fedepalma
XVI International Oil Palm Conference and Expopalma
cenipalma
Cartagena de Indias, Colombia
22 to 25 September 2009
Challenges in Sustainable Oil Palm Development

The Prospects of Biochar

Carbon Sequestration, Nutrient Cycling and Energy Generation

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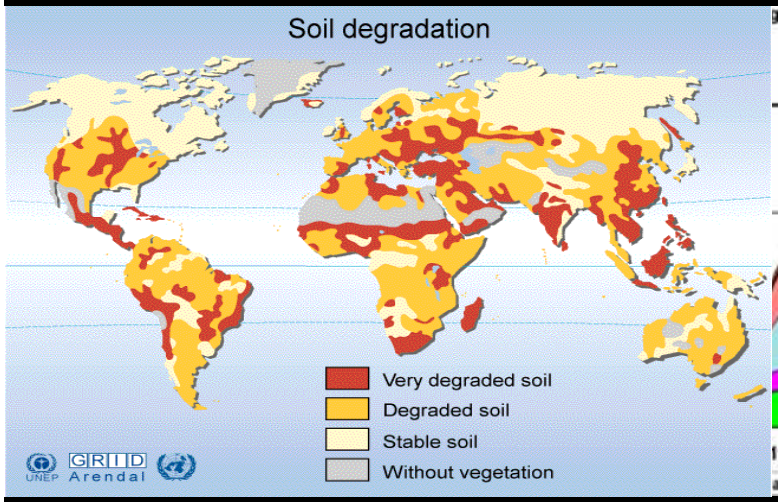
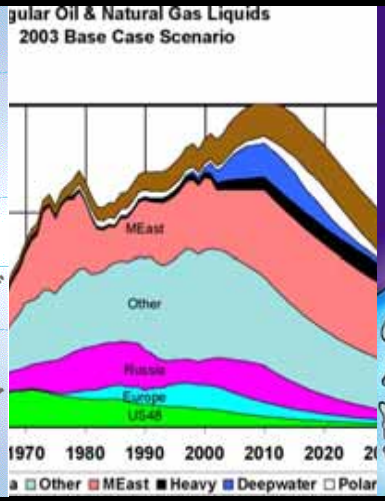
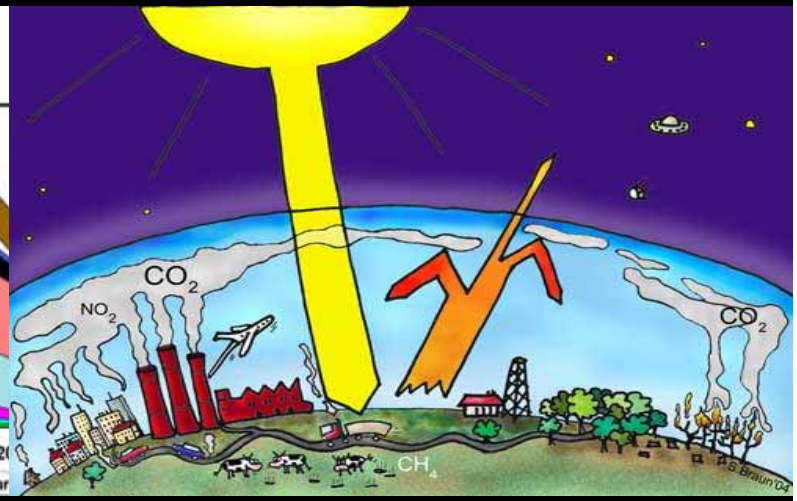
Biorefining and Carbon Cycling Program
The University of Georgia

Global problems







soil degradation peak oil “Hubbert’s Peak” Climate change

in 2007

World **fertilizer prices** surge **200%, food price** index rose **40%**

International Center for Soil Fertility and Agricultural Development, IFDC

Values of SOC

Biochar ?

Nutrient content

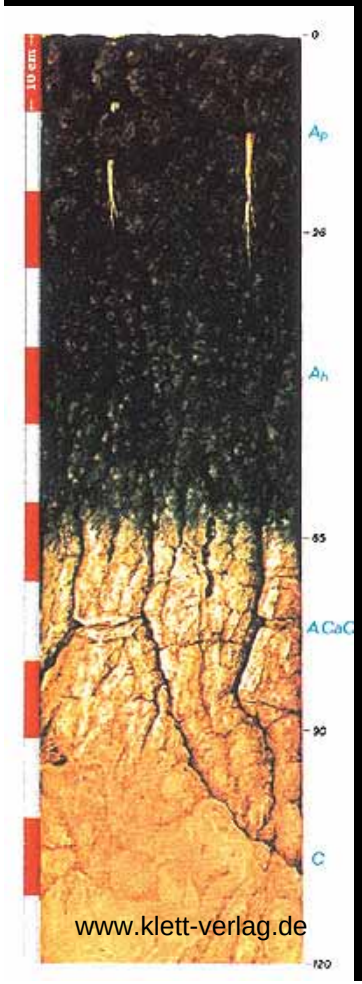
Carbon sink

- CDM
- Easy quantifiable

Soil Quality

- maintenance and improvement of water infiltration
- Water holding capacity
- Structure stability
- Nutrient storage and supply
- Healthy soil biological activity

Example I Chernozem or millisol



- Most agriculturally productive soils (Duchaufour, 1998)

(5. 12. 2004 world soil day, “Schwarzerde” = soil of the year 2005)

- Residues from vegetation fires, such as black carbon (BC) (Glaser *et al*., 2000)
- BC constituting up to 45% of the SOM
- BC is several millennia in age (Schmidt *et al*., 2002)

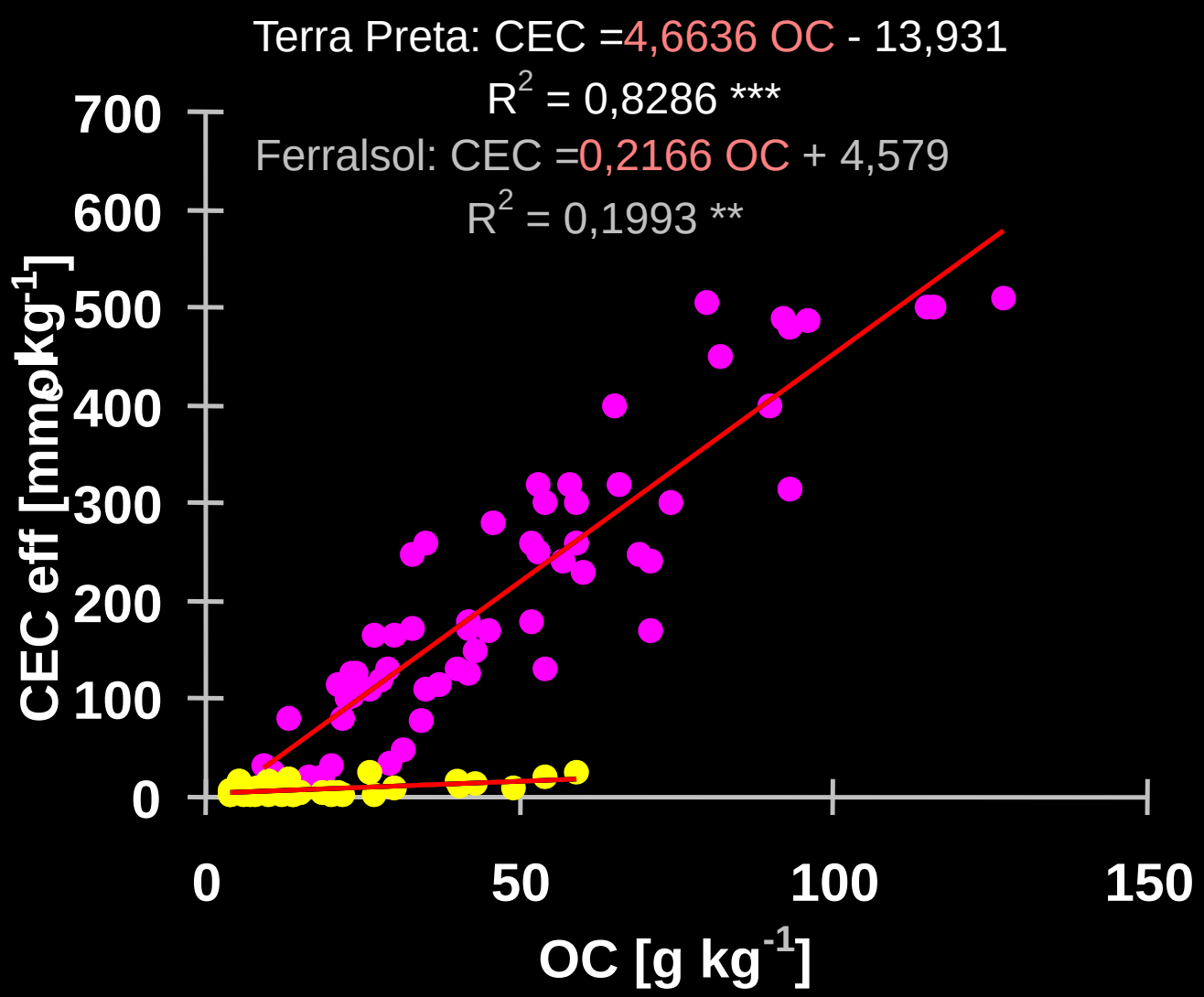
Example II Terra Preta

Terra Preta fertility

Irrigated horticulture

lawn production

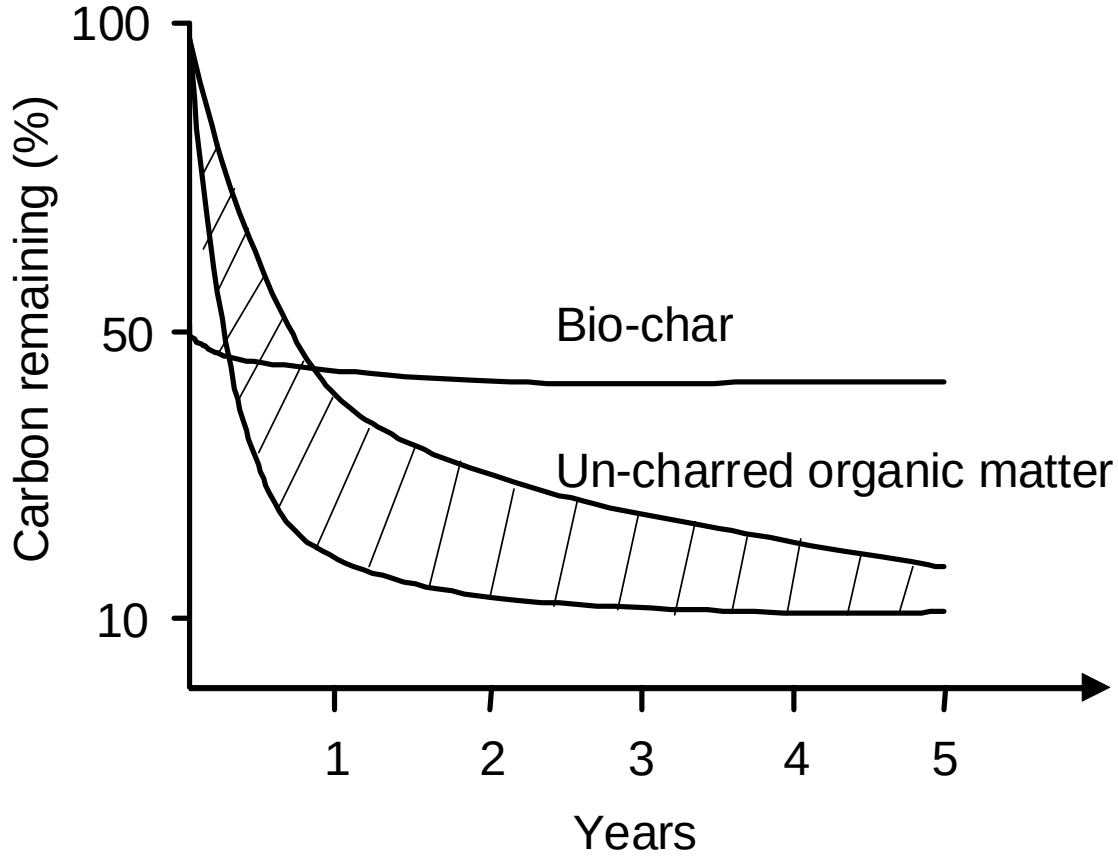
Biochar, BC, Chernozem and Terra Preta


Terra Preta: CEC =4,6636 OC - 13,931
R2 = 0,8286 ***
Ferralsol: CEC =0,2166 OC + 4,579
R2 = 0,1993 **
CEC eff [mmolc kg-1]
700
600
500
400
300
200
100
0
0
50
100
150
OC [g kg-1]


SOLTUR
Manaus
RAÇÕES PARA
TERRA PRETA
XEROX


TERRA
PRETA


TERRA
PRETA



⇒ *Charcoal is a long-term carbon sink*

JOHANNES LEHMANN, JOHN GAUNT, and MARCO RONDON Mitigation and Adaptation Strategies for Global Change 2006

Slash and Char as Alternative to Slash and Burn

~50% of C remains as charcoal

~2% of C remains as charcoal

Biochar research

EMBRAPA research station Brazil

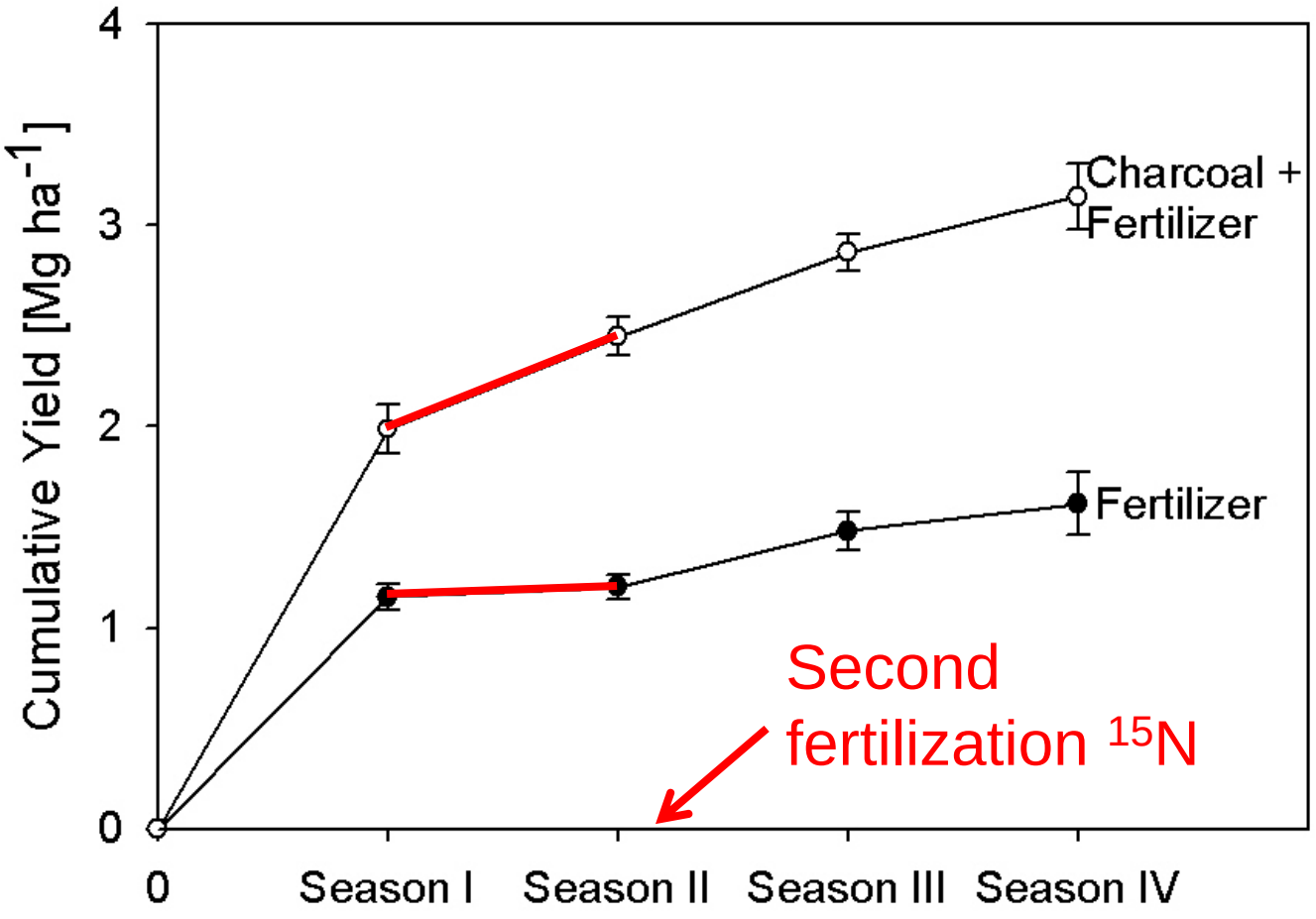
Research results, sorghum

Plants after 55 days

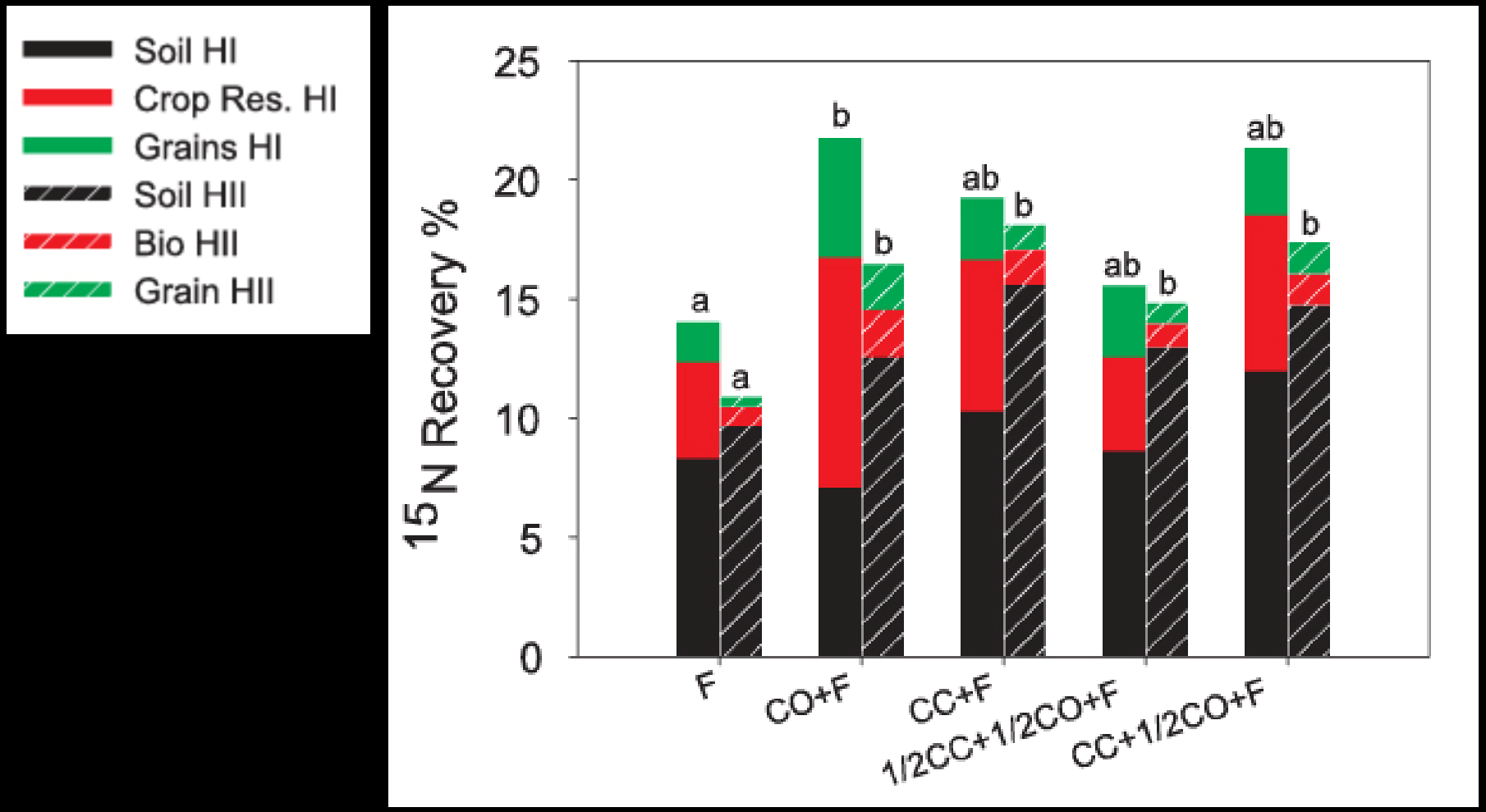
NPK fertilizer & charcoal

NPK fertilizer without charcoal

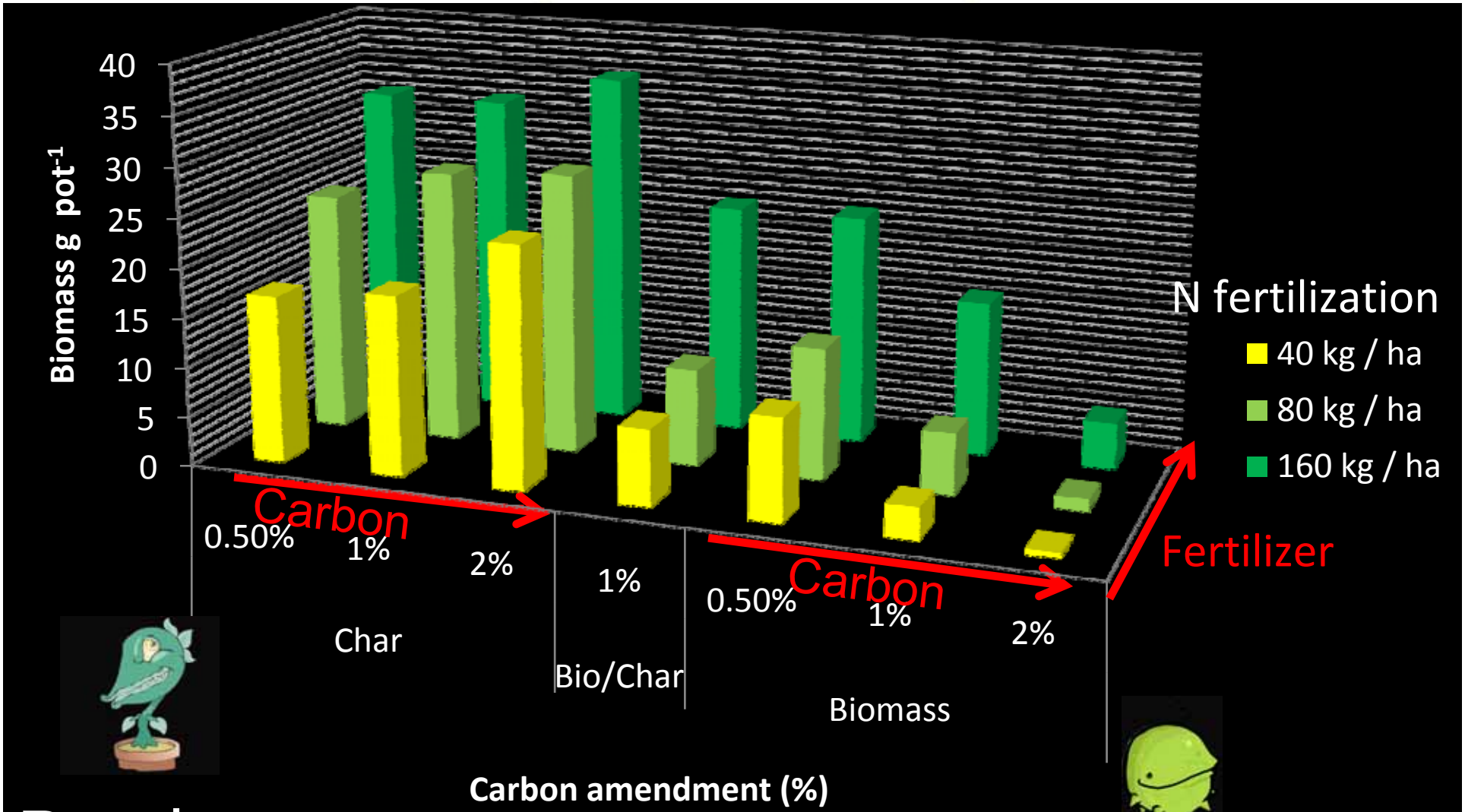
C. Steiner, UN climate change conference 2007; Bali – Indonesia, www.biochar.org



Steiner et al. (2008), Plant and Soil, n=5, means and SE

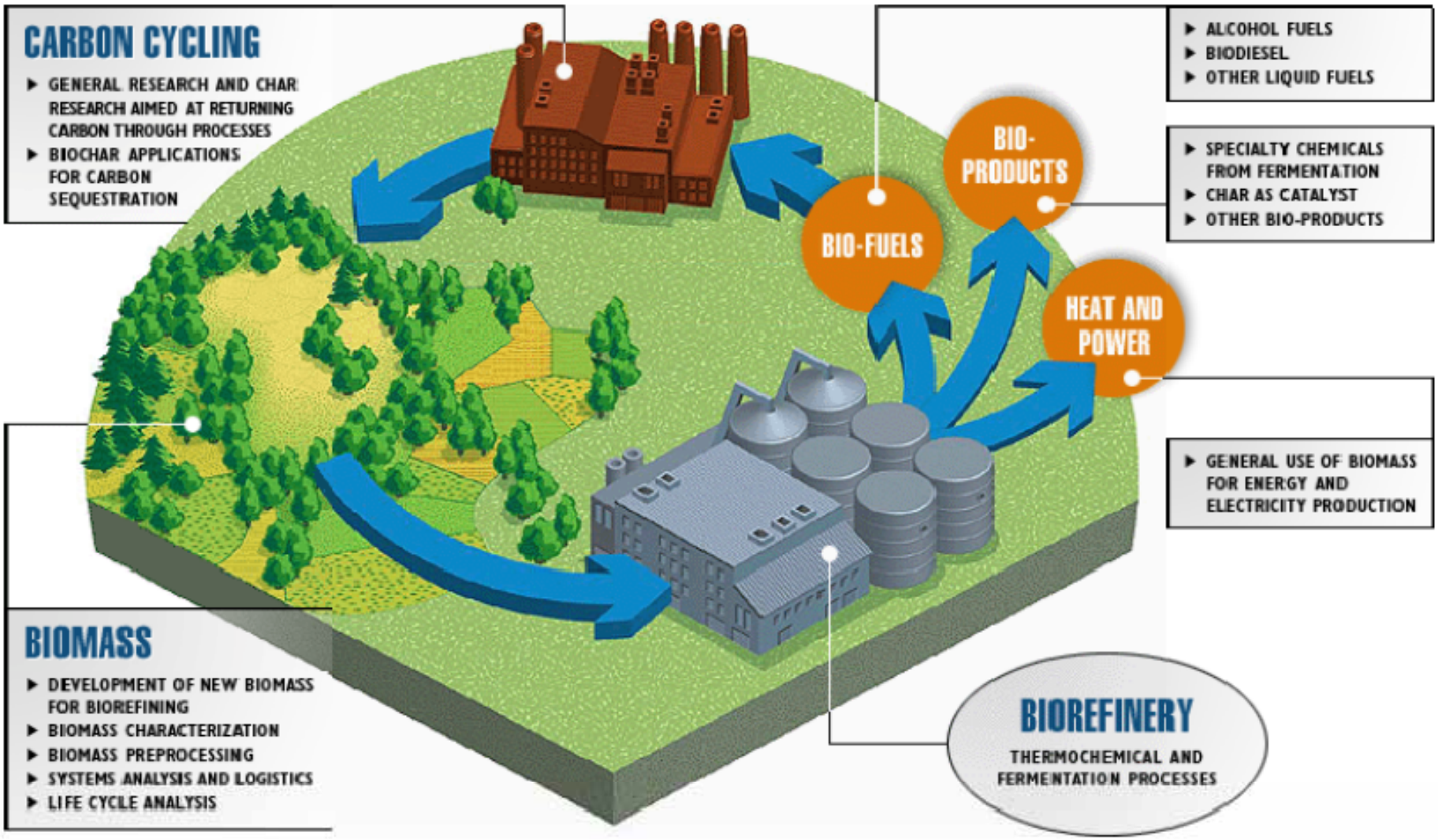


Steiner et al. (2008), J Plant Nutr Soil Sci, n=5, means and SE



Results biomass at harvest 7 weeks (at tasseling stage)

UGA Biorefining and Carbon Cycling Program www.biorefinery.uga.edu



The products of pyrolysis, char, oil and syngas


KANSO
Technos

Implementation KANSO Technos

Okimori, et al. (2003) Mitigation and Adaptation Strategies for Global Change

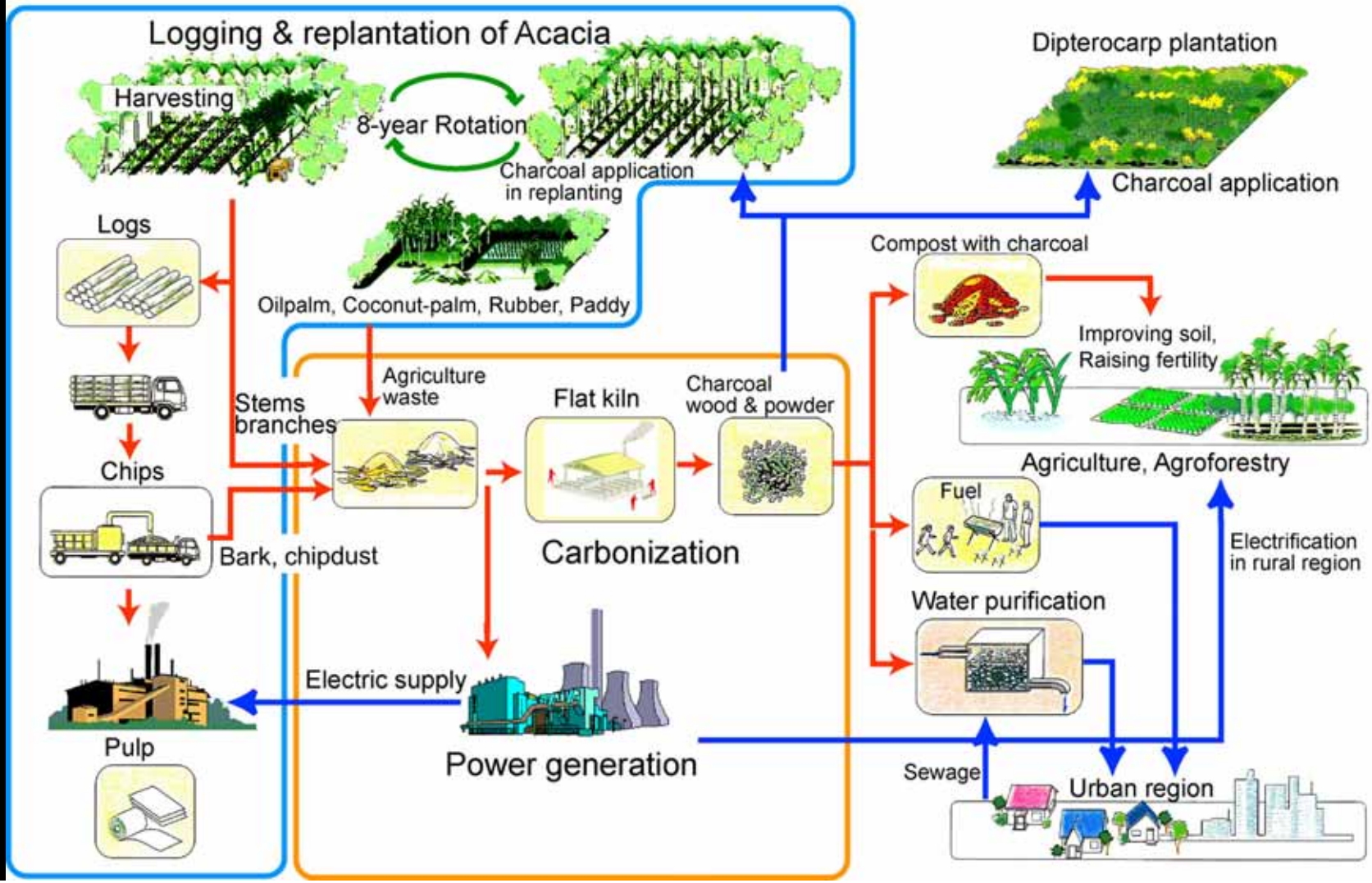
Implementation KANSO Technos

Okimori, et al. (2003) Mitigation and Adaptation Strategies for Global

Challenges in Sustainable Oil Palm Development

CFC-scheme (Carbon sequestration by Forestation and Carbonization)

Ogawa.M, 2001



Empty fruit bunches	1.55 Mg ha^{-1} yr^{-1}
Fiber	1.63 Mg ha^{-1} yr^{-1}
Shells	1.10 Mg ha^{-1} yr^{-1}

(Salétes et al. 2004b).

10.4 Mg ha^{-1} yr^{-1} pruned fronds and
90 Mg ha^{-1} palm trunks and fronds at renovation, every 20 to 30 years (Yusoff 2006)

Accumulating biomass

- Nutrients leached and lost
- Diseases & pests
- Carbon released as CO_2

EFB Potassium concentration
22.3 g kg^{-1}.
Carbonized EFB
58.7 and 65.1 g kg^{-1}
if carbonized at 350°C or 600°C respectively.

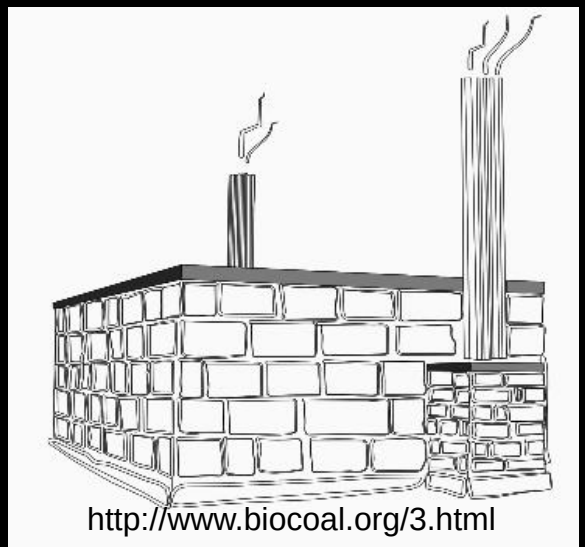
Furthermore, preliminary results suggest that leaching of minerals such as K is decelerated if EFB were carbonized (Bibens et al, unpublished).

GHG emissions from traditional charcoal making, CH_4

www.dynamotive.com


www.worldstove.com


http://www.twinoaksforge.com/BLADSMITHING/MAKING%20CHARCOAL.htm


http://www.biocoal.org/3.html


http://www.fourseasonsfuel.co.uk/charcoal-retorts.asp

Biochar a market for carbon sequestration?

UN Climate Change Conference 2007
Bali - Indonesia

UNITED NATIONS
CLIMATE CHANGE CONFERENCE
POZNAŃ 2008
POLAND

COP15
COPENHAGEN
UN CLIMATE CHANGE CONFERENCE 2009

UNCCD, Micronesia, Belize, Swaziland, Gambia, Ghana, Lesotho, Mozambique, Niger, Senegal, Tanzania, Uganda, Zambia, Zimbabwe, Australia, Costa Rica