Towards Deployment and Commercialisation

Biochar Markets : Closing the Technology Gap

Ian McChesney, Simon Manley and Craig Sams
Carbon Gold Ltd, Hastings, UK
www.carbongold.com

- Introduction
- Belize : Organic Cacao
- Char Production
- Technology Gap
- Commercialisation
Introduction

How did we start?

- Set up by Craig Sams and Dan Morrell in 2008
- Re-structured in 2010 with support from Venearth
- Core team; Craig Sams, Simon Manley, Ian McChesney
- Focused on UK/Belize markets in 2011

What do we do?

- Market concepts and products
- Develop technology
- Raise investor awareness
- Have Gt ambitions
The Biochar Supply Chain

Feedstock → Biochar → Soil Improvers

- Low cost pyrolysis systems
- Agronomy & product development
- Routes to market

Biochar production

Product formulations

Branded products

Retail
Horticultural
Agricultural
Carbon

3rd UK Biochar Conference, Edinburgh, 25-26 May 2011

Branded Products

Design and Packaging:
Iconic, Challenging, Disruptive, Engaging
Product Formulations

Temperate char applications:
- Soil Improver
- Peat-Free Composts
- Horticulture
- Agriculture

Tropical field trials:
- Cacao
- Sugar Cane
- Banana
- Citrus

Using international expertise on biochar farming:
- Nikolaus Foidl
- Gregory Clark

Biochar Production

Requirements:
- low temperature char
- pyrolysis, not combustion
- variable feedstocks
- transportation issues
- weak infrastructures

Methods:
- Manageable costs
- Ease of use
- Efficient as possible
- Emissions
- Sustainable

Options:
- Contract for suitable char
- Modify existing systems
- Introduce new technologies
Belize: Organic Cacao

Market Development:
- Green & Blacks support TCGA in Toledo, Belize
- Real chocolate products succeeded
- Brand sale to develop the sector

Future Prospects:
- Good consumer awareness
- Productivity challenge for growers
- Avoid brand dilution

TCGA observations in Belize

- Top dressing of biochar applied to semi-mature trees 18 months ago
- Application rate equivalent to 10t/ha
- Trees in biochar amended soils produce after only 2.5 years
Char Production

Ideal situation:
- Small volumes for field trials
- Gear up output to meet initial demand
- Low costs for commercial viability

Usual circumstances:
- Difficult to produce trial quantities
- Scaling by replication inefficient
- Larger plants must link to energy markets

Production Options

Contractor char
- Fuel char is expensive for agriculture
- Some fines available
- Difficult to ensure sustainability

Modify Existing Systems
- Artisan technology
- R&D practical, not theoretical
- Control development costs

New technologies
- Rarely work as described
- Economically impaired
- Carry delivery risks
## Relative Kiln Performance

<table>
<thead>
<tr>
<th></th>
<th>Traditional Ring Kiln 8'</th>
<th>Carbon Gold 5' MRK</th>
<th>Carbon Gold 10m³ TRK</th>
<th>Adam Retort 3m³</th>
<th>BigChar Village 1000</th>
<th>ProNatura Pyro 7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cost (£)</strong></td>
<td>£1,500</td>
<td>£3,500</td>
<td>£30,000</td>
<td>£3,000</td>
<td>£16,000</td>
<td>£300,000</td>
</tr>
<tr>
<td><strong>Output (kg/day)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>125</td>
<td>1,500</td>
<td>250</td>
<td>200</td>
<td>3,000</td>
</tr>
<tr>
<td></td>
<td>(3d/750kg)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Feedstock/Char Ratio (Efficiency)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7:1 (15%)</td>
<td>4:1</td>
<td>3:1</td>
<td>4:1</td>
<td>5:1</td>
<td>3:1</td>
</tr>
<tr>
<td></td>
<td>Wet wood</td>
<td>(33%)</td>
<td>Wet wood</td>
<td>(20%)</td>
<td>(33%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6 man days/burn</td>
<td>1 man day/burn</td>
<td>2 persons</td>
<td>2 man day/burn</td>
<td>2 persons</td>
<td>3 persons</td>
</tr>
<tr>
<td><strong>CAPEX Cost (500 day £1=$1.5)</strong></td>
<td>$19/t</td>
<td>$90/t</td>
<td>$65/t</td>
<td>$39/t</td>
<td>$258/t</td>
<td>$323/t</td>
</tr>
</tbody>
</table>
Cacao Biochar in Belize

**Agriculture**
- Cacao trees and shade need pruning
- Labour expensive and outputs low
- Many fields far from roads

**Biochar**
- Long term investment
- ‘Slash and Char’ opportunity to replace Milpa ‘Slash and Burn’
- No fuel char market

**Institutional Framework**
- Support from Green & Blacks
- Project Officer with TCGA
- Extension Officers work with farmers

---

**Technology Progression**

**Adam Retort for trial quantities**
- Mixed cycle system - carbonisation, indirect pyrolysis
- Works better with dry feedstock
- €1,000 Licence (5), but expensive to construct in Belize

**Modified Ring Kiln (MRK) for farm scale**
- Steam drying/Direct pyrolysis operation
- Process wetter materials
- Simple to build and maintain

**Tilting Ring Kiln (TRK) for commercial market**
- Improved handling
- Reduced emissions
- Heat recovery option
Adam Retort

Drying phase – chimney down

Charring phase – chimney up

5’ MRK
## Indicative Char Costs $/ton

<table>
<thead>
<tr>
<th></th>
<th>Traditional RingKlin 8’</th>
<th>Carbon Gold 5’ MRK</th>
<th>Carbon Gold 10m³ TRK</th>
<th>Adam Retort 3m³</th>
<th>BigChar Village 1000</th>
<th>ProNatura Pyro 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedstock</td>
<td>$175</td>
<td>Free</td>
<td>$45</td>
<td>$125</td>
<td>$75</td>
<td>$45</td>
</tr>
<tr>
<td>Logs $25/t, Residues $15/t</td>
<td>$30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>$60</td>
<td>$20</td>
<td>$13.3</td>
<td>$40</td>
<td>$100</td>
<td>$10</td>
</tr>
<tr>
<td>Capital</td>
<td>$19</td>
<td>$90</td>
<td>$65</td>
<td>$39</td>
<td>$258</td>
<td>$323</td>
</tr>
<tr>
<td>Handling</td>
<td>$20</td>
<td>$5</td>
<td>$5</td>
<td>$15</td>
<td>$5</td>
<td>$15</td>
</tr>
<tr>
<td>Total</td>
<td>$274</td>
<td>$145</td>
<td>$128</td>
<td>$194</td>
<td>$438</td>
<td>$393</td>
</tr>
</tbody>
</table>
Technology Gap

What is missing?
- Kilns better integrated with feedstock situation
- Faster more efficient systems (e.g., multiple kilns)
- Appreciation of economic challenge
- Agreed performance measures

What needs to be done?
- Larger batch systems
- Cheaper continuous systems
- Build, Own, Operate delivery

Carbon Gold Biochar Kilns

5ft Modified Ring Kiln
- Farm-scale
- 10 sold overseas
- UK and Int. orders

8ft Modified Ring Kiln
- Larger-scale for commercial users
- Potential upgrade for existing kilns
- Biochar and charcoal production
Carbon Gold Biochar Kilns

Tilting Ring Kiln 10m³

- Semi-automatic
- Skid mounted
- Production capacity >1 t/day
- Lower emissions

Tilting Ring Kiln Array

- Continuous batch
- Fixed site
- Production capacity > 3 t/day
- Energy recovery

Commercialisation

The challenge:
- Deliver measurable benefits
- Develop and maintain standards
- Provide a reliable return to investors

The opportunity:
- Climate uncertainty is back
- Biochar is a proven adaptation strategy
- Soil sequestration could be significant
**Temperate applications:**

- **Feedstock** ➔ **Biochar** ➔ **Grochar** ➔ **Retail**
- **Horticultural** ➔ **Agricultural**

Biochar Production

- 3% of UK Hort
- 0.5% of UK Ag

<table>
<thead>
<tr>
<th>Product</th>
<th>App rate (t/ha)</th>
<th>Hectares</th>
<th>Grochar (t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biochar</td>
<td>4</td>
<td>8,450</td>
<td>33,800t</td>
</tr>
<tr>
<td>Grochar</td>
<td>4</td>
<td>150,000</td>
<td>600,000t</td>
</tr>
</tbody>
</table>

**Retail**

- Waitrose
- Webbs

**Horticultural**

- Notcutts
- Greenfingers
- B&Q

**Agricultural**

- M&G
- Harrods

**3rd UK Biochar Conference, Edinburgh, 25-26th May 2011**

---

**Tropical applications:**

- **Feedstock** ➔ **Biochar** ➔ **Grochar** ➔ **Retail**
- **Horticultural** ➔ **Agricultural**

Biochar Production

- 300 tons char sold
- 5 Adam Retorts built
- 10 MRK supplied
- Local partners for large scale production

**Branded Products**

Field-scale Grochar trials underway with:
- Sugar Cane (Belize Sugar Industries)
- Bananas (Banana Growers Association)
- Cacao (Toledo Cacao Growers Association)
- Citrus – Cayo and Toledo district growers

<table>
<thead>
<tr>
<th>Product</th>
<th>Cacao</th>
<th>Sugar Cane</th>
<th>Banana</th>
<th>Citrus</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>App rate (t/ha)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Hectares</td>
<td>350</td>
<td>1,000</td>
<td>1,000</td>
<td>3,000</td>
<td>5,350</td>
</tr>
<tr>
<td>Volume</td>
<td>1,050t</td>
<td>3,000t</td>
<td>3,000t</td>
<td>10,500t</td>
<td>16,050t</td>
</tr>
</tbody>
</table>

**Retail**

- Cadbury
- Kraft Foods
- UNDP

**Horticultural**

- TATE & LYLE

**Agricultural**

- Fyffes

**3rd UK Biochar Conference, Edinburgh, 25-26th May 2011**
Carbon Markets:

1 tonne biochar : 2.35 tonnes CO₂

1 tonne biochar : 3 tonnes CO₂

1 tonne biochar : 6 tonnes CO₂