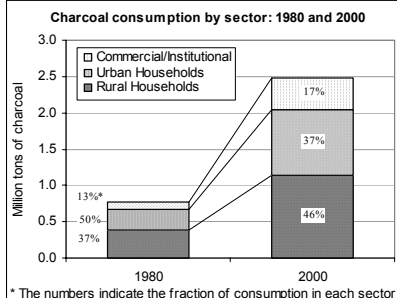
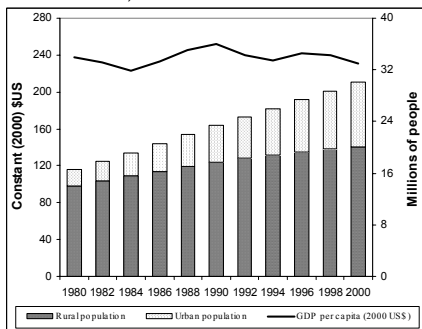




## Environmental and Socio-economic Impacts of Charcoal Production in Kenya

### Between 1980 and 2000:

- charcoal consumption in Kenya increased by over 200%
- total population increased by 81%, but urban population increased by nearly 300%
- GDP per capita has not changed in real terms
- The fraction of rural households using charcoal increased by a factor of two (from 16% to 34%)



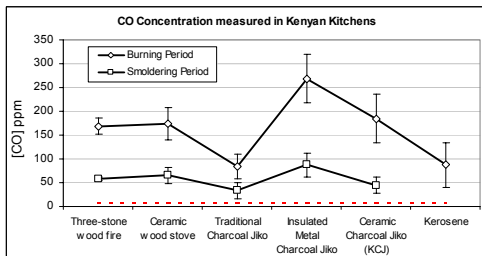
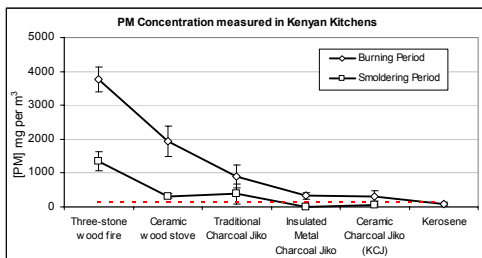
\* The numbers indicate the fraction of consumption in each sector

- Charcoal consumption attributable to rural households has increased by over 300% so that in 2000, nearly half of all charcoal consumption is attributable to rural households
- The charcoal trade has important implications for:
  - Indoor air pollution and public health
  - Greenhouse gas emissions
  - Forest cover
- ...with potentially conflicting impacts on social welfare resulting from these factors

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## Indoor Air: Pollution Concentrations Observed in Real Kenyan Kitchens



### Indoor air pollution:

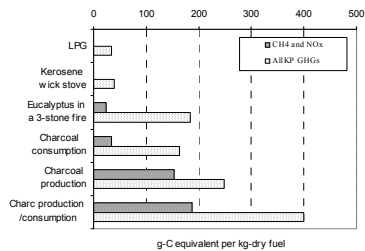
- Improved charcoal stoves result in lower [PM] concentrations than woodstoves, but this pattern does not repeat for [CO], which are as high, or higher, than [CO] from woodstoves.
- Kerosene is associated with the lowest [PM], but results in [CO] that is comparable to most other stoves.
- Each plot also shows the USEPA's standard for concentration of each pollutant (dashed line).
  - EPA standard for PM is 150 mg/m<sup>3</sup> for a 24-hour period.
  - CO is 9 ppm for an 8-hour period.
- A transition from using open wood fires to charcoal reduces exposure to PM by 90%.
  - This level of reduction can decrease incidence of ARI by 50% in children under 5 and 33% in adults.

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# Charcoal and the environment: GHGs and Forest Cover

**Greenhouse gases:** The charcoal sector is potentially the largest source of GHG emissions in the Kenyan economy



	Net Global Warming Impact (tons C in 20 year CO <sub>2</sub> equivalent units)	
	Renewable	Non-renewable
Firewood	966,000	7,556,000
Charcoal	2,382,000	5,092,000
Total woodfuels	3,348,000	12,648,000
Solid fuels		76,000
Liquid fuels		1,649,000
Cement		214,000
Manufacturing		
Total "modern" sector		1,940,000

Fossil fuel and cement data originate from WRI: <http://earthtrends.wri.org>. They only account for CO<sub>2</sub>.

## Forest cover:

- Typical charcoal conversion efficiencies are 10-20% by mass (wet wood @ 20-30% moisture).
- Kenya's annual charcoal consumption of 2.5 Mton represents 12-25 Mton of wood (18-36 million m<sup>3</sup>).
- ~90% of Kenya's charcoal comes from semi-arid woodlands.
- Combined, fuelwood and charcoal consumption exceed estimates of national sustainable yield by 50% - *is this a new fuelwood crisis?*
- If managed well, arid lands can recover from harvesting for charcoal production, but how are lands managed in practice?



From Stockholm Environmental Institute (SEI) CHAPOSA Project: [downloaded from http://www.sei.se/chaposas/photogallery.html](http://www.sei.se/chaposas/photogallery.html)