

ENVIRONMENTAL IMPACTS OF CHARCOAL PRODUCTION IN TROPICAL ECOSYSTEMS OF THE WORLD

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2. CHARCOAL PRODUCTION TECHNIQUES

3. IMPACTS ON FOREST CONDITION

Deforestation and forest degradation

Post-harvest forest regeneration

Impacts on soil

**Greenhouse gases emissions during
carbonization**

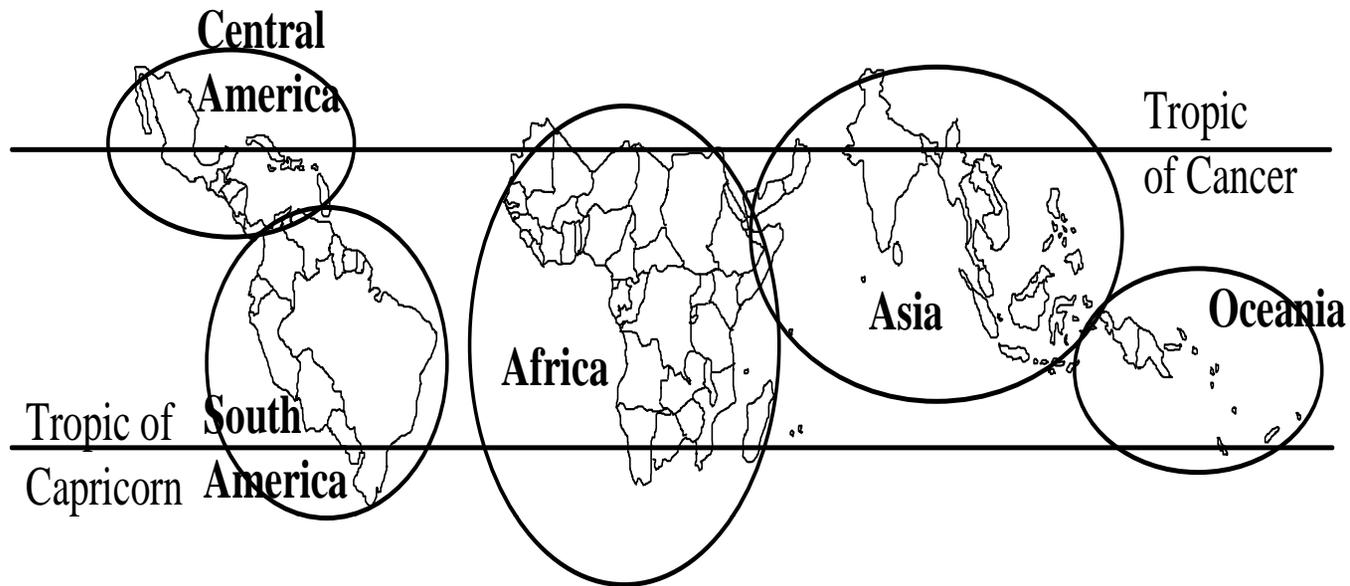
Effects on catchment hydrology

4. IMPACTS ON ECOSYSTEM SERVICES

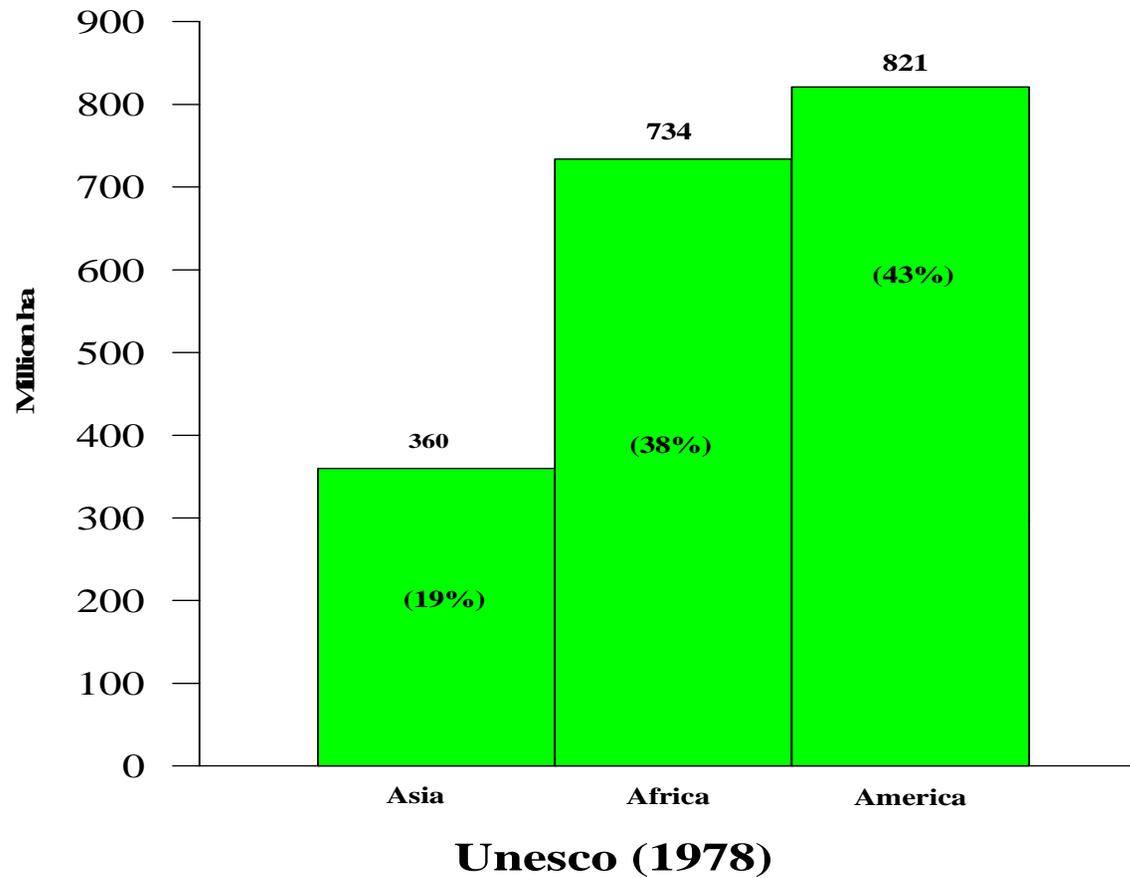
5. POLICY AND MANAGEMENT CHALLENGES

INTRODUCTION

Tropical forest ecosystems of the world are diverse and range from closed moist (rain) forests to open woodlands and scrub



Tropical forest ecosystems are found in at least 114 countries and cover 1915 million ha



Regional distribution of tropical forest ecosystems

CHARCOAL PRODUCTION TECHNIQUES:

TYPES OF KILNS

**The bulk of the charcoal in
tropical ecosystems is made
in earth kilns**



PIT EARTH KILN (FAO)



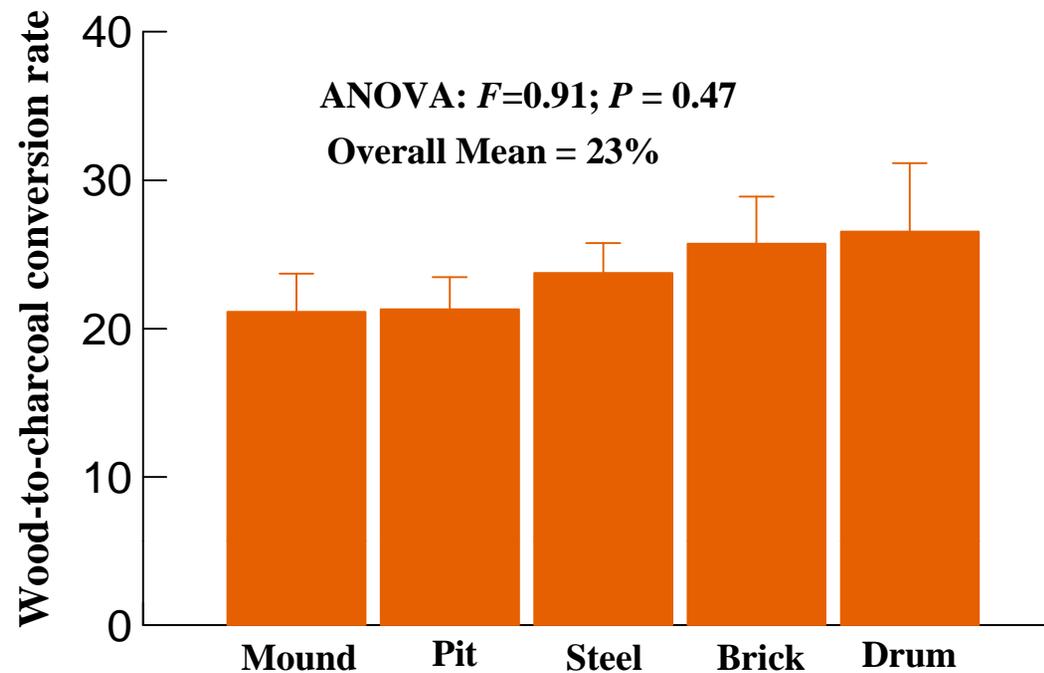
SURFACE EARTH-MOUND KILN

Wood pile is covered with leafy or herbaceous material and soil before ignition

OTHER KILNS

Modified forms of the surface earth kiln may have ventilation channels, such as chimneys (e.g. Casamance kiln).

Other kilns are made of bricks (brick kilns) or metal (metal kilns)



WOOD-TO-CHARCOAL CONVERSION RATE

Significant differences between mound & pit kilns (0.19) and other kilns (0.28): T-test = 4.98; $P < 0.0001$. (Different data)

IMPACTS OF CHARCOAL PRODUCTION ON FOREST CONDITION

Deforestation and forest degradation

In almost all countries where charcoal is produced there have been reports highlighting concern about deforestation and forest degradation linked to charcoal production.

DEFORESTATION AND FOREST DEGRADATION

Forest degradation refers to less obvious changes in the woody canopy cover

Deforestation is the complete loss of forest cover

DEFORESTATION AND FOREST DEGRADATION

**Forest clearing for charcoal
production varies spatially within
and among countries**

DEFORESTATION AND FOREST DEGRADATION

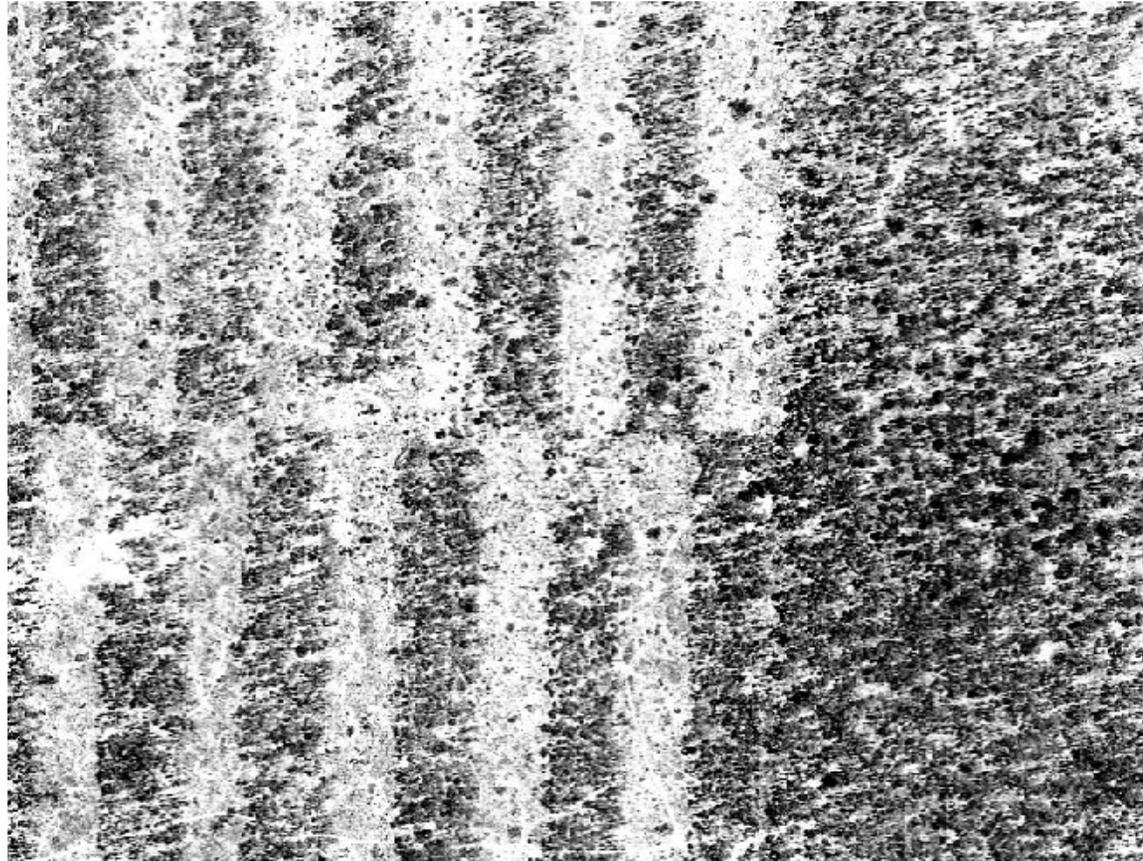
Generally the impact of producing a specified amount of charcoal depends primarily on:

- wood stocking rate
- tree-cutting system
- site history
- land tenure and
- policy and legislation

DEFORESTATION AND FOREST DEGRADATION

**Selective cutting is common in West
Africa  Forest degradation**

**Clear cutting at small spatial scales is
common in east & southern Africa
 Small scale deforestation**



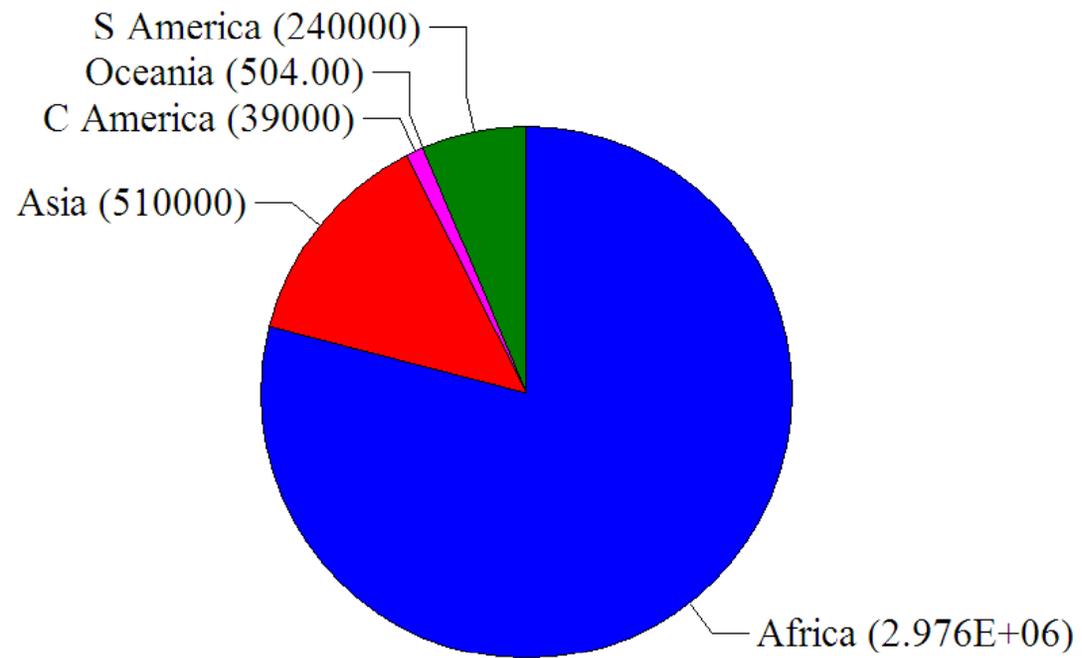
Shelterbelt and strip-cutting system in Zambia

On a larger landscape scale charcoal production → Forest degradation

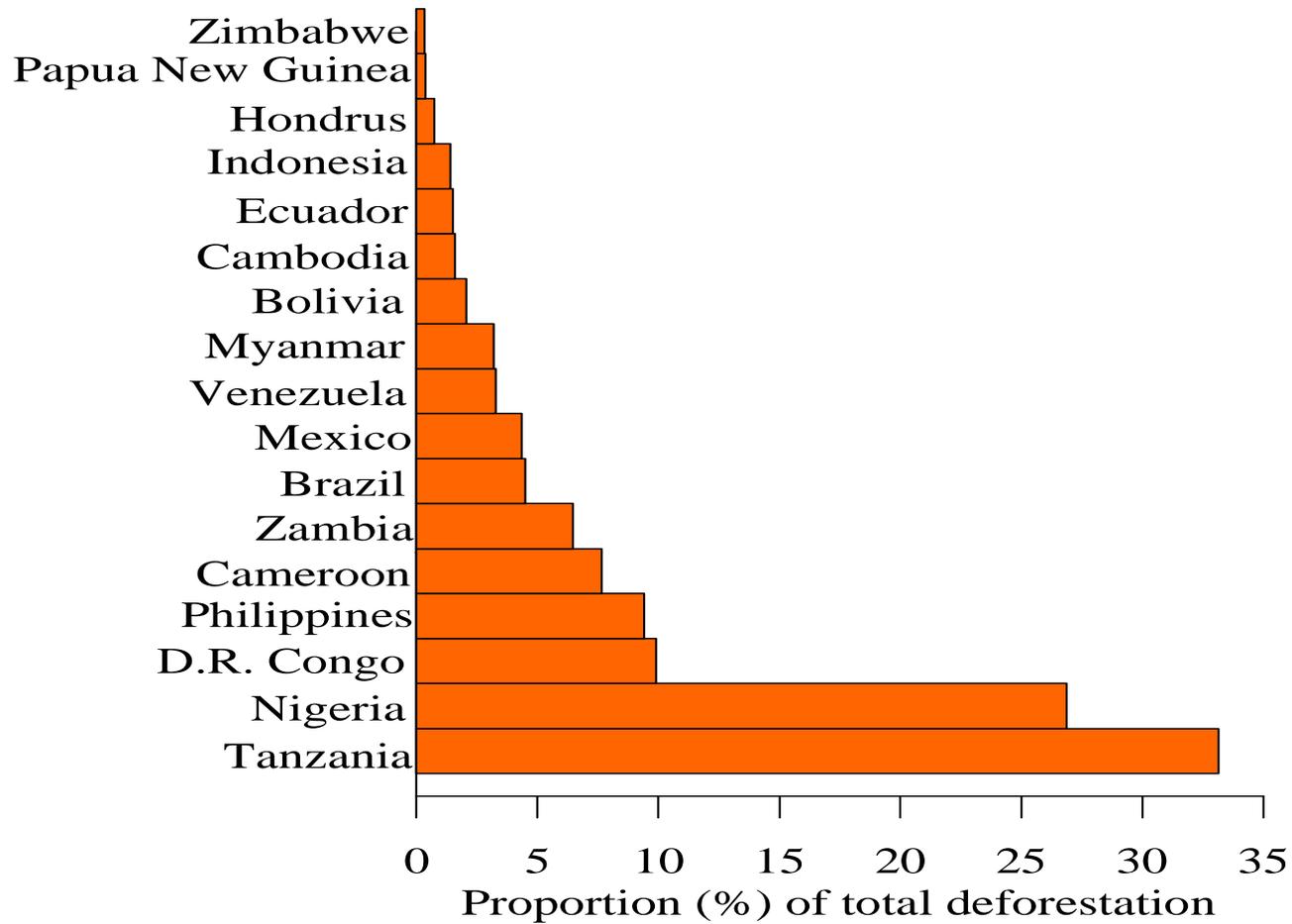
ESTIMATING DEFORESTATION CAUSED BY CHARCOAL PRODUCTION

$$\text{Deforestation}_{2009} \text{ (ha)} = (\text{charcoal}_{\text{produced}} \text{ (1/0.19)}) / \text{biomass}_{\text{density}}$$

Where 0.19 is the wood-to-charcoal conversion rate for earth kilns and $\text{biomass}_{\text{density}}$ is the country wood biomass stocking rate (FAO, 2005).



**ESTIMATED DEFORESTATION CAUSED
BY CHARCOAL PRODUCTION**



CONTRIBUTION OF CHARCOAL PRODUCTION TO TOTAL DEFORESTATION

POST-HARVEST FOREST RECOVERY

**Many tropical forest species have
the potential to regenerate after
clearing for charcoal production**

POST-HARVEST FOREST RECOVERY

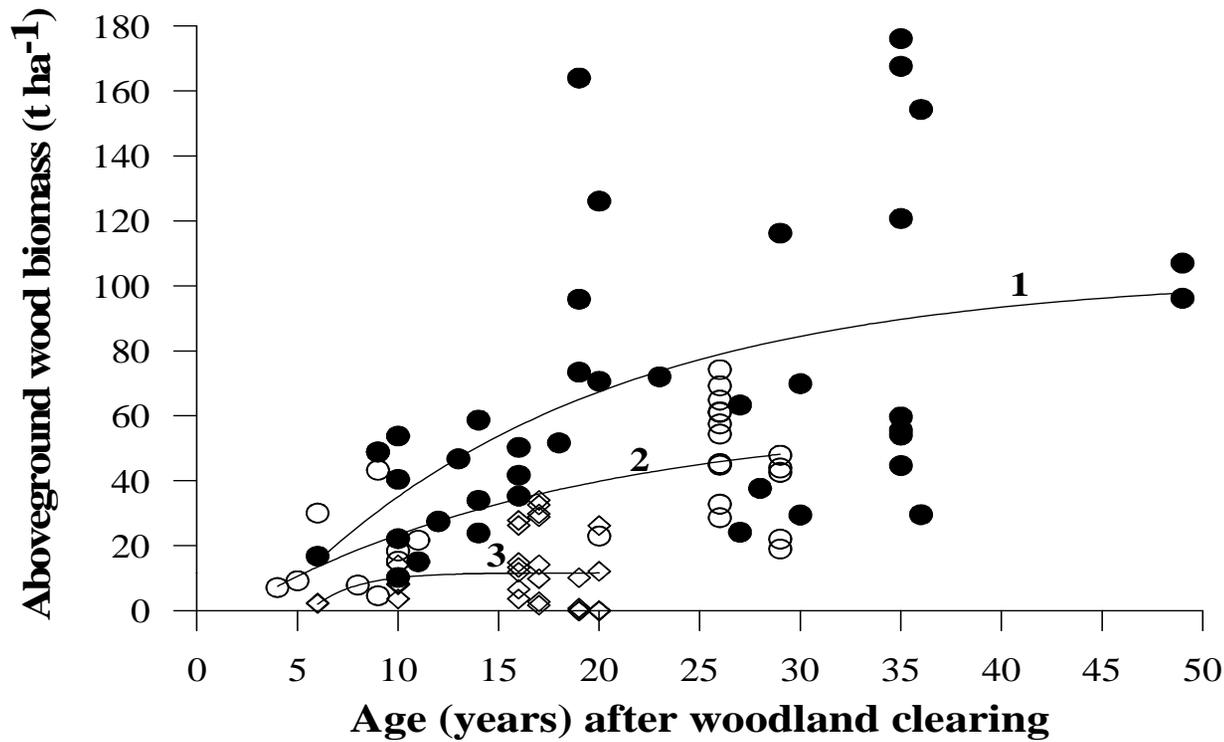
Rotational harvesting of wood for charcoal production of same sites have been reported in West, East and Southern Africa.

Cutting cycles range from 8 to 23 years

POST-HARVEST FOREST RECOVERY

However, forest regeneration rates are a function of:

- forest type,
- cutting system,
- climate (rainfall),
- fire management and
- grazing intensity



Effect of good (1), moderate (2) and poor (3) management on post-harvest biomass recovery in miombo woodland, Zambia



Permanent deforestation on kiln sites due to extreme heat

IMPACTS ON SOIL

Increased nutrients & better hydrological properties



GREENHOUSE GASES EMISSIONS DURING CARBONIZATION



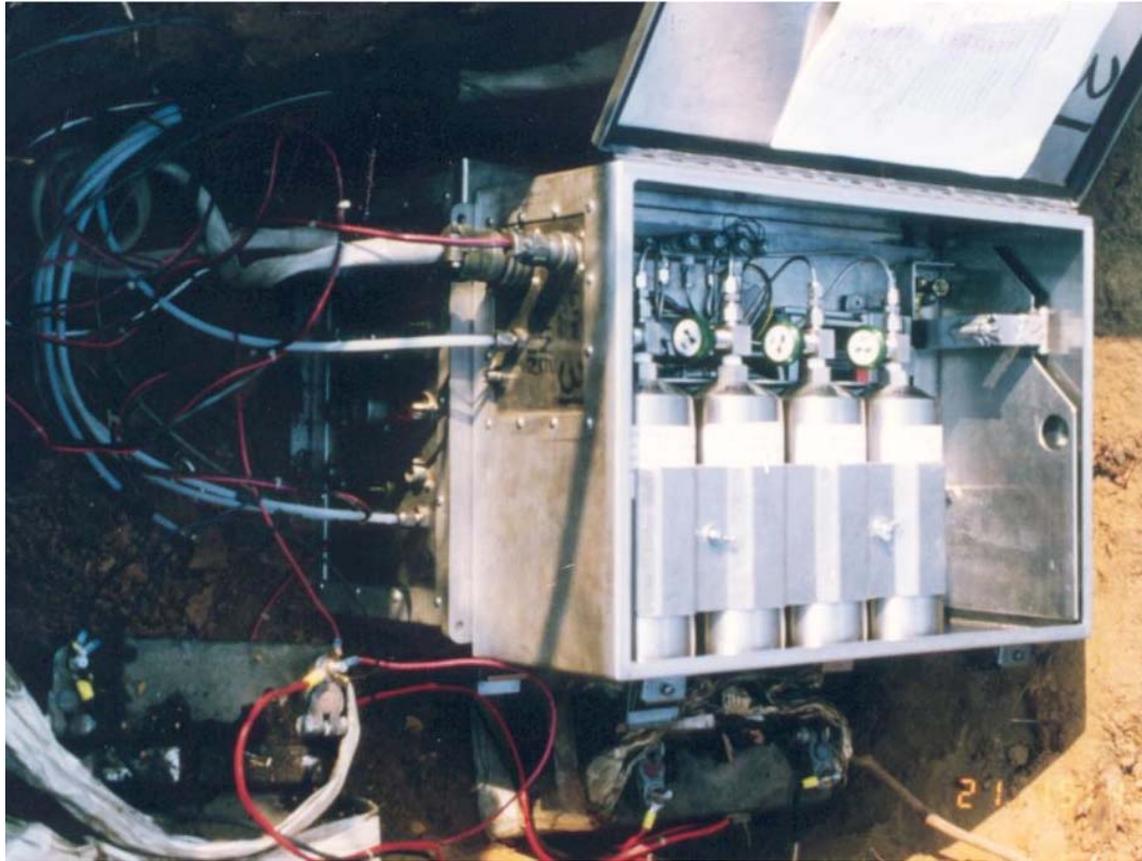
GREENHOUSE GASES EMISSIONS DURING CARBONIZATION

Charcoal production affects global warming through the production and emission of greenhouse gases, such as

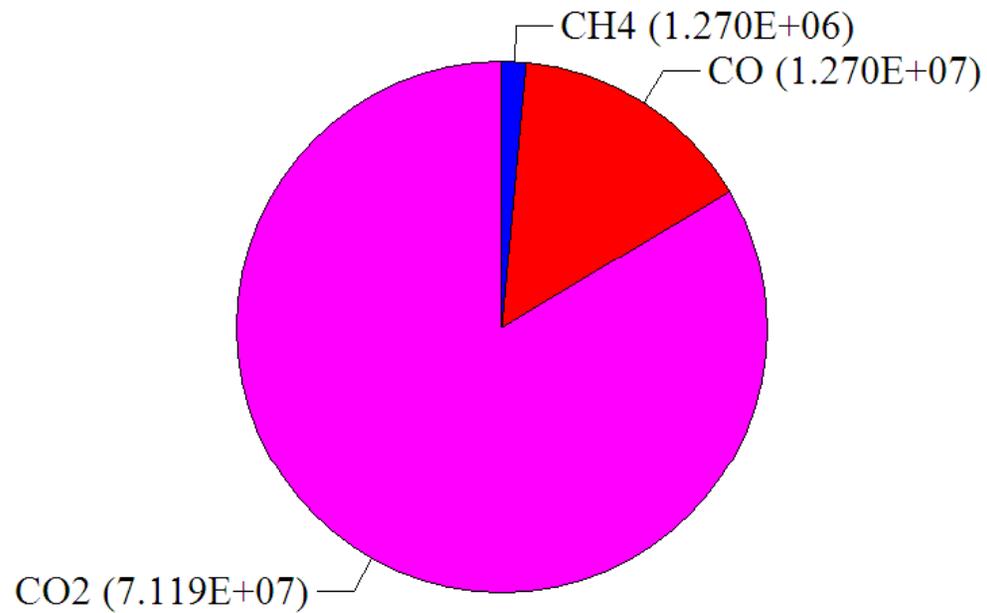
- carbon dioxide (CO₂),**
- carbon monoxide (CO) and**
- methane (CH₄).**



**Metal shelter for kiln before
monitoring emissions**



**Canister sampling systems
for earth kilns**



Emission factors (g greenhouse gas/kg charcoal produced) of 1788 ± 337 for CO₂, 319 ± 86 for CO and 32 ± 5 for CH₄.

Effects on catchment hydrology

Small catchments

- More runoff
- Increase in peak flow
- Shortened flow duration after rainfall events
- Less water uptake,
- Less evapotranspiration and
- Fast recovery of evapotranspiration due to secondary forest regrowth

Effects on catchment hydrology

Large catchments/Basins

**No negative impacts
have been observed.**

IMPACTS ON ECOSYSTEM SERVICES

Goods provided by tropical forest ecosystems include timber, woodfuel (firewood and charcoal) and non-wood products, such as bush meat, honey, bees wax, edible insects, fruits, tubers and medicines that contribute to human well being.

IMPACTS ON ECOSYSTEM SERVICES

Deforestation and forest degradation caused by charcoal production negatively affects the quality and quantity of these ecosystem services.

POLICY AND MANAGEMENT CHALLENGES

Concerns over the role of wood fuel extraction in tropical deforestation and the wood fuel shortages reached a peak in the late-1970s and the 1980s.

But except in a few cases, policy and programme interventions failed to effectively deal with the problem of charcoal-based deforestation and its associated environmental concerns.

POLICY AND MANAGEMENT CHALLENGES

Charcoal industry has great potential to contribute to rural development because production utilizes locally available and potentially renewable resource.

The charcoal industry can generate employment and local income in both rural and urban areas.

POLICY AND MANAGEMENT CHALLENGES

For this to happen new policies should be developed and implemented that provide for the following:

- 1. Recognition of charcoal as a key source of energy.**
- 2. Establishment of specific institutions to implement wood energy policies.**

POLICY AND MANAGEMENT CHALLENGES

3. The effective regulation of charcoal production from both plantations and natural forests.

4. Strong public and private sector participation.

5. Establishment of clear marketing arrangements and rules.

POLICY AND MANAGEMENT CHALLENGES

6. Mechanisms for government to raise royalties and taxes, which are reinvested in forest management.

7. Establish secure tenure and encourage sustainable forest management.

THANK YOU

FOR LISTENING