Microgassificatori e biochar per la mitigazione dei cambiamenti climatici nei Paesi in via di sviluppo

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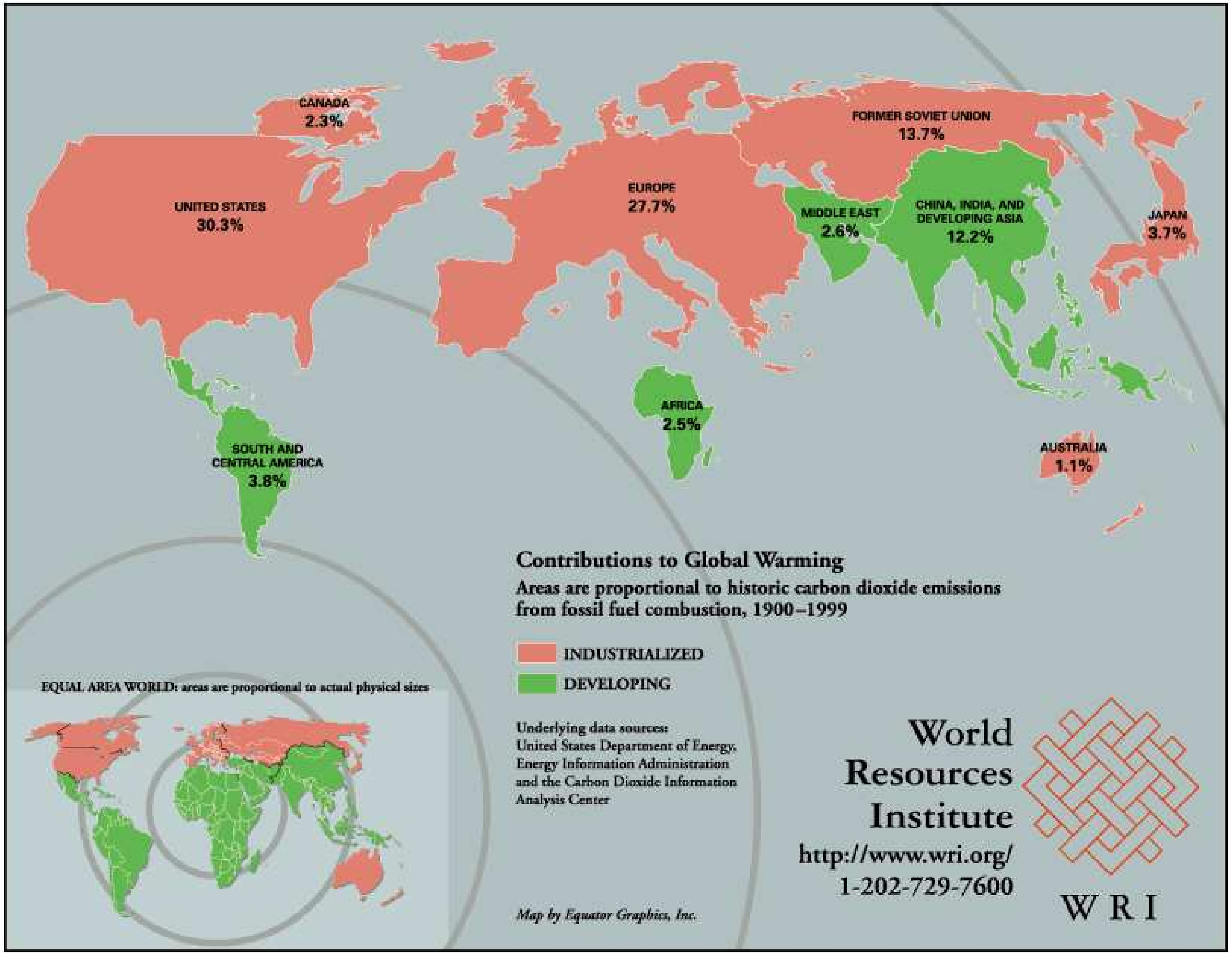
climatica mente cambiando
TRENTINO CLIMA 2011

Provincia Autonoma di Trento

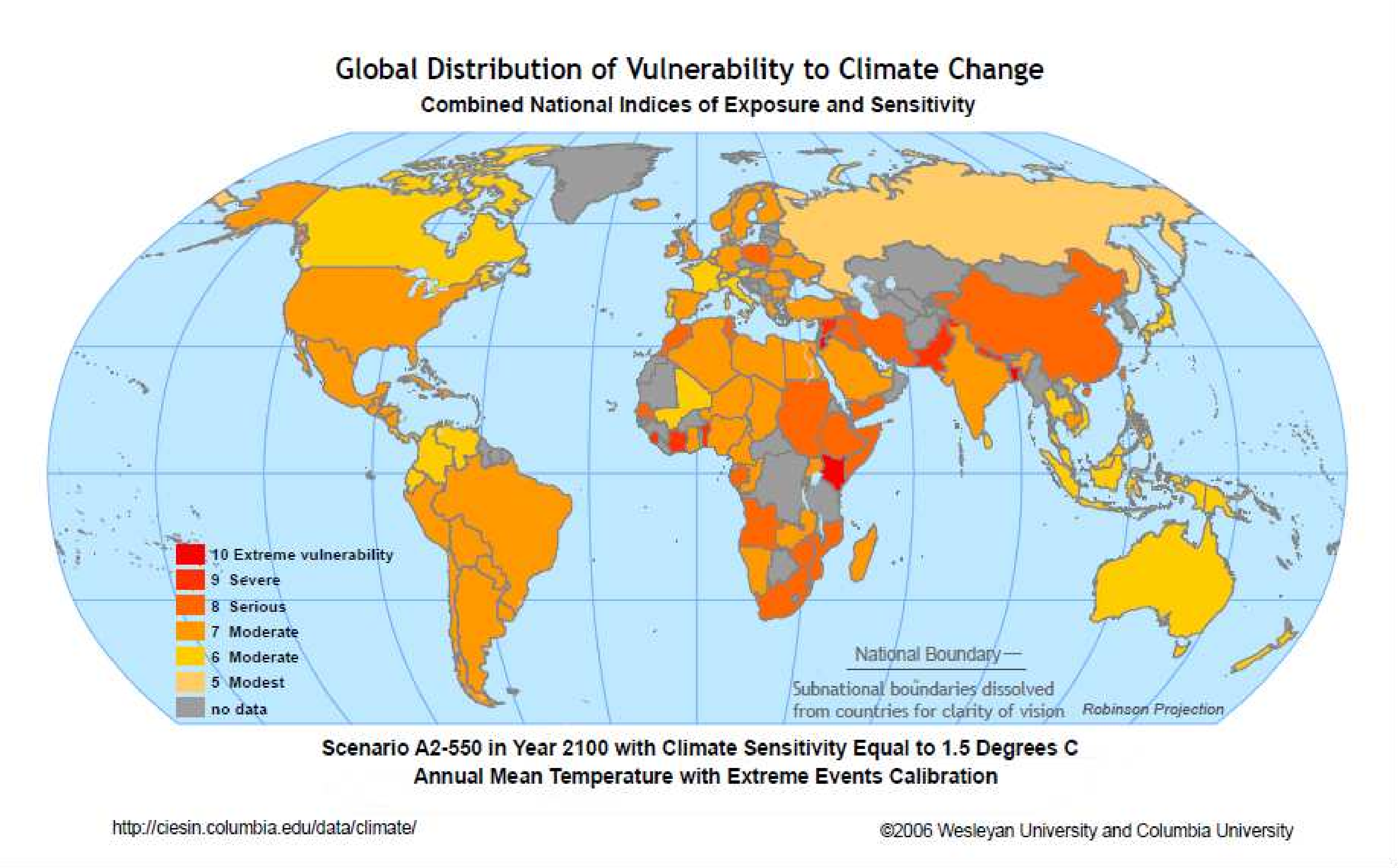
Trento,
5-11 Settembre 2011

Le emissioni di gas climalteranti

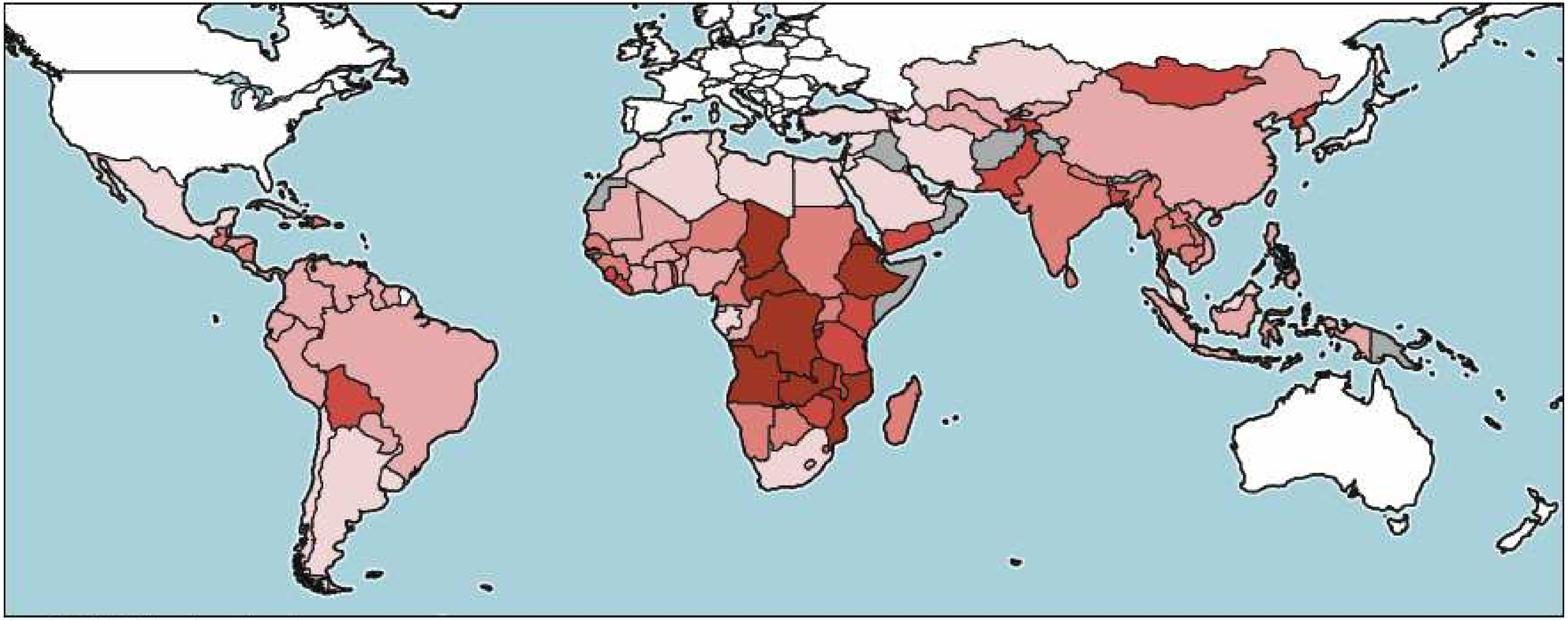


(Université de Tours, MEDD, December 2007)

Vulnerabilità ai cambiamenti climatici

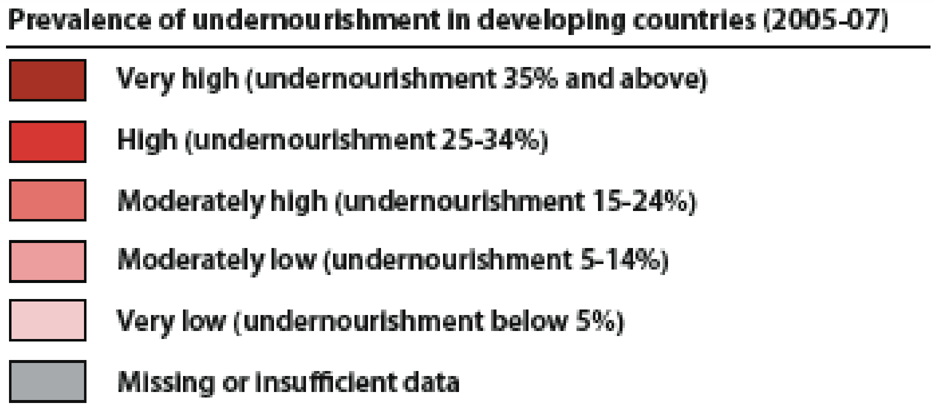


Sicurezza alimentare

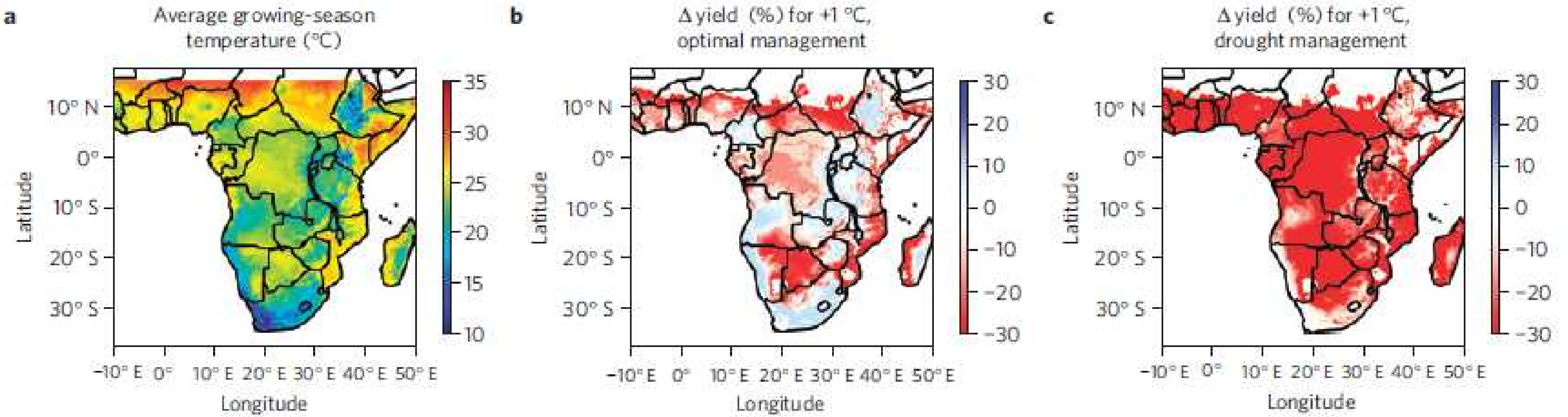


Source: FAOSTAT 2010 (www.fao.org/hunger)

FAOSTAT, 2010



Sicurezza alimentare



Temperatura media attuale della stagione di crescita delle colture

Impatto dell'aumento di 1℃ sulle rese di mais

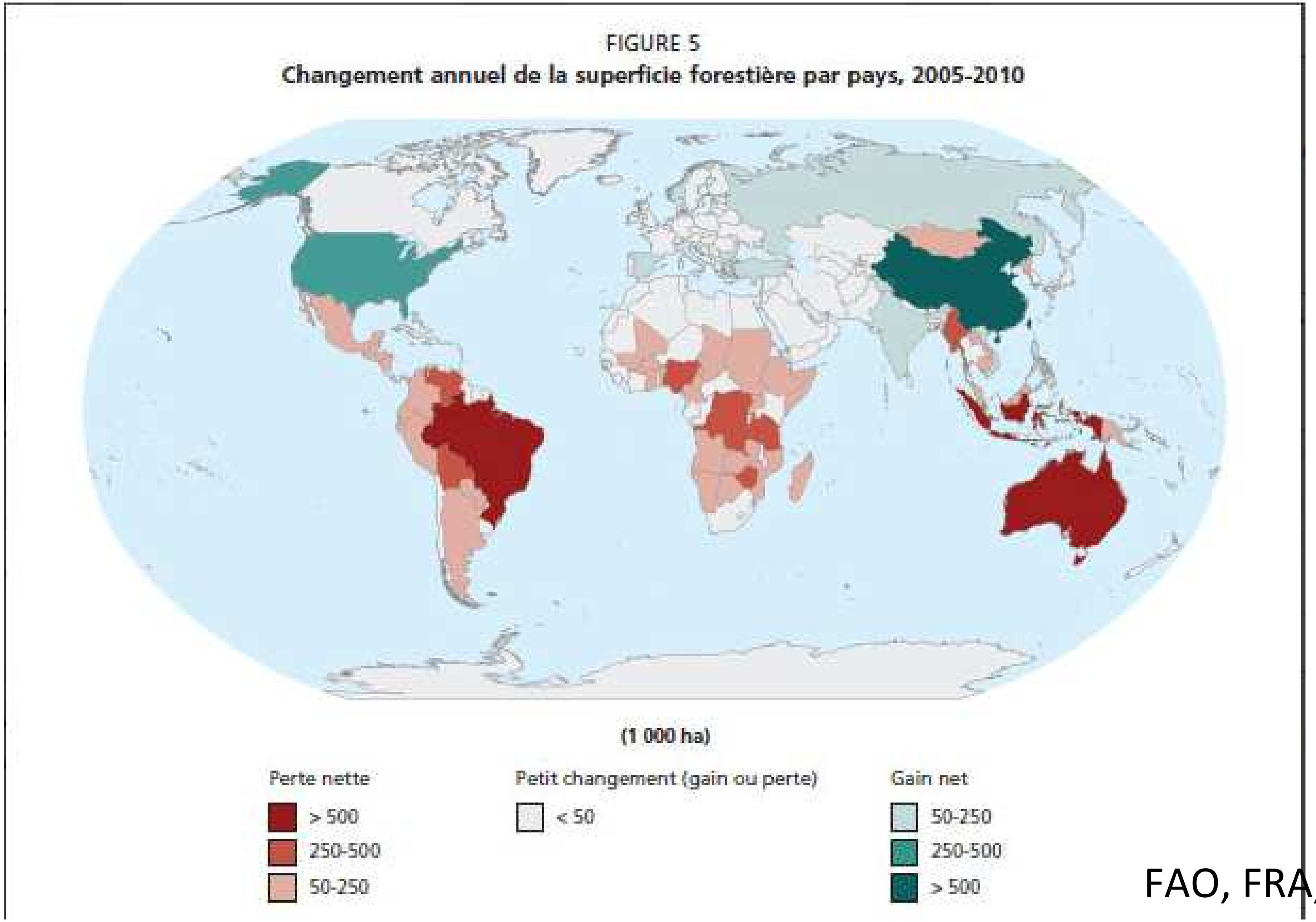
Impatto dell'aumento di 1℃ sulle rese di mais in caso di siccità

(Lobell, 2011)

Metodi di cottura tradizionali

Deforestazione

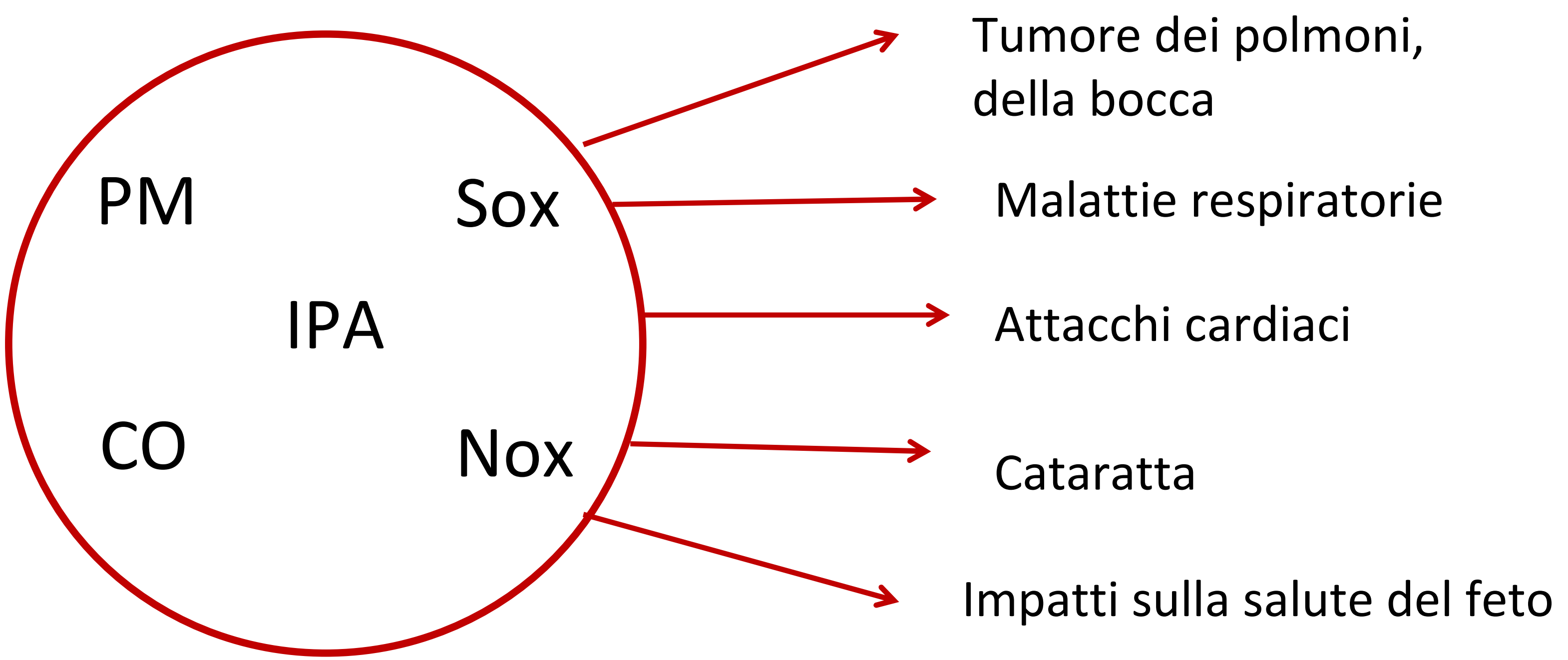
- 13 millioni di ettari all'anno in tutto il mondo, soprattutto nelle zone tropicali (FAO, 2005) → 25-30% emissioni di gas serra globali (FAO, 2006)



FAO, FRA, 2010

Effetti sanitari

Inquinamento interno alle case provoca 1.3 milioni di morti all'anno: più della malaria (WHO, 2006)



Soluzione: I microgassificatori





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

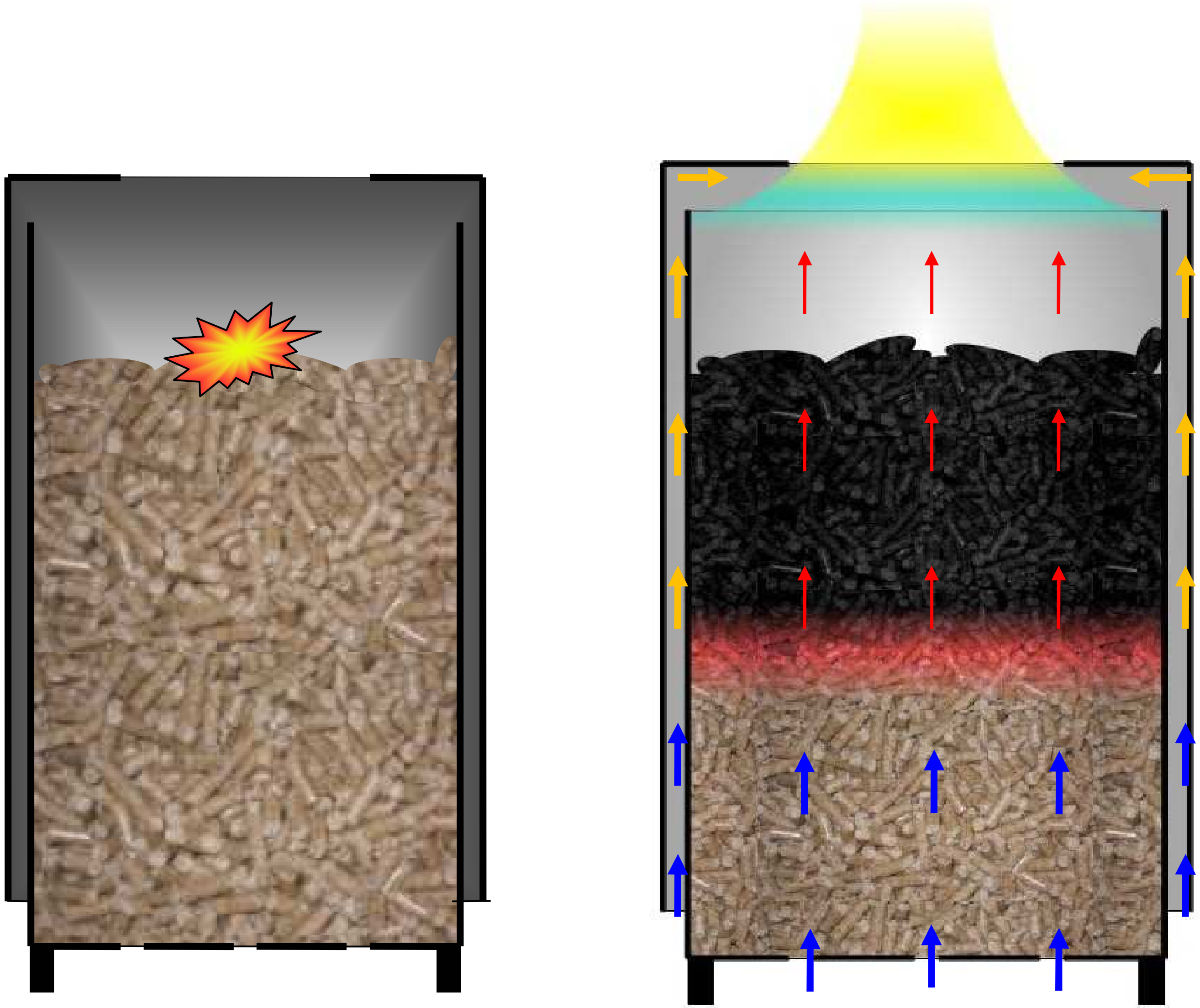
1. Reed Campstove *#6
2. BP Oorja *#7
3. Reddy Magh-CM1
4. Anderson Juntos B
5. Drummond-Cedar
6. Flanagan Biochar
7. A&W Servals PP-Plus
8. Wendelbo Peko Pe *#10
9. Anderson Champion *#5
10. ARTI Agni (based on Champion)
11. Karve Sampada Charcoal Maker *#8
12. Daxu (China)

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).

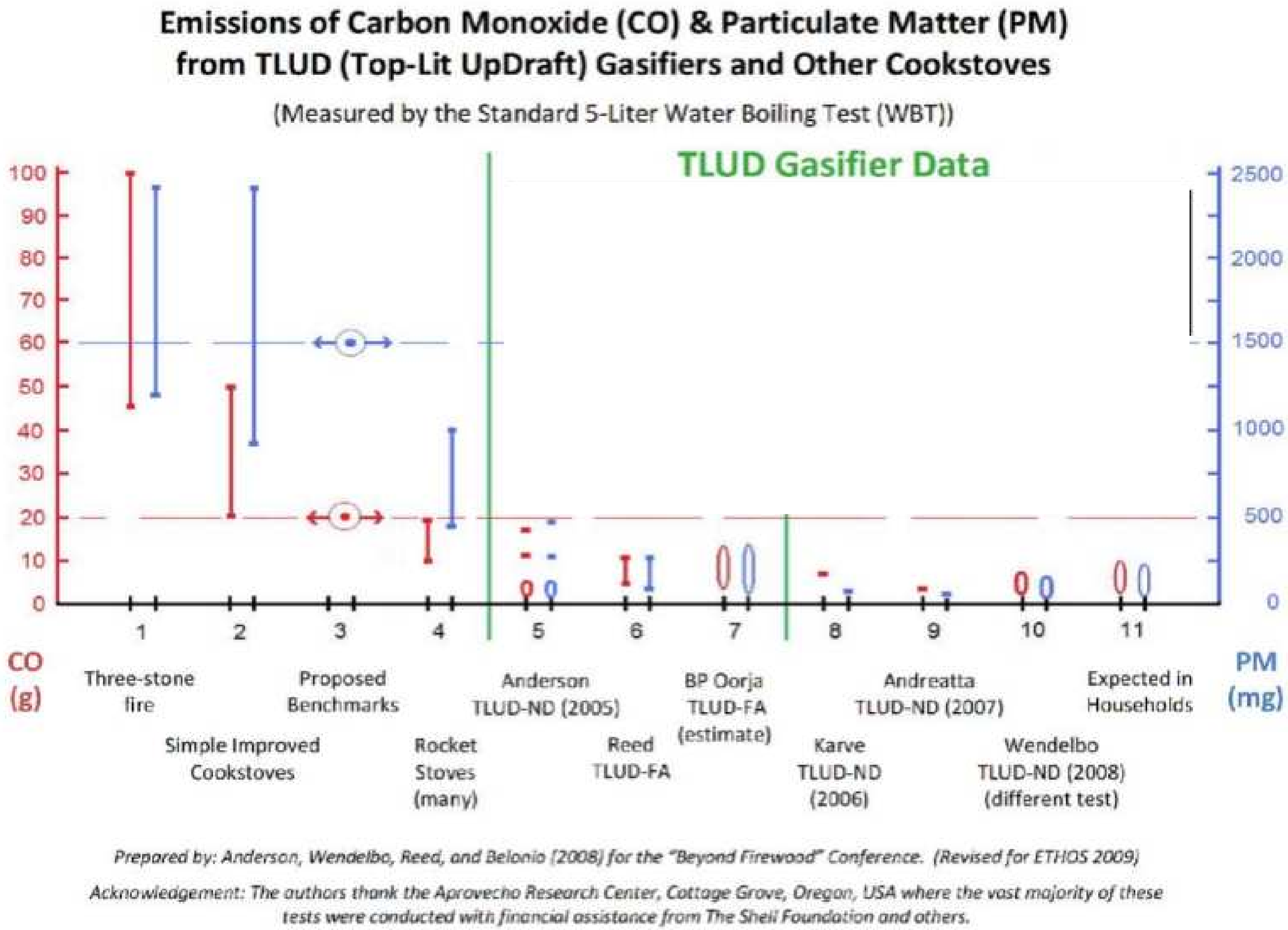




Funzionamento microgassificatori (TLUD)



Riduzione inquinamento dell'aria



Microgassificatori e cambiamento climatico

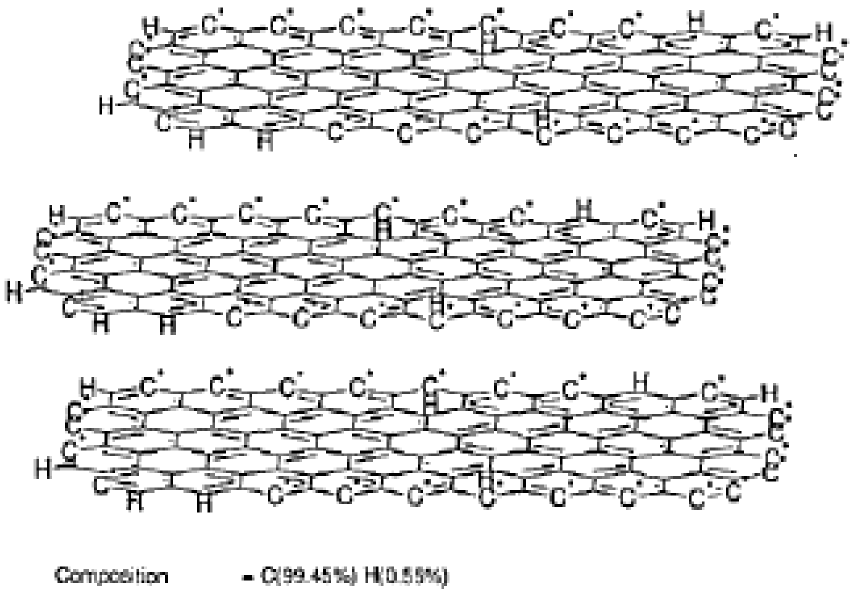
- Residui agricoli vs la legna < deforestazione
- Alta efficienza < biomassa < emissioni CO_2

CETAMB, Università di Brescia, 2011:
Riduzione dei consumi di legna del 55% = 1.9 t/anno legna
= 1.8 t CO_2 /anno per stufa

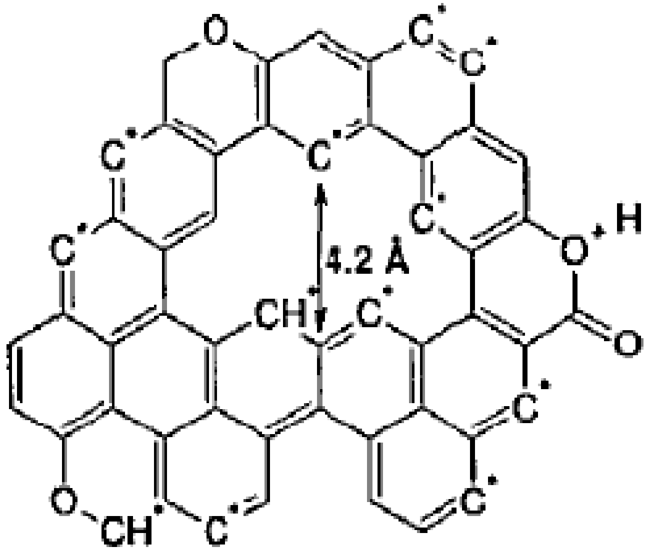
+ biochar: carbonella distribuita nei suoli

Il biochar sequestra carbonio nei suoli

80-90% di Carbonio organizzato in una struttura stabili: non viene trasformata in CO_2



Struttura grafitica



Struttura aromatica

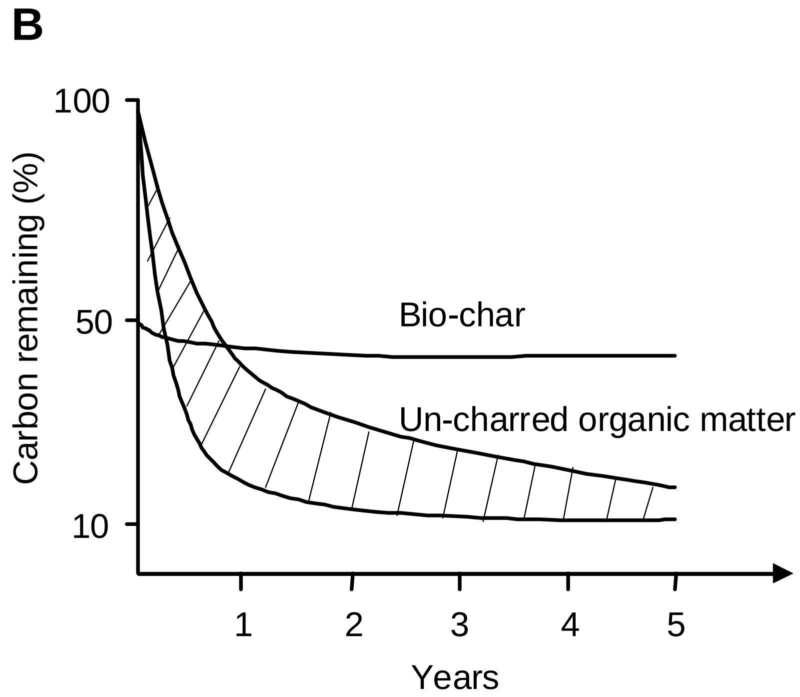
(Lehmann and Joseph, 2009 e 2010)

Il biochar sequestra il Carbonio nel suolo

Tempo medio di residenza del Carbonio nel suolo :

- Materia organica del suolo in media : 26 – 40 anni
- Biochar : 2000 anni

Glaser et al., 2007



Lehmann e Rondon,2006

- Biochar da residui agricoli e forestali globali = stock 0.16 Gt di carbonio all'anno
  (Lehmann et al., 2006)

- Aumento di carbonio in atmosfera = 3.75 GtC all'anno
  (NASA, 2008)

Origini del Biochar: Terra preta in Amazzonia

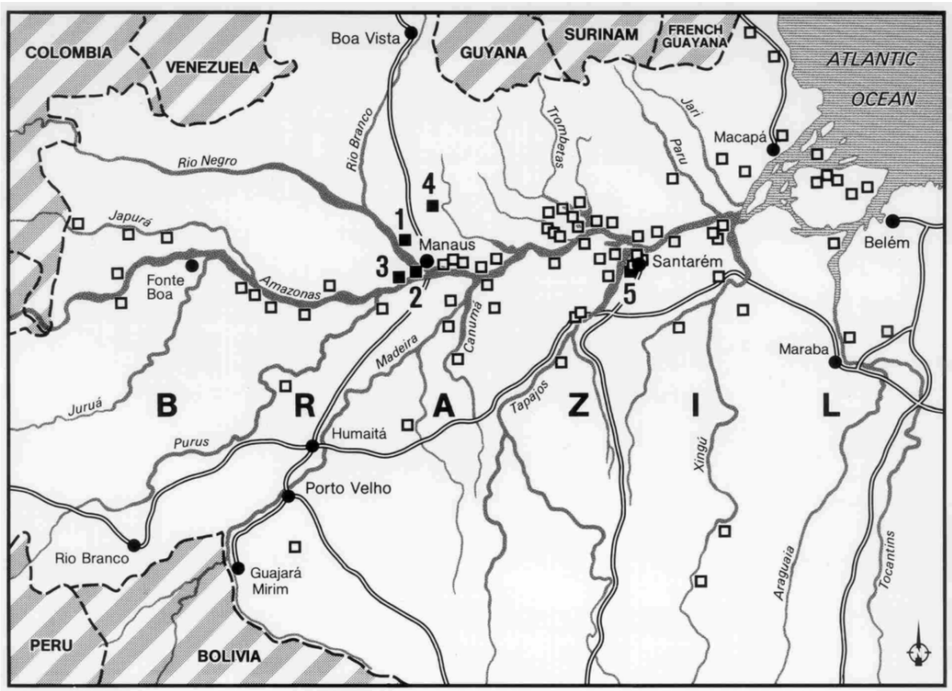


Photo: Glaser

- carbone antropogenico (10.000 anni) (Woods et al., 2009)
- 6.000 – 18.000 km2 (Sombroek, 2000)
- 3 – 5 million persone (Woods et al. 2010)

Altri antichi biochar

- African Anthropogenic Dark Earths
  - 1.500 fino ad oggi
- Egitto faraonico (*sebakh)*
- Italia:
  - Terramare (Valle del Pò): 16s aC
  - Val di Pejo, Carbonare

(Fairhead J, Leach M, 2009)

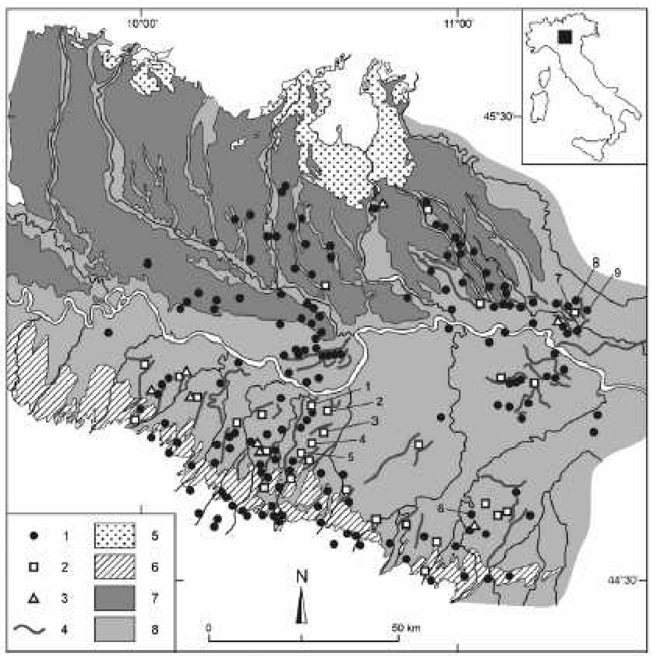


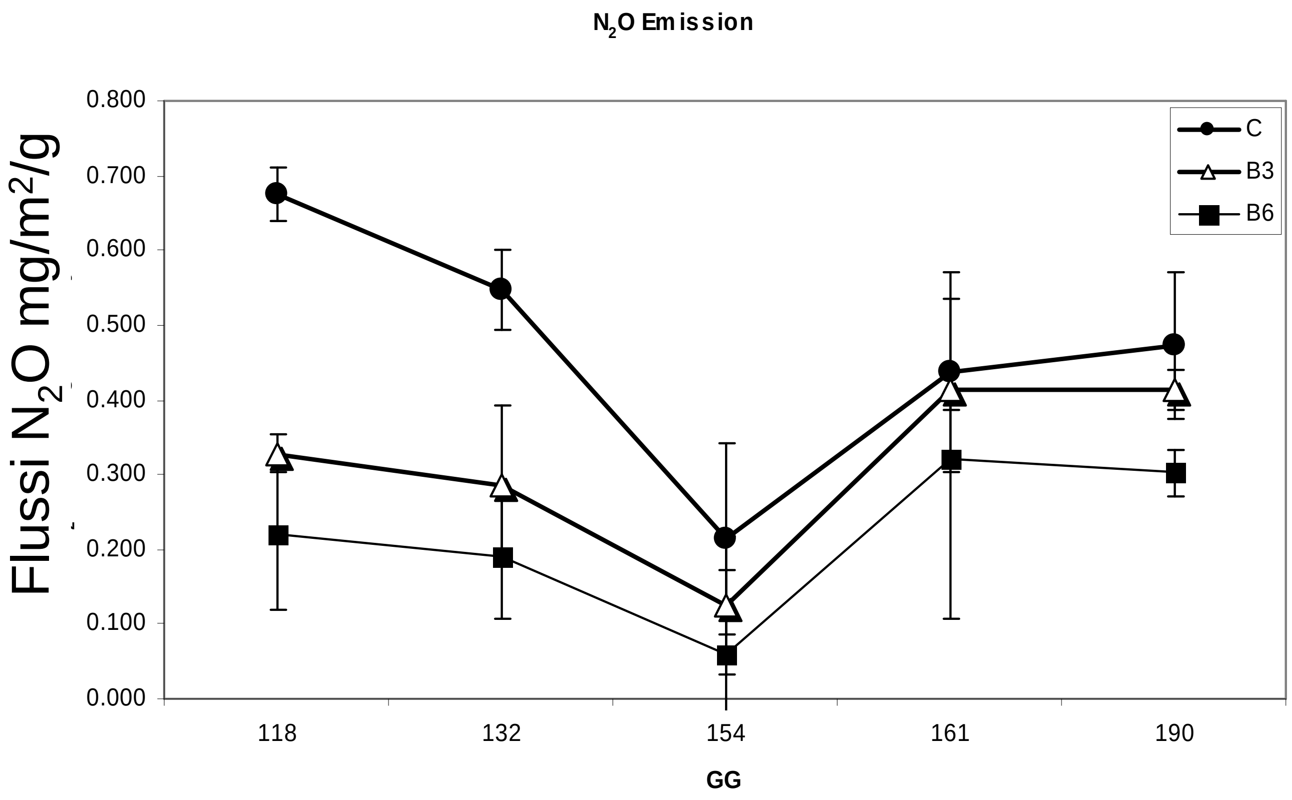
Fig. 1. Distribution of the Middle and Recent Bronze age sites in northern Italy. (1) Archaeological sites, (2) banked and ditched sites, (3) terramare covering pile-dwellings sites, (4) Holocene palaeochannels, (5) Pleistocene moraines, (6) Pre-Holocene terraces, (7) Upper Pleistocene outwash fans and (8) Holocene alluvial plain. Terramare quoted in the text: 1—Motta Balestri; 2—Santa Rosa; 3—Monticelli di Poviglio; 4—Case Cocconi; 5—Case del Lago; 6—Gaggio; 7—Fondo Paviani, 8—Castello del Tartaro; 9—Fabbrica dei Soci.

(M. Cremaschi et al. 2006)

Il biochar riduce le emissioni di N_2O

Esperimento di campo con grano duro (*Triticum durum* L.), Pistoia 2009

C. Coltrollo
B3 Biochar 30t/ha
B6: Biochar 60t/ha



(Baronti et al., 2009)

Il biochar per migliorare le rese agricole

- Ghana:

Rese di mais in luoghi di produzione di carbonella

Treatment	Increase in maize grain yield as compared to soils without charcoal and without fertilizer
Charcaol sites + fertilizer	276%
Charcaol sites without fertilizer	91%
soils without charcoal + fertilizer	78%

(Oguntunde et al, 2003)

- Costa d'Avorio e Togo: savana → foreste e suoli fertili

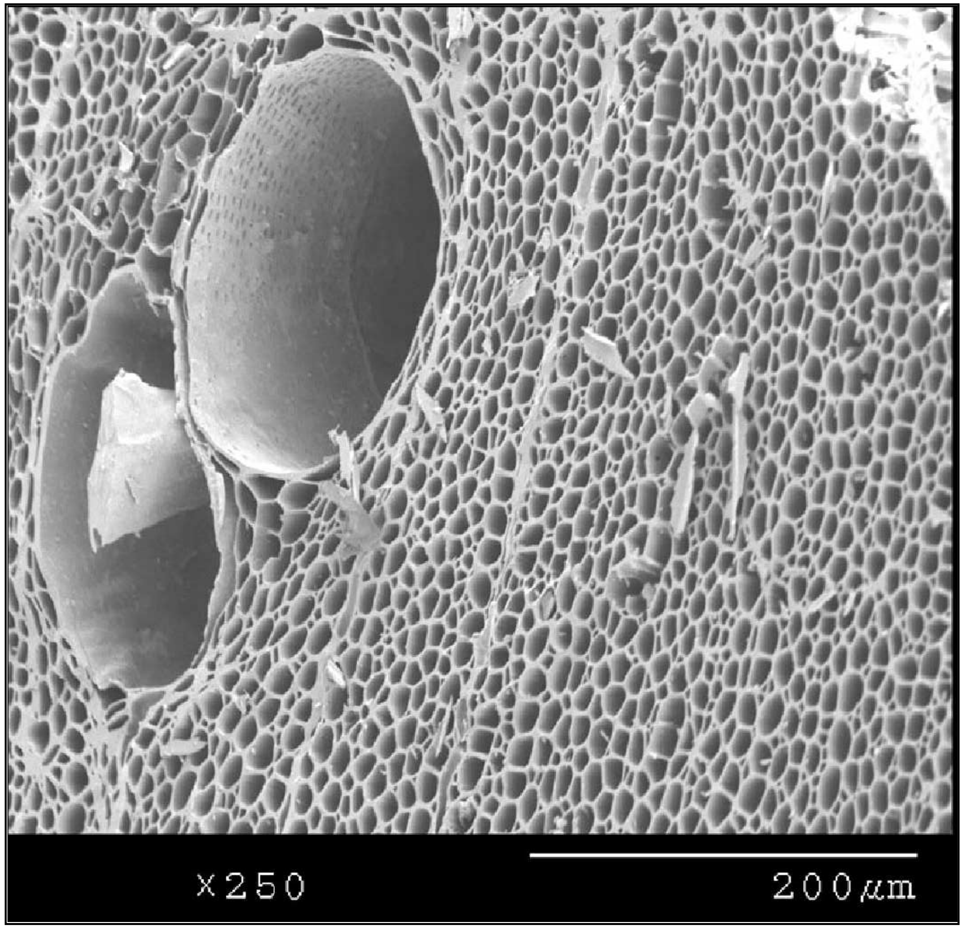
(Mitja 1990, and Mitja and Puig, 1991, Mondjannagni, 1969, Guelly et al. 1993, O'Neill et al. 2006)

Il biochar per migliorare le rese agricole

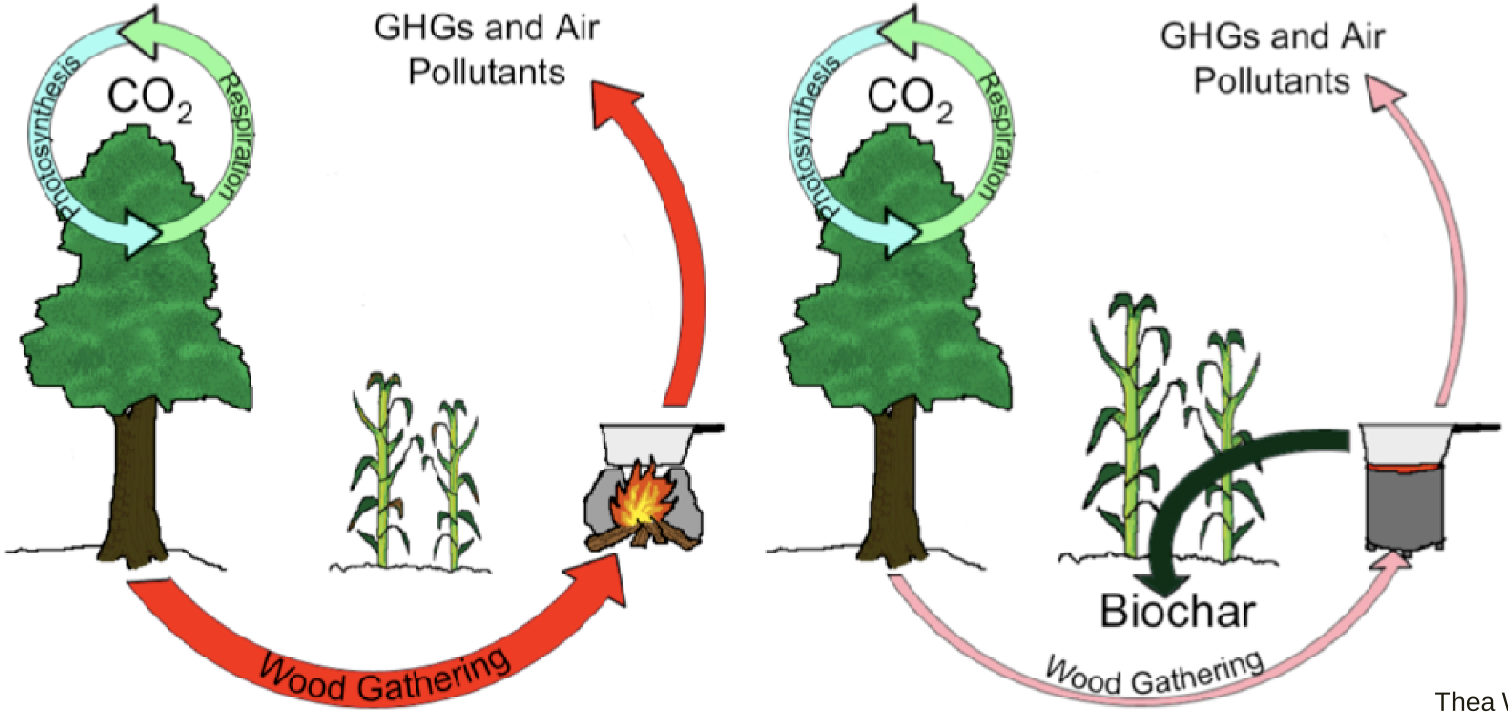
Aumento in

- Porosità suolo
- Infiltrazione acqua
- Minerali disponibili (Potassio +329%)
- macrofauna
- pH
- Materia organica

(Oguntunde et al. 2003, 2008)



Ricapitolando



Thea Whitman, 2009

	locali	regionali	globali
Problemi ambientali	Inquinamento aria interna alle case	Impoverimento dei suoli Inquinamento atmosferico Deforestazione	Cambiamento climatico

Altri punti di vista sul biochar

- studiare i biochar antichi e i loro metodi di impiego (STEPS center)

- risultati nella ricerca contradditori e basati su esperimenti di breve termine
- Rischi gestione industriale (PT Perhutani, Dynamotive)
- Rischi di geoengineering (James Hansen, Johannes Lehmann, Peter Read, Tim Flannery) (Biofuelwatch)

- agricoltura biologica aumenta gli stock di C nei suoli (Rodale Institute: +30% C in 27 anni, Vandana Shiva)

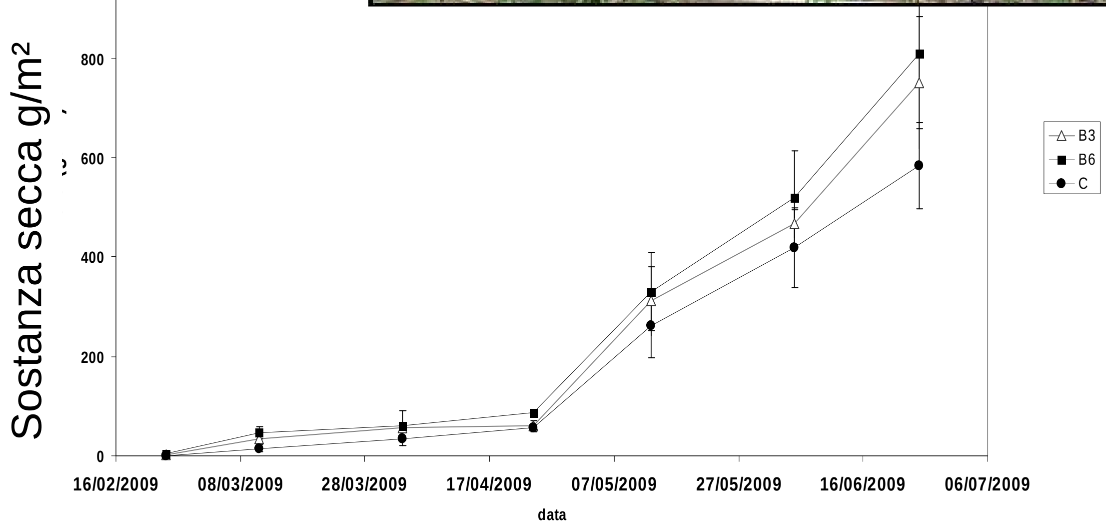
- Compost (Glaser)


GRAZIE PER LA VOSTRA
ATTENZIONE

Il biochar aumenta le rese agricole

Esperimento di campo con grano duro (*Triticum durum* L.), Pistoia 2009

C. Coltrollo
B3 Biochar 30t/ha
B6: Biochar 60t/ha



(Baronti et al., 2009)

Criteri di creazione delle mappe di sensibilità ai cambiametni climatici

Brenkert and Malone, Moss: Vulnerability-Resilience Indicator Model (VRIM) for 100 countries wherein more than 80% of the world's population resides;. Their index is also moot on sensitivity to climate change stresses, per se, but their approach does have the advantage of dividing their indicator into two major components – one that reflects sensitivity and a second that reflects adaptive capacity. conform well to the determinants of adaptive capacity highlighted in IPCC (2001, Chapter 18) and

•The Vulnerability-Resilience Indicator Model (VRIM) constructs a vulnerability index as the geometric mean of various measures of sensitivity (how systems could be negatively affected by environmental stresses) and adaptive capacity (the capability of a society to maintain, minimize loss of, or maximize gains in welfare).

•Sensitivity and adaptive capacity are composed, in turn, by underlying determinants that include, for adaptive capacity, human resources (dependency ratios and literacy rates), economic capacity (market GDP per capita and income distribution), and environmental capacity (population density, sulfur dioxide emissions, percentage of unmanaged land). For sensitivity, they include settlement/infrastructure, food security, ecosystems, human health, and water resources.

•Table 1 divides their sample of 102 countries into thirds according to their VRIM estimates of vulnerability.

•ranges of possible temperature change at the national level for 2050 and 2100 drawn from Country Specific Model for Intertemporal Climate (COSMIC) downscaling described in

•Schlesinger and Williams (2000): A2 1.5oC and B2 (5.5oC see Andronova and Schlesinger (2001), these global trends vary, of course, from location to location

Be.Bi. : Agricultural and environmental Benefits from Biochar use in ACP Countries

ACP S&T PROGRAMME

University of Udine, Italy

ISTITUTO DI BIOMETEOROLOGIA

Njala University
Sierra Leon

CORD SL
Sierra Leon

University of Cape Coast, Ghana

ASA Initiative
Ghana

University of Lomé
Togo

Sauve Flore
Togo

Microgassificatori nel progetto Be.Bi.

- Distribuzione di 180 stufe per Paese adattate a :
  - Metodi di cottura tradizionali
  - Disponibilità di biomasse locali

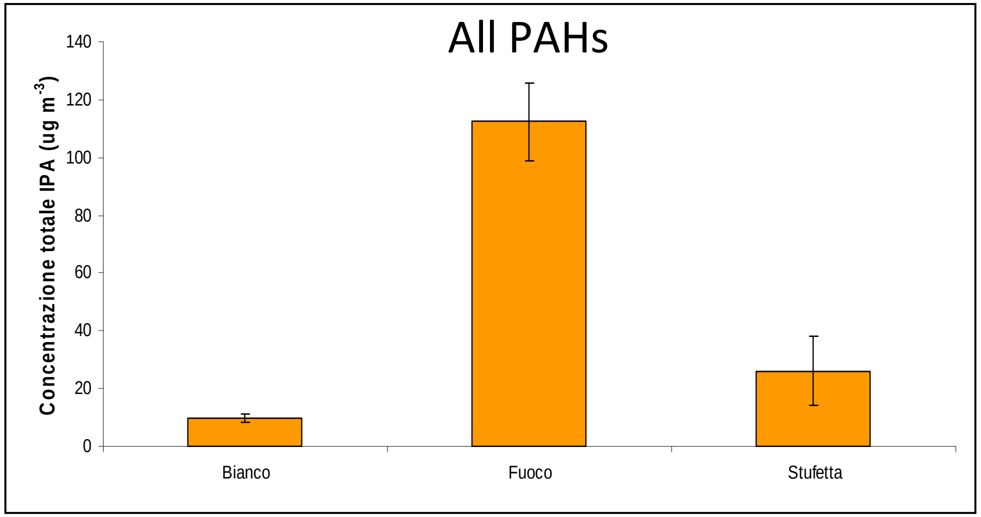
  (scarti agricoli non riutilizzati)

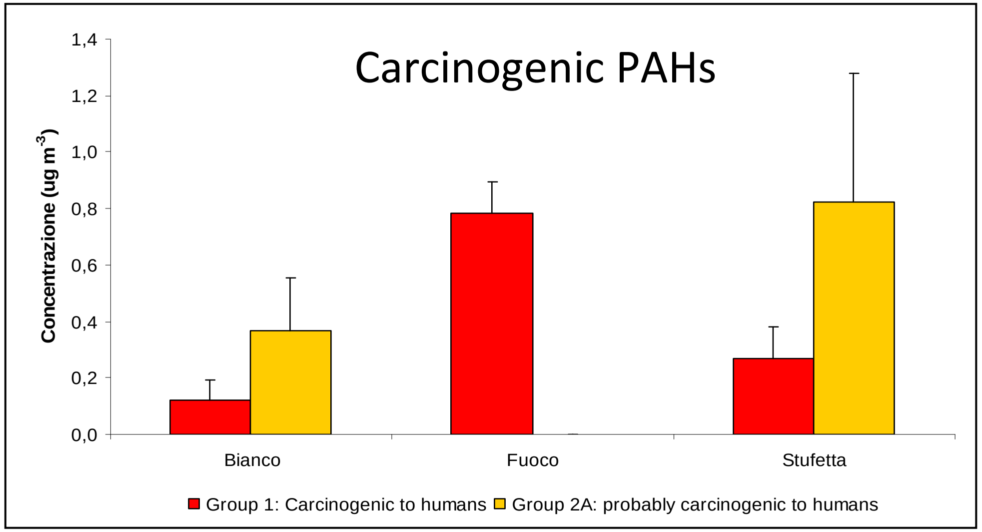
- Misure emissioni stufa (IPA)

- Trasferimento tecnologico : costruzione delle stufe in loco

Indoor air pollution assessment - PAHs

Air sampling (Teflon membrane filters + Tenax trap) → Analysis with GC-MS-MS (CISM, Università di Firenze) → Preliminary results





Necessità degli abitanti per cucinare

Esempio per il Ghana

Table: 1 Report on number of Household/Meals/Pots and Stoves owned by household

	N	Min.	Max.	Mean	Std. Dev.
Members of household (number)	20	1	15	8.50	3.5
No. meals cooked per day	20	2	6	3	0.91
No. of pots and owned by the household	20	3	16	9	3.4
No. of stoves owned by the household	20	1	6	2.6	1.32
Valid N (listwise)	**20**				

Biochar today in developing countries

International Biochar Initiative + Cornell University for the World Bank:
> 150 projects in 43 developing countries (June 2011)

Improved cookstoves

- Technologies:
  - MJ rice jusk gas stove (Indonesia), Alexis Belonio,
  - Luciastove, Worldstove Co.,
  - TLUD Champion, P.Anderson and Servals automation,
  - ANILA stove,
  - 1G Toucan

- Government subsidies: China daxu stove

- NGO and research insitutes:
  - BEBI project – University of Udine
  - Biochar-based inoculants and pyrolysis cookstoves for human and soil health – Cornell University

Biochar today in developing countries

Pro-natura international

- Biochar producing **plant** in Senegal (Pyro 7)

- A biochar enriched Super Vegetable Garden (Niger, Senegal)
  - less than 60 m2 → family of 10 people
  - 80% less water consumption
  - Production is constant all year round (cycle of 45 days)

Biochar today in developing countries

- Kyoto Protocol
  - Poznan Decembre 2008 : IBI + UNCCD *submissions* to includes biochar in Clean Development Mechanisms as a mitigation technology against climate change (UNCCD, 2008 ; UNFCCC, 2008).
  - Cancun and December 2010: no progress
  - June 2011 the Subsidary Body on STA, discussions about biochar
  - 26 african countries: « REDD-AFOLU Bio-carbon Coalition »: agriculture and biochar in CDM post-2012 Kyoto protocol
- Voluntary Emission Reduction

UK, Belize, the Maldives, Mozambique, Dominican Republic, Ghana, Nevada (USA) and Brazil.

Veneto e il Friuli Venezia Giulia

Results: CO2 emission savings

Woodfuel savings per stove	1.9 tonnes/year
CO_2 emission avoided per stove	1.8 tonnes/year

$$ER_y = B_{y,savings} * f_{NRB,y} * NCV_{biomass} * EF_{projected\_fossilfuel}$$

Where:

ER_y	Emission reductions during the year y in tCO_2e
$B_{y,savings}$	Quantity of woody biomass that is saved in tonnes
$f_{NRB,y}$	Fraction of woody biomass saved by the project activity in year y that can be established as non-renewable biomass
$NCV_{biomass}$	Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/tonne)

AMS-II.G.: Energy efficiency measures in thermal applications of non-renewable biomass