Soil and land resources in the context of addressing food and energy security through sustainable biomass value chain

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Soil Resources

• Soil is a non-renewable natural resource. Its preservation is essential for food security and sustainable development of nations.

• Soil is a core component of land resources; it is the basis for food, feed, fuel and fibre production and for many critical ecosystem services.
The **SOIL** is vital for sustainable agricultural production and food security.
Total land area of Ghana is 23,853,900 ha.
13,628,179 ha (57.1%) is suitable for agriculture

**Nutrient depletion:**
- Occurs primarily through crop removal in harvested products and residues, leaching, erosion and N volatilization
- Annual depletion rate is 35 kg N, 4 kg P and 20 kg K ha⁻¹
## Fertility status of the soils

<table>
<thead>
<tr>
<th>Agro-Ecological Zones</th>
<th>Soil pH</th>
<th>Organic C (%)</th>
<th>Total N (mg/kg soil)</th>
<th>Available P (mg/kg soil)</th>
<th>Available K (mg/kg soil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Rainforest</td>
<td>3.8 – 5.5</td>
<td>1.52 – 4.24</td>
<td>0.12 – 0.38</td>
<td>0.12 – 5.42</td>
<td>63.57 – 150.41</td>
</tr>
<tr>
<td>Forest-Transition</td>
<td>5.1 – 6.4</td>
<td>0.59 – 0.99</td>
<td>0.04 – 0.16</td>
<td>0.30 – 4.68</td>
<td>58.29 – 72.53</td>
</tr>
<tr>
<td>Semi-Deciduous Forest</td>
<td>5.5 – 6.2</td>
<td>1.59 – 4.80</td>
<td>0.15 – 0.42</td>
<td>0.36 – 5.22</td>
<td>62.01 – 84.82</td>
</tr>
<tr>
<td>Coastal Savanna</td>
<td>5.6 – 6.4</td>
<td>0.61 – 1.24</td>
<td>0.05 – 1.16</td>
<td>0.28 – 4.10</td>
<td>48.02 – 58.71</td>
</tr>
<tr>
<td>Guinea Savanna</td>
<td>6.2 – 6.6</td>
<td>0.51 – 0.99</td>
<td>0.05 – 0.12</td>
<td>0.18 – 3.60</td>
<td>46.23 – 55.27</td>
</tr>
<tr>
<td>Sudan Savanna</td>
<td>6.4 – 6.7</td>
<td>0.48 – 0.98</td>
<td>0.06 – 0.14</td>
<td>0.06 – 1.80</td>
<td>36.96 – 44.51</td>
</tr>
</tbody>
</table>

Source: Annual Report, CSIR-SRI and Fening et al., 2013.
Nutrient losses versus application rate
Soil Suitability Information

- What to grow and where for sustainable crop production
Crop Suitability Information

Crop (Cocoa) Suitability Distribution
Soil Fertility Information

What fertilizer to apply where and at what rate for sustainable crop production.
Improve agricultural productivity to buffer against high input prices

- Make soils more productive
- Improve efficiencies of inputs
Fertile Soil is Essential to Make it More Productive

Integrated Soil Fertility Management (ISFM)
## Improved Effectiveness of Fertilizers Through ISFM

After 4 years of ISFM, the improvement in crop yield for various crops in West Africa is shown below:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Farmer’s practice</th>
<th>After 4 years of ISFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>750</td>
<td>2,750</td>
</tr>
<tr>
<td>Sorghum</td>
<td>1,000</td>
<td>1,800</td>
</tr>
<tr>
<td>Cotton</td>
<td>1,150</td>
<td>2,000</td>
</tr>
<tr>
<td>Irrigated rice</td>
<td>3,000</td>
<td>5,500</td>
</tr>
</tbody>
</table>

* Cereal yield (kg/ha)

Source: Henk Breman
Micro Dosing on Millet and Sorghum: Point placing 1 bottle cap (4.5g) of compound fertilizers for every plant stand to enhance fertilizer use efficiency and reduce crop failures in semi-arid areas.

Fertilizer Deep Placement on Irrigated Rice: Point placement of urea super granules between rice plants 7-10 cm below the soil surface and 7 days after transplanting rice.

Source: IFDC
## Improve Efficiency of Fertilizers (cont.)

### Mali

**FDP technology**

<table>
<thead>
<tr>
<th>Average Yield paddy</th>
<th>Results 2015/16 (demo plots)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FP</td>
<td>FDP</td>
<td>Δ</td>
<td>% Δ</td>
</tr>
<tr>
<td>Irrigated rice (kg/ha)</td>
<td>6,147</td>
<td>8,475</td>
<td>2,328</td>
<td>38%</td>
</tr>
<tr>
<td>Lowland rice (kg/ha)</td>
<td>1,455</td>
<td>2,687</td>
<td>1,232</td>
<td>85%</td>
</tr>
</tbody>
</table>

**MD technology**

<table>
<thead>
<tr>
<th>Average Yield</th>
<th>Results 2015/16 (demo plots)</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FP</td>
<td>MD</td>
<td>Δ</td>
<td>% Δ</td>
</tr>
<tr>
<td>Millet (kg/ha)</td>
<td>1,140</td>
<td>1,700</td>
<td>561</td>
<td>49%</td>
</tr>
<tr>
<td>Sorghum (kg/ha)</td>
<td>1,001</td>
<td>1,778</td>
<td>777</td>
<td>78%</td>
</tr>
</tbody>
</table>

Source: IFDC
Improving Efficiency of Fertilizers

*Plant Nutrition Is More Than NPK*

Extra 1.2-2.2 Mt/ha due to SMN addition
ASSESSMENT OF AREAS FOR BIOENERGY CROPS

In assessing whether a given physiographic land unit is suitable for the production of bioenergy crops, the following factors have been considered within the framework of land systems:

- Climate
- Size and distribution of the land system
- Soil limitations to crop growth
- Slopes in relation to erosion hazard
- Mechanization with tractors
- Present farming systems
- Existing extension coverage
- Communications
CONCLUSION

ECOWAS Bioenergy Policy is good but it should be implemented alongside with ECOWAS Fertilizer Policy

Integrated Soil Fertility Management (ISFM) is important to improve nutrient use efficiency

Considering the overriding role agriculture plays in the development of ECOWAS economies, strengthening agricultural inputs and produce markets is central to West Africa’s economic integration.

Increase agricultural production and crop productivity to increase farmers’ income and reduce poverty to ensure food and nutrition security
Assist resource poor farmers to access quality seeds and fertilizers
CONCLUSION CONT...

Reassess subsidy package

Quantity and type of fertilizers should be based on soil test and crop requirement
Seed should be distributed in small packs (e.g., 2.5 kgs, 5 kgs, 10 kgs or 25 kg) to make it affordable by small holder farmers

Develop nutrient-status maps of district and regions
THANK YOU