 emissions

Challenges for biochar

Seems to good to be true, but…..

- Is it really stable?
- Toxic compounds in biochar
- Competition between biochar feedstock and food crops
- Competition for feedstocks
- Increased deforestation just for making biochar?
- Sufficient incentive for the extra work required?
- No large capital investment possibilities

Outlook – biochar in Africa

- Biochar is mitigation and adaptation
- Biochar regards carbon as a resource rather than a waste
- Local fertilization solution: spontaneous adoption by farmers?
- Traditional and directly applicable technique