

# **ESTIMATES OF CO<sub>2</sub> EMISSIONS FROM SOIL ORGANIC CARBON FOR DIFFERENT LAND USES**

**By**

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# ORDER OF PRESENTATION

- Brief Introduction
- Objectives
- Materials and Methods
- Results
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- Conclusions

# INTRODUCTION

- Human activities have shifted the composition of the earth's atmosphere from its natural equilibrium resulting in increased global atmospheric concentration of CO<sub>2</sub>.
- This problem due to anthropogenic factors has been compounded by increased world population.
- Increased world population means increased food demand. In Africa, increases in food production are usually achieved through opening new forest lands.

# INTRODUCTION

- Burning of forests for the purpose of land clearing and the oxidation of carbon in the vegetation and soil result in CO<sub>2</sub> emission into the atmosphere.
- Non-sustainable land use in Africa, leads to nutrient mining and soil erosion compounding the problem of CO<sub>2</sub> emission into the atmosphere.

# OBJECTIVES

- Estimate CO<sub>2</sub> emissions from soil organic carbon in the High Rainforest zone of Ghana.
- Compare CO<sub>2</sub> emissions from intact virgin forest with those from different land use systems.

# MATERIALS AND METHODS

- The study was carried out in 1997 as part of sustainable land use study at Aiyinasi in the High Rainforest zone.
- Bulk soil samples were taken from 0-15cm depth in
  - virgin forest
  - one year old cassava farm
  - recent maize farm (slashed and burnt)
  - established rubber plantation
  - a two-year bush fallow

# MATERIALS AND METHODS

- Soil organic carbon was determined on 2mm air-dried sieved soil samples by wet oxidation method of Walkley and Black.
- Soil organic carbon was converted to CO<sub>2</sub> by multiplying by a factor of 44/12.

# RESULTS

**Table 2. Texture of the soils**

<b>Land Use</b>	<b>Sand (%) 2-0.02mm</b>	<b>Silt (%) (0.02 – 0.002mm)</b>	<b>Clay (%) 10.002mm)</b>	<b>Texture Class</b>
<b>Virgin forest</b>	<b>77.9</b>	<b>5.5</b>	<b>16.6</b>	<b>SL</b>
<b>One year old Cassava farm</b>	<b>72.4</b>	<b>7.7</b>	<b>19.9</b>	<b>SL</b>
<b>Recent maize farm</b>	<b>72.6</b>	<b>5.7</b>	<b>21.7</b>	<b>SCL</b>
<b>Rubber Plantation</b>	<b>71.7</b>	<b>5.9</b>	<b>22.4</b>	<b>SCL</b>
<b>Bush Fallow</b>	<b>70.2</b>	<b>6.8</b>	<b>23.0</b>	<b>SCL</b>

**SL = Sandy Loam; SCL = Sandy Clay Loam**

# RESULTS

**Table 3. Bulk density, organic carbon, converted CO<sub>2</sub> and pH**

Land Use	Bulk density (kg m <sup>-3</sup> )	Organic Carbon (%)	kg/ha	CO <sub>2</sub> kg/ha	pH
Virgin forest	1400	2.48	5208	19113.36	4.4
One year old Cassava farm	1400	2.30	4830	17726.10	4.9
Recent maize farm	1400	1.47	3087	11329.10	5.4
Rubber plantation	1400	1.33	2793	10250.31	4.6
Bush Fallow	1400	1.25	2625	9633.75	4.7

# RESULTS

**Table 4. CO<sub>2</sub> emissions – the difference in CO<sub>2</sub> between virgin forest and the other land uses**

<b>Land Use</b>	<b>CO<sub>2</sub> Emission (kg/ha)</b>	<b>%</b>
<b>Virgin Forest</b>	<b>-</b>	<b>-</b>
<b>One year old cassava farm</b>	<b>1387.26</b>	<b>7.26</b>
<b>Recent maize farm (slashed and burnt)</b>	<b>7784.07</b>	<b>40.73</b>
<b>Rubber (20 years)</b>	<b>8863.05</b>	<b>46.37</b>
<b>Bush Fallow (Two years fallow)</b>	<b>9479.61</b>	<b>49.60</b>

# **SUMMARY OF RESULTS**

Loss of CO<sub>2</sub> relative to the virgin forest was highest in the two-year fallow, followed by rubber plantation, slashed and burnt maize farm and one year cassava farm in that order.

# DISCUSSION

- The loss of carbon is in conformity with carbon loss from typical Tropical forest (Table 5).

Carbon sequestration in Tropical soils may be increased by the following practices:

- Use of fertilizers
- Limiting soil degradation through erosion
- Reforestation with fast growing trees

# DISCUSSION

- Adopting conservation tillage
- Adopting shelterbelt in forest regeneration practice
- Adoption of Agroforestry Practices

# CONCLUSIONS

- Carbon sequestration in acid soils is naturally weak due to acid soil infertility
- Slashed and burnt in tropical forest leads to substantial loss of CO<sub>2</sub> (41%).
- Soils under rubber plantation do not sequester enough carbon due to limited litter fall and difficulty in the decomposition of the leaves.

# CONCLUSIONS

- Tropical bush fallow systems require long retiring periods for soil organic carbon to be regenerated.
- When tropical forest is cut and fallowed, the original forest does not reform leading to decreased carbon density.

THANK YOU

MERCIE

GRAZIE