“Climate change mitigation & adaption in Thai Palm Oil Industry”

Presented by
Mr. Daniel May
(Project Director)
Content

- Overall framework
- GHG emission results
- Recommendations
  - GHG mitigation
  - GHG adaptation
Overall framework

Main objectives are:

1. Development of GHG calculation methodology to promote consistency and good practice
2. Development of emission factors for various stages of a whole palm oil life cycle
3. Development of recommendations on GHG reduction options
4. Recommendations for policy makers
Overall framework

A cooperation of:

- giz
- PBCA
- Thai Biodiesel Producer Association
- TGO
- JGSEE
- CEE-PERDO
- MTEC
- Office of Agricultural Economics
- Thailand Environment Institute
- Prince of Songkla University
- Office of Agricultural Economics
Overall framework
Land use change

- *Land use change scenarios* were chosen from data collected from 52 farmers in various parts of Thailand.
- GHG calculations were done with literature default values and equations based on the farming practices.
- IPCC’s 2006 Guidelines for National Greenhouse gases Inventory
  - Stock-Difference method is chosen for the study.
Land use change scenarios

• Cropland converted to cropland
  – Rubber to Palm
  – Crop farm to Palm
  – Fruit orchard to Palm
  – Paddy rice to Palm

• Land converted to cropland
  – Forest to Palm
  – Unused land to Palm
## GHG balance comparison

<table>
<thead>
<tr>
<th>Case example</th>
<th>GHG balance (Ton CO$_2$eq ha$^{-1}$ yr$^{-1}$)</th>
<th>First approach$^1$</th>
<th>Second approach$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber</td>
<td></td>
<td>8.72</td>
<td>~2.16</td>
</tr>
<tr>
<td>Field crop</td>
<td></td>
<td>~17.55</td>
<td>~2.67</td>
</tr>
<tr>
<td>Fruit orchard</td>
<td></td>
<td>~12.82</td>
<td>0</td>
</tr>
<tr>
<td>Paddy field</td>
<td></td>
<td>~17.69</td>
<td>~1.79</td>
</tr>
<tr>
<td>Forest</td>
<td></td>
<td>8.51</td>
<td>24.41</td>
</tr>
<tr>
<td>Unused land</td>
<td></td>
<td>~18.89</td>
<td>~2.98</td>
</tr>
</tbody>
</table>

**Note:**
1. Consider crop biomass and dead organic matter as ‘carbon stock’
2. Not consider crop biomass and dead organic matter as ‘carbon stock’

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**GHG mitigation:**

- Avoid planting oil palm on (primary) forest.
- Planting on unused land is the best ⇒ create C sink
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Data Collection

Upper Southern
- Phetchaburi,
  - Prachuapkhirikhan

Eastern
- Chonburi, Trat, Rayong,
  - Chanthaburi, Prachinburi,
  - Sakaeo, Chachoengsao

Eastern-Lower Southern
- Chumphon, Suratthani,
  - Nakhonsithammarat,
  - Songkhla, Phatthalung,
  - Yala, Pattani, Narathiwat

Western-Lower Southern
- Ranong, Phangnga,
  - Krabi, Trang, Phuket,
  - Satun

Classified by amount of rainfall annually

Planted area

Large plantation (8 mills)
Small plantation (544 smallholders)
Methodology

Functional unit
• 1,000 kg of FFB

Data Allocation
• none

Data Cut-off
• Emission factor of seed production

Data substitution
• none
Palm oil mill

Data collected from 14 participating mills (10 mills with BG capture and 4 mills w/o BG capture) ⇒ ~32% of total capacity in Thailand

System Boundary
Methodology

**Functional unit**
- 1,000 kg of CPO

**Data Allocation**
- Energy

**Data Cut-off**
- None

**Data substitution**
- None
Palm oil refinery

Data collected from 6 participating factories
⇒ ~63% of total capacity in Thailand

System boundary
Methodology

**Functional unit**
- 1,000 kg of each product

**Data Allocation**
- By energy

**Data Cut-off**
- None

**Data substitution**
- None
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Biodiesel production

Data collected from 7 participating factories

CPO
Palm Stearine
RBDPO

Foreign
Methanol
KOH
H₂SO₄
NaOH
HCl
H₃PO₄

Harbour

Fuel oil
Oil palm sheel
LPG

Product
B100

By-product
Glycerin

⇒ ~87% of total capacity in Thailand

System boundary

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Methodology

**Functional unit**
- 1,000 kg of B100

**Data Allocation**
- Energy

**Data Cut-off**
- None

**Data substitution**
- Emission factor of Additives => substituted by the highest EF of phenolic group
Content

- Overall framework
- GHG emission results
- Recommendations
  - GHG mitigation
  - GHG adaptation
## GHG emissions

<table>
<thead>
<tr>
<th>Region</th>
<th>GHG emissions (Kg CO₂/Ton B100)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rapeseed</strong></td>
<td></td>
</tr>
<tr>
<td>Japan [8]</td>
<td></td>
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<tr>
<td>Europe [4]</td>
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<tr>
<td>France [7]</td>
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<tr>
<td>Australia [6]</td>
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<tr>
<td>US [4]</td>
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<tr>
<td>China [5]</td>
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<tr>
<td>Brazil [4]</td>
<td></td>
</tr>
<tr>
<td>Malaysia (W/ biogas) [3]</td>
<td></td>
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<td>Malaysia (WO/biogas) [3]</td>
<td></td>
</tr>
<tr>
<td>South East Asia [2]</td>
<td></td>
</tr>
<tr>
<td>Thailand [1]</td>
<td></td>
</tr>
<tr>
<td><strong>Oil palm</strong></td>
<td></td>
</tr>
<tr>
<td>4. Best observation</td>
<td>232 155 36 121</td>
</tr>
<tr>
<td>3. Avg. Thailand</td>
<td>318 466 108 157</td>
</tr>
<tr>
<td>2. Avg./WO biogas</td>
<td>298 684 133 157</td>
</tr>
<tr>
<td>1. Avg/W biogas</td>
<td>329 347 105 157</td>
</tr>
</tbody>
</table>

**Note:** GHG emissions w/o Land Use Change
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**EU-RED requirement**

<table>
<thead>
<tr>
<th>% GHG reduction</th>
<th>60% (2018)</th>
<th>50% (2017)</th>
<th>35% (2012)</th>
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<tbody>
<tr>
<td>Cultivation</td>
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<tr>
<td>Palm oil mill</td>
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<tr>
<td>Palm oil refining</td>
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<td>Biodiesel production</td>
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<tr>
<th>Diesel</th>
<th>Kg CO₂ / MJ B100</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Avg/W biogas</td>
<td>0.01</td>
</tr>
<tr>
<td>2. Avg./WO biogas</td>
<td>0.02</td>
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<tr>
<td>3. Avg. Thailand</td>
<td>0.03</td>
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<td>4. Best observation</td>
<td>0.04</td>
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Kg CO₂ / MJ B100
## Reference

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<tr>
<th>Feedstock</th>
<th>Symbol</th>
<th>Research topic</th>
<th>Location</th>
<th>Institute</th>
<th>Year</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>[2]</td>
<td>GHG Accounting Methodology and Default. Determination of GHG contributions by subsystems in the oil palm supply chain using the LCA approach.</td>
<td>South East Asia</td>
<td>IFEU</td>
<td>2008</td>
</tr>
</tbody>
</table>
Content

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- GHG emission results

Recommendations

- GHG mitigation
- GHG adaptation
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GHG mitigation - I

Cultivation

1. Increase productivity and quality (%OER)
2. Optimize fertilizer consumption through:
   • Leaf & soil analysis ⇒ Apply fertilizer in the right time at the right amount
   • Use slow release (osmocote) N-fertilizer
   • Substitute synthesis N-fertilizer by high N- organic fertilizer

Palm oil mill

1. Sourcing FFB from the nearest source
2. Wastewater management
   • Install biogas system
   • Using air stripping tower to reduce Temp
   • Upgrading the open pond to be the cover pond
   • Enhance the performance of biogas system
   • Changing stabilization pond to aerated lagoon

- 54% N₂O from N-fertilizer
- 27% Production of N-fertilizer
- 7% Transportation of raw mat. to plantation
- 57% CH₄ from Wastewater
- 41% Prod. & Trans. of FFB
- 24% stabilization pond
- 16% biogas plant
- 60% open pond
- 5% Prod. & Trans. of FFB
• Sourcing CPO from the mill with biogas capture.
• Substitute dirty fossile fuel (crude oil, diesel) by cleaner fuel (NG) or renewable energy (biomass, biogas)
• Improve logistic system by selecting the nearest suppliers, transported by marine, full loading truck, and etc.

• Substitute synthesis Methanol by Bioethanol or Biomethanol
• Install biogas capture system ⇒ generate electricity
• Use cleaner fuel instead of dirty fossil fuel
• Apply Co-generation technology (heat exchanger) ⇒ maximize energy efficiency
Adaptation

- Integrated analysis to evaluate impact of climate change on oil palm
- Research and dissemination of crop varieties and breeds adapted to changing climatic conditions
- Improving local farmer or stallholder knowledge on good farm management practice ⇒ these practices are identified reducing GHG emissions
Capacity building: smallholders

**Increase FARM PRODUCTIVITY**
- Training & technical support: Fertilizer Management, Leaf & soil analysis, Oil palm farm management
- Farm inputs coordination: seedling, fertilizer, EFB

**Improve FRESH FRUIT BUNCH QUALITY**
- Price premium based on quality
- Grading system
- Harvesting and fruit handling guidelines/training

**Internalize SUSTAINABILITY**
- Best Practices to comply with standard (Socio, Eco. Environ.)
- Farmer group & institutional development
- Database management system (record book, GPS)
- Internal Control System
- Mutual interest, benefit & information sharing
- Long-term relationship & interdependence

Technical Support, Capacity Building, Value Chain Coordination, etc…
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