Results of Carbon Balance Measurements in Mature Oil Palm Plantations for ISCC certification at PT Hindoli

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Tropical Crop Consultants Ltd
(Representing PT Hindoli, a Cargill company)
Presentation outline

• Use of the ISCC system to certify crude palm oil production
• Impact of land use change is not accounted for in the ISCC system
• Case study using data from Cargill’s plantation PT Hindoli based on successful certification in 2009
• Accounting of emissions related to the production, milling and refining of fruit bunches to produce refined bleached deodorized palm oil
• Consideration of scope for reduction in emissions through improved production practices
• ISCC = International Sustainability & Carbon Certification [www.iscc-system.org](http://www.iscc-system.org)

• Main objectives:
  – Reduction of greenhouse gas emissions;
  – Sustainable use of land;
  – Protection of natural biospheres; and
  – Social sustainability.

• Provides evidence to stakeholders of the sustainability of raw material production

Source: ISCC website
Characteristics of sustainable production

- Features:
  - Not from bio diverse or carbon rich area
  - Not exceed GHG threshold
  - Correspond to GAP and social criteria
  - Mass balance approach

- Recognized by Germany and EU

- Procedure involves registration > preparation for audit > audit > certification

Source: ISCC website
Characteristics of production at PT Hindoli

- Estates supplying Sungei Lilin Mill in 2008/09
- Area under harvest 5,896 ha
- Yield 19.4 t ha\(^{-1}\) fruit bunches (impact of drought)
- OER 22%
- Oil yield 4.3 t ha\(^{-1}\) crude palm oil
- Fertilizer used 1.6 kg/palm N (urea), 0.5 kg/palm P\(_{2}O_{5}\) (RP), 0.9 kg/palm K\(_{2}O\) (KCl) and 0.24 kg/palm MgO (Kieserite)

Source: PT Hindoli
Calculations

• Emissions are calculated for crude palm oil (CPO) by partitioning emissions between palm oil and palm kernel oil.
• 85% of emissions are allocated to CPO.
1. Crop production

Emissions related to crop production are mainly:
- Urea (74%);
- Electricity for housing (13%); and
- Diesel for field transport (9%)

Total emissions 350 kg CO$_2$-eq t$^{-1}$ crude palm oil

Scope for reduction:
- Improve nitrogen management;
- Increase estate transport efficiency (back-loading empty bunches);
- Reduce energy use in housing; and
- Increase yield and oil extraction rate!

Source: PT Hindoli
Nitrogen management

• Maximum use of legume cover plants as source of biological $N_2$ fixation
• Substitution of N fertilizer with lower emissions during manufacture?
• Improved splitting, timing and spreading of N fertilizer
• Improved accuracy of N fertilizer recommendations
2. Mill processing and crop transport

Total emissions 577 kg CO₂-eq t⁻¹ crude palm oil

Emissions related to mill processing are mainly:
• Emissions from POME (99%)

Scope for reduction:
• Install CH₄ capture system and flare CH₄
• Install CH₄ capture and generate electricity for sale to the national grid
• Reduce mill losses (target 1.3%) to reduce pond emissions

Source: PT Hindoli
3. Mill storage

Total emissions 39 kg CO$_2$-eq t$^{-1}$ crude palm oil

Emissions related to mill processing are mainly:
- Emissions from fuel use (100%)

Scope for reduction:
- Improved efficiency of transport by truck and barge

Source: PT Hindoli
4. Refinery emissions

Total emissions 32 kg CO$_2$-eq t$^{-1}$ crude palm oil

Emissions related to mill processing are mainly:
- Natural gas use (76%)

Scope for reduction:
- Increased refinery efficiency

Source: PT Hindoli
5. Refinery transport

Total emissions 88 kg CO\textsubscript{2} t\textsuperscript{-1} crude palm oil

Emissions related to mill processing are mainly:
- Barge transport (100%)

Scope for reduction:
- Improved barge efficiency

Source: PT Hindoli
Summary of emissions along the production chain

Source: PT Hindoli
## Summary of CO2-eq emissions

<table>
<thead>
<tr>
<th>Activity</th>
<th>kg CO₂-eq/t CPO</th>
<th>kg CO₂-eq/t RBDPO</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plantation production</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urea</td>
<td>257.5</td>
<td>274.5</td>
<td>24</td>
</tr>
<tr>
<td>Rock phosphate</td>
<td>1.3</td>
<td>1.4</td>
<td>0</td>
</tr>
<tr>
<td>Potassium chloride</td>
<td>8.2</td>
<td>8.7</td>
<td>1</td>
</tr>
<tr>
<td>Kieserite</td>
<td>5.1</td>
<td>5.4</td>
<td>0</td>
</tr>
<tr>
<td>Herbicide</td>
<td>1.9</td>
<td>2.0</td>
<td>0</td>
</tr>
<tr>
<td>Diesel</td>
<td>30.1</td>
<td>32.1</td>
<td>3</td>
</tr>
<tr>
<td>Electricity</td>
<td>45.8</td>
<td>48.8</td>
<td>4</td>
</tr>
<tr>
<td><strong>Milling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel</td>
<td>2.1</td>
<td>2.3</td>
<td>0</td>
</tr>
<tr>
<td>POME</td>
<td>572.4</td>
<td>610.1</td>
<td>53</td>
</tr>
<tr>
<td>Crop transport</td>
<td>2.2</td>
<td>2.4</td>
<td>0</td>
</tr>
<tr>
<td><strong>Transport to wharf</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck transport</td>
<td>0.0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Barge transport</td>
<td>38.7</td>
<td>41.3</td>
<td>4</td>
</tr>
<tr>
<td><strong>Refining</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>23.9</td>
<td>25.5</td>
<td>2</td>
</tr>
<tr>
<td>Electricity</td>
<td>5.9</td>
<td>6.3</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1.8</td>
<td>1.9</td>
<td>0</td>
</tr>
<tr>
<td><strong>Transport to refinery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel</td>
<td>87.7</td>
<td>93.5</td>
<td>8</td>
</tr>
<tr>
<td><strong>All</strong></td>
<td><strong>1,084.9</strong></td>
<td><strong>1,156.3</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: PT Hindoli
## Summary of CO$_2$-eq emissions

<table>
<thead>
<tr>
<th>Item</th>
<th>kg CO$_2$-eq/t CPO</th>
<th>kgCO$_2$-eq/t RBDPO</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plantation production</td>
<td>350.0</td>
<td>373.0</td>
<td>32</td>
</tr>
<tr>
<td>Milling</td>
<td>576.8</td>
<td>614.7</td>
<td>53</td>
</tr>
<tr>
<td>Transport to wharf</td>
<td>38.7</td>
<td>41.3</td>
<td>4</td>
</tr>
<tr>
<td>Refining</td>
<td>31.7</td>
<td>33.8</td>
<td>3</td>
</tr>
<tr>
<td>Transport to refinery</td>
<td>87.7</td>
<td>93.5</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,084.9</strong></td>
<td><strong>1,156.3</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

**Saving against fossil fuel use %** 65

**Note**
Savings against fossil fuel use compares to CO$_2$-eq emissions per MJ energy of palm oil with diesel using standard reference value for diesel defined by REDD.
Value for crude palm oil is 29.5g CO$_2$-eq/MJ compared with 85 g CO$_2$-eq/MJ for diesel.

Source: PT Hindoli
Comparison with other studies

• RSPO estimates:
  – emissions from diesel use at 45-25 kg CO2-eq/t CPO compared with 34.5 in this assessment
  – emissions from fertilizer use at 250-470 kg CO2-eq/t CPO compared with 272 in this assessment

• EU-RED has values ranging from 29 to 50 g CO2-eq/MJ for palm oil biodiesel compared with 29.5 g CO2-eq/MJ in this assessment
Comparison of emissions between palm oil, rapeseed oil and soyabean oil

Source: AarhusKarlshamn Denmark AS Rapeseed Oil and PT Hindoli
Importance of data collection

• Importance of maintaining accurate agronomic information in each planted block in a database
  – Yield
  – Fertilizer use
  – Pesticide use
  – Diesel use

• Provides the means to calculate emissions and monitor and evaluate the efficiency of input use and track efficiency

• Improved agronomic efficiency delivers profit and emissions benefits!
## Impact of best management practice on yield and CO$_2$-eq emissions

<table>
<thead>
<tr>
<th>Units</th>
<th>Present case</th>
<th>BMP</th>
<th>Δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>t/ha fruit bunches</td>
<td>19.4</td>
<td>25</td>
</tr>
<tr>
<td>Oil extraction rate</td>
<td>%</td>
<td>22</td>
<td>23.5</td>
</tr>
<tr>
<td>Oil yield</td>
<td>t/ha</td>
<td>4.3</td>
<td>5.9</td>
</tr>
<tr>
<td>Emissions</td>
<td>kg CO2-eq/t CPO</td>
<td>1,084.9</td>
<td>956.35</td>
</tr>
</tbody>
</table>

Comparable yield increases without increasing fertilizer rates but using Best Management Practices (BMPs) have been demonstrated by IPNI in eight locations in Indonesia since implementation began in 2002.

Main areas for yield improvement:
- Improved crop recovery and ripeness; and
- Improved agronomic practices (pruning, fertilizer application, soil conservation)

Average yields in the estates in 2010/11 were 24.5 t/ha fruit bunches with oil extraction of 22%.

Source: PT Hindoli
Conclusions

• The greatest potential to reduce emissions related to crude palm oil production are:
  – More efficient use of N fertilizer utilizing sources from low emission fertilizer plants;
  – Capture of CH\textsubscript{4} from effluent ponds and either flaring or co-generation of electricity; and
  – Yield improvement by deploying best management practices

• Policy should favour measurement at each site rather than use of generic values for emissions
About Tropical Crop Consultants Limited

Tropical Crop Consultants Ltd was set up by Thomas Fairhurst in 2008 to provide consultancy services in tropical crop agronomy and management. The overall focus of the consultancy service is to assist clients with ecological and sustainable crop intensification in lowland, upland and plantation agriculture systems.

Our core areas of expertise are:

• Management and agronomy of plantation crops (particularly oil palm, coffee and rubber).
• Intensification of lowland agriculture systems (through efficient nutrient use in rice).
• Productivity improvement in upland agriculture (particularly increasing productivity through soil fertility re-capitalization in upland farming systems).
• Computer software development for data management in agriculture (particularly development and deployment of database and geographic information systems).
• Preparation of educational agricultural extension material for extension workers, managers, agricultural scientists, and farmers.
• Trouble shooting in plantations, agriculture projects and farming systems.

For more information, visit www.tropcropconsult.com
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