AGRO-INDUSTRIAL BIOMASS - UTILIZATION FOR FOOD AND ENERGY SECURITY IN GHANA

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Biogas Association of Ghana - Executive Member
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ECOWAS/GBEP BIOENERGY WEEK
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About ISEES

- The Institute for Sustainable Energy and Environmental Solutions (ISEES) is a Non Profit - social enterprise institution.

Mission:

- identifying (through research),
- promoting (awareness creation and training) and
- deploying (market deployment) of innovative solutions in renewable energy, environmental conservation, climate change, natural resources, water, sanitation and hygiene for improving the livelihoods of households and efficiency of small enterprises in Ghana and Africa.

website [www.iseesonline.org](http://www.iseesonline.org) / [www.iseesonline.wordpress.com](http://www.iseesonline.wordpress.com)
Thematic Areas of Operation

- Renewable Energy & Energy Efficiency
- Natural Resources - Forestry, Fisheries and Agriculture - REDD+
- Environment - Climate Change and Biodiversity Conservation
- WASH - Water, Sanitation and Hygiene
How we do it

Training
- Entrepreneurship based training (seminars, short courses, academic courses)

Research and Policy Advocacy
- Evidence based research for advocacy

Consultancy
- Professional Advisory Services

Community Development
- Outreach, education and behavioral change communication, livelihood empowerment

Technology Deployment & Marketing
- Sale of innovative products and technologies through innovative business models

Business Development
- Sanitation and WASH Business Development Solutions
Biomass

- All over the world biomass is seen as a very important renewable energy resource, contributing significantly to energy production
- Biomass is used to meet a variety of energy needs, including
  - generating electricity,
  - heating homes,
  - household energy
  - fuelling vehicles
  - process heat for industrial facilities
- (Balat, 2005)
Biomass in Ghana

- **Fuel wood and charcoal** make up about 70% of primary energy supply in Ghana (Energy Comm 2010)

- In 2010, **40.2%** of households used fuelwood for cooking, **33.7%** used charcoal and **18.2%** used LPG.

- Average household uses **1064.7kg of firewood** and **434.4kg of charcoal** every year.

- The main uses are household cooking and small scale processing
The main fuels are wood, in rural regions, and charcoal, predominant in urban regions.

Source: Ghana Standard Living Survey
COUNTRY PROFILE.- PROBLEM STATEMENT

State of Cookstove & Biomass Fuels Sector

- 70% reduction of forest cover largely via unsustainable woodfuel collection and Charcoal Burning.
- 84% households use solid fuel.
- 21% impacted by Indoor Air Pollution.
- 13,400 deaths every year with 50% are children
- 30% low awareness of health, economic, and environmental impacts.
- LPG penetration rate is 26% lower than expected target of 50% to be achieved by 2020.
- Media campaign/ education on sector issues very minimal

(Land Area: 238.5 km²)
PROBLEM STATEMENT: HOUSEHOLD COOKING ENERGY BOTTOM OF THE PYRAMID
PROBLEM STATEMENT:
This is how 85% Cook Today in Ghana
Agro-industries heavily dependent on biomass fuels

- Biomass Energy is required in all aspects of society to drive productivity

- Agro-Processing Activities

- **Boiling** - Palm Oil Processing, Palm Kernel Oil Processing, Mushroom Sterilization, Shea Butter Processing,

- **Roasting** - Gari Processing, Groundnut roasting, Shea nuts roasting

- **Drying** - Gari, Fish, Mushroom, Fruit Drying, Leaves drying, Vegetables,

- **Smoking** - Fish
Examples of interventions implemented and on-going

- Traditional Fish smoking technologies
improved stoves for healthier Fish smoking - low PAH levels
Background on Industry & Baseline Technology

- About 80% of landed fresh water and marine fish in Ghana is smoked.
- 120,000 baseline ovens counted along the coast and fresh water regions.
- SNV’s interest in reducing deforestation through promotion and adoption of efficient ovens.

Barrel traditional Oven

Chorkor Oven
Baseline Technology

<table>
<thead>
<tr>
<th>Barrel Traditional oven</th>
<th>Chorkor Oven</th>
<th>Morrison Oven</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency; Baseline</td>
<td>Efficiency; Baseline</td>
<td>Efficiency; 37% over chorkor</td>
</tr>
<tr>
<td>BaP 15; PAH4 72</td>
<td>BaP 22; PAH4 84</td>
<td>BaP 30; PAH4 110</td>
</tr>
<tr>
<td>Where EU limit is BaP2; PAH 12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The Ahotor oven was designed by SNV, FRI, FC, Morrison Energy Services, Best Performance and Crispin Pemberton an international stove consultant.

- Reduced PAH deposit levels on smoked fish. (BaP 6; PAH 53)
- 32% more fuel efficient than Chorkor
- Similar to baseline design and user friendly
- A standard double unit costs about $500.
- 30% discounted for early adopters.
- Users are trained on the use and maintenance of the oven.
Product Quality Impacts

Chorkor Oven

Ahotor Oven

Images of fish drying in Chorkor Oven and Ahotor Oven.
Ahotor am Results

“My family and I can now cook in the kitchen whilst smoking my fish without having to deal with a smoky environment”.

“I haven’t been to the hospital in the past three months since I started using the Ahotor oven.”

“I currently make savings on the firewood cost because I use about half of what I previously used for the Chorkor oven.”
Lessons Learned and Recommendations

Research & Baseline

Pilot new concept

Stakeholder involvement & Knowledge Sharing

Technology Development

Periodic monitoring
Next Steps - Sustainability Model

Diagram showing the relationship between end-users, government, CSO/DP, and financial institution with various components such as policy formulation, quality assurance, advocacy, product development, and business financing.
Gari Processing Stoves

Traditional Circular Gari Stoves
Traditional Rectangular Gari Roasting
Improved Rectangular GARI ROASTING Stoves

Chrisaach Stove

Morrison Gari stove
WOMEN IN PALM OIL PROCESSING INDUSTRIES
Palm Oil and Palm Kernel Oil Processing with support from ECREEE and Austrian development Cooperation
Protecting and saving lives and our forests
Cookstoves for Boiling
Gasification using palm kernel shells to generate electricity for agro-processing. Installed in an off-grid community Papasi, by Kumasi Institute of Tropical Agriculture, ISEES/CEESD with funding from USADF Power Africa.
Exploring Agro-waste utilization for Fuel in Agro-industries
Business As Usual Scenarios for Energy Use in Productive Activities and its effects

- **Biomass** (firewood and Charcoal) for boiling, roasting, smoking, baking,
  
  = Use of traditional cookstoves - high volumes of fuelwood used causing deforestation and poverty (firewood constitute the second highest portion of food processors cost of processing, thereby increasing poverty

  = high levels of smoke emitted causing serious health problems for women involved in agro-processing

- **Electricity** - Lighting, processing, operating machinery, = mainly from the grid which over the years have not been consistent

- Results in smoke emissions, high cost of fuel, contributes to climate change
Some biomass fuels in Ghana

<table>
<thead>
<tr>
<th>Coconut shells</th>
<th>Coconut husk</th>
<th>Rice husk</th>
<th>Sawdust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn cobs</td>
<td>Pellets</td>
<td>Bamboo</td>
<td>Corn cob pellet</td>
</tr>
<tr>
<td>Rice husk pellet</td>
<td>Sawdust pellet</td>
<td>Rice straw</td>
<td>Wood chips</td>
</tr>
</tbody>
</table>

Figure 3. Some Types of Fuels Used in Ghana
Baseline Scenario of agro-residue
Biomass Residue - palm fruit bunch, rice husk, corn stovers, wood waste
Crop Residue Generation from agricultural crops in 2011

<table>
<thead>
<tr>
<th>Biomass type</th>
<th>Annual Production - 2011 (t)</th>
<th>Field based residue</th>
<th>Processing residue</th>
<th>Theoretical residue (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>1,699,134</td>
<td>Stalks</td>
<td></td>
<td>2,707,288</td>
</tr>
<tr>
<td>Maize</td>
<td>1,699,134</td>
<td></td>
<td>Husks</td>
<td>339,827</td>
</tr>
<tr>
<td>Maize</td>
<td>1,699,134</td>
<td></td>
<td>Cobs</td>
<td>486,802</td>
</tr>
<tr>
<td>Rice</td>
<td>465,967</td>
<td>Straw</td>
<td></td>
<td>771,641</td>
</tr>
<tr>
<td>Rice</td>
<td>465,967</td>
<td></td>
<td>Husks</td>
<td>119,986</td>
</tr>
<tr>
<td>Millet</td>
<td>183,922</td>
<td>Stalks</td>
<td></td>
<td>337,190</td>
</tr>
<tr>
<td>Sorghum</td>
<td>287,069</td>
<td>Straw</td>
<td></td>
<td>571,267</td>
</tr>
<tr>
<td>Groundnut</td>
<td>479,252</td>
<td></td>
<td>Husks/Shells</td>
<td>179,001</td>
</tr>
<tr>
<td>Groundnut</td>
<td>479,252</td>
<td></td>
<td>Straw</td>
<td>1,030,392</td>
</tr>
<tr>
<td>Cowpea</td>
<td>240,825</td>
<td>Straw+Pods</td>
<td></td>
<td>421,444</td>
</tr>
<tr>
<td>Soybean</td>
<td>164,511</td>
<td>Stems/stalk</td>
<td></td>
<td>575,788</td>
</tr>
<tr>
<td>Cassava</td>
<td>14,368,535</td>
<td>Peeling</td>
<td></td>
<td>890,849</td>
</tr>
<tr>
<td>Cocos</td>
<td>14,368,535</td>
<td></td>
<td>Peeling</td>
<td>3,592,134</td>
</tr>
<tr>
<td>Plantain</td>
<td>3,681,078</td>
<td>Trunks/Leaves</td>
<td></td>
<td>1,840,539</td>
</tr>
<tr>
<td>Yam</td>
<td>6,323,782</td>
<td>Straw</td>
<td></td>
<td>3,161,891</td>
</tr>
<tr>
<td>Cocos</td>
<td>1,345,149</td>
<td>Straw</td>
<td></td>
<td>672,575</td>
</tr>
<tr>
<td>Sweet Potato</td>
<td>43,834</td>
<td>Straw</td>
<td></td>
<td>21,917</td>
</tr>
<tr>
<td>Oil palm*</td>
<td>2,004,300</td>
<td>EFB</td>
<td></td>
<td>330,710</td>
</tr>
<tr>
<td>Oil palm*</td>
<td>2,004,300</td>
<td>Kernel shells</td>
<td></td>
<td>130,280</td>
</tr>
<tr>
<td>Oil palm*</td>
<td>2,004,300</td>
<td>Fibre</td>
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<td>280,602</td>
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<tr>
<td>Coconut*</td>
<td>297,900</td>
<td>Husks</td>
<td></td>
<td>124,820</td>
</tr>
<tr>
<td>Coconut*</td>
<td>297,900</td>
<td>Shells</td>
<td></td>
<td>75,468</td>
</tr>
<tr>
<td>Sugarcane*</td>
<td>145,000</td>
<td>Leaves</td>
<td></td>
<td>16,554</td>
</tr>
<tr>
<td>Sugarcane*</td>
<td>145,000</td>
<td>Bagasse</td>
<td></td>
<td>25,375</td>
</tr>
<tr>
<td>Cotton*</td>
<td>26,500</td>
<td>Stalks</td>
<td></td>
<td>76,254</td>
</tr>
<tr>
<td>Cocoa beans*</td>
<td>903,646</td>
<td>Pods</td>
<td></td>
<td>835,873</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>19,616,465</td>
</tr>
</tbody>
</table>

*2010 Data
Improved stoves using agro-waste for households - with palm kernel shells and coconut husk
Alternative and Preffered Energy Options for Driving Productive Use Interventions

- Improved Cookstoves for Agro-Processing
- Exploring the use of Agro-waste as fuels for processing
- Biogas for cooking and electricity generation
- Biofuels for driving machinery instead of dependence on diesel powered pumps (biofuels from Sunflower, Jatropha, Cassava, Recycled Plastics, etc)
- Agro-waste Utilisation as Alternative Fuels - Palm kernel shells, palm kernel chaff (Mmefe), Rice Husk, Coconut husk, Bamboo Briquettes, Charcoal Dust,
- Biomass fueled crop Dryers for food/crop drying
- Solar/Biomass Integration for industries
- Biomass Gasification for agro-industries
- CHP
Renewable Charcoal Development - Sustainable Fuels

- Charcoal Briquettes
- Bamboo plantations as alternatives for fuel
- Improved Kilns Development for Charcoal Producers
Sustainable Woodlot plantations and Agro-forestry
Renewable Energy Market Development Program - bringing RE solutions to the doorstep of grassroots
Promotional activities among women groups
Exhibition at events and workshops
Pop Up shops - to market RE technologies
Contact Us

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