Dynamics of the Malaysian Oil Palm Industry: Enhancing Competitiveness

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Director-General MPOB

Monday, 15 October 2012
FACTORS AFFECTING DYNAMICS OF OIL PALM INDUSTRY

• Performance of oil palm vis-à-vis other oil crops
• Shortage of labour
• Shrinking availability of land
• Sustainability issues

AFFECTS GDP CONTRIBUTION
COMPETITIVENESS PARAMETERS

• Palm oil as a commodity
  • Price competitive
  • Yield competitive
  • Output / labour uncompetitive
Strategic Action

• **Issues**
  - Land shortage
  - Labour shortage
  - Sustainability
  - Increasing GDP contribution

• **Strategic actions**
  - Increasing productivity
  - Mechanisation, etc
  - Improve practices
  - Increasing production of value added products

R&D and Innovations

USD18 billion (2009)

USD60 billion (2020)
PRODUCTION OF 17 MAJOR OILS & FATS

2000

- Palm oil: 19%
- Palm kernel oil: 3%
- Soybean oil: 22%
- Rapeseed oil: 13%
- Other vegetable oils: 16%
- Animal fat: 19%

Total: 114,757,000 tonnes

2011

- Palm oil: 29%
- Other vegetable oils: 14%
- Soybean oil: 23%
- Rapeseed oil: 13%
- Sunflowerseed oil: 7%
- Palm kernel oil: 3%

Total: 179,377,000 tonnes

Source: Oil World
WORLD PRODUCERS OF PALM OIL (‘000 tonnes)

**2000**

- **Indonesia**: 7,080 (32%)
- **Malaysia**: 10,842 (50%)
- **Thailand**: 525 (2%)
- **Others**: 3,450 (16%

**2011**

- **Indonesia**: 24,100 (48%)
- **Malaysia**: 18,912 (37%)
- **Thailand**: 1,530 (3%)
- **Others**: 5,976 (12%)

Source: Oil World
WORLD EXPORTERS OF PALM OIL (‘000 tonnes)

Source: Oil World

- **Malaysia**
  - 2010: 16,664
  - 2011: 17,993

- **Indonesia**
  - 2010: 16,450
  - 2011: 17,250

- **Others**
  - 2010: 3,430
  - 2011: 2,922

- **Papua/NGuinea**
  - 2010: 496
  - 2011: 510

Source: Oil World
Average Oil Yield for Major Crops

Source: Oil World 2011
* Combined tonnage of palm oil and palm kernel oil

<table>
<thead>
<tr>
<th>Oil Crop</th>
<th>Production (million t)</th>
<th>% of total production</th>
<th>Total area (million ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil palm</td>
<td>51.10*</td>
<td>34.6</td>
<td>12.8</td>
</tr>
<tr>
<td>Soya bean</td>
<td>40.18</td>
<td>27.2</td>
<td>104.2</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>23.78</td>
<td>16.1</td>
<td>33.0</td>
</tr>
<tr>
<td>Sunflower</td>
<td>12.43</td>
<td>8.4</td>
<td>24.4</td>
</tr>
</tbody>
</table>
Strategies to Address Labour Shortage

- Need workers from more source countries
- Improve local wages/conditions
- Re-engineer the tree
  - shorter palms
  - longer stalk
- Reverse Investment
  - Indonesia
  - Papua New Guinea
  - Africa
- Mechanisation
- Training through Institute of Malaysian Plantation and Commodities (IMPAC)
Mechanisation in harvesting, evacuation and transportation of fruit to increase productivity and reduce labour requirement.

**Motorised cutter (Cantas)** improves productivity from 1.5 tonnes/man-day to 2.8 tonnes/man-day.
Malaysia: Oil Palm Total Planted Area (Million Hectares)
Strategies to Address Shortage of Land

Increase the value of the oil palm on the available land through:

- Enhanced productivity
- Pest and disease management
Strategies to Value Add in a Sustainable Manner

Value addition in a Sustainable Manner

- Biomass utilization
- Renewable energy
- Downstream activities on food, phytonutrients and oleochemicals
Palm oil – yield potential (tons/ha)

Oil yield: tons/ha

Category of Production

- African Groove: 0.2 tons/ha
- African Plantation (national): 2.0 tons/ha
- Malaysian Plantation (national): 3.9 tons/ha
- Malaysia Commercial Plantation: 6.0 tons/ha
- Best Experimental Plot: 8.6 tons/ha
- Selected progeny: 12.2 tons/ha
- Individual palm: 13.6 tons/ha
- Max Theoretical yield: 18.2 tons/ha
Enhanced Productivity through Improved Planting Materials

A) Elite DxP planting material
Oil yield: >6 t/ha/yr

B) Clonal production through tissue culture
Oil yield potential: 8-12 t/ha/yr

Germinated seeds

Fresh Fruit Bunch (FFB)

P379
Ortet performance
OTB=31.89%
FFB=190.13 kg/palm/year

Oil palm clone
MPOB has successfully sequenced 3 oil palm genomes
First organization in the world to sequence the *oleifera* and *pisifera*
The sequences are being mined for useful traits

**Enhanced Productivity through Oil Palm Genome Program**

- AVROS Pisifera 0.182/77
- Dura 0.212/70

**E. oleifera**

**E. guineensis**
TARGETED TRAITS

SHELL THICKNESS

YIELD

HEIGHT

DISEASE RESISTANCE

TISSUE CULTURE UNIFORMITY

Fruit Color

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International Collaborations in Oil Palm Genome Spearheaded by MPOB

Industry Members

- Orion Genomics, USA
- Macrogen, South Korea
- Cold Spring Harbor Labs, USA
- Washington University Genome Center, USA
- MOgene, LLC, USA
- Arizona Genome Institute, USA
- Tufts University, USA
- Fasteris, Switzerland
- Gene Works, Australia
- Beijing Genome Institute, China
- Oxford Gene Technology, UK
- Broad Institute, USA
- 454 Roche, USA

(MOgene, LLC, USA)
Enhanced Productivity through Best Management Practice

Agronomic research on sustainable practices:

1. Optimum fertilizer inputs
2. Nutrient recycling – conserving soil fertility
3. Maintaining biodiversity of soil fauna and microbial communities
4. Moisture conservation and improved soil fertility

Study on nutrients: One set of lysimeter tubes at palm circle

Cover crops and nutrient recycling
VALUE ADDITION TO THE OIL PALM

Commodity Oil

Food Uses

Industrial chemicals

Nutraceuticals

Cosmoceuticals

Pharmaceuticals
Value Addition through Biomass Utilization

Abundance of Oil Palm Biomass

- Crude Palm Oil
- Biofuel / Biodiesel
- Palm Biomass
- Fuel for CHP
- Biogas

10% oil
90% biomass
Chemicals Obtainable from Biomass

- **Pyrolysis**
  - Gas (CO, CO₂, H, hydrocarbons)
  - Liquid (methanol, acetic acid, acetone, phenol derivatives, charcoal/activated carbon)

- **Hydrogenation**
  - Gas (hydrocarbon)
  - Phenol and cyclohexane derivatives

- **Hydrolysis**
  - Alcohols, polyols, ketones and acids
  - Hydroxymethylfurfural, levulinic acid
  - Polyols, Glucose

- **Hexoses**
  - Yeast, furfural, alcohol, polyols (xylitol)
  - Xylose

- **Pentoses**
  - Yeast, furfural, alcohol, polyols (xylitol)
  - Xylose

- **Lignin**
  - Cresol, phenol, catechols, vanillin, Thermosetting resin, dispersant, Antioxidant, rubber reinforcement
Value Addition through Biodiesel/Biofuel

• National Biofuel Policy launched in March 2006
• Main strategic thrusts among others, involve production of palm biofuel for export and local use
• Benefits
  • value addition
  • support the price of palm oil: every RM100/tonne price increase of palm oil will increase export revenue by RM1.6 billion a year;
  • reduce reliance on imported fossil fuels;
  • preserve the environment.
First Generation Biofuel

- Palm Biodiesel
  - Normal grade biodiesel
  - Winter grade biodiesel

- RBD palm oil / petroleum diesel blends as diesel substitute

- Feedstock – **palm oil**, palm stearin, used frying oil, PFAD, spent bleaching earth oil
Second Generation Biofuel

- Biomass to Solid (BTS)
  - Palm biomass briquettes
- Biomass to Gas (BTG)
  - Biogas capture and utilisation from POME
  - Production of producer gas
- Biomass to Liquid (BTL)
  - Production of bio-oils
  - Production of Palm bioethanol
  - Production of synthetic diesel
  - Production of aviation fuel

Third Generation Biofuel

Algae (non-food feedstock for biofuels and bio-oil production)
Value Addition through Food & Nutrition

- 85% of world’s palm oil is used as food

Physical Attributes
- Good oxidative stability – long shelf life
- Excellent thermal stability – perfect for shallow and deep frying
- Most other vegetable oils need to be partially hydrogenated to increase stability

Nutritional Attributes
- Palm Oil is TRANS-FREE
- Importance of Sn-2 position
- Palm oil does not behave like a typical saturated fat

Positioning palm oil as a superior functional and nutritive oil
Fatty acid composition alone does not tell you the whole story – the position of the fatty acid in the TG is more important.

- Altering the fatty acid in the Sn-2 position alters the lipid profile.
- Palm oil does not behave like a saturated fat because of oleic acid in the Sn-2 position.
- Palm oil has similar health properties to olive oil.
Palm Olein and Olive Oil Have Similar Effects on Blood Lipids

- Numerous human studies including one conducted at the University of Sydney, comparing the health effects of palm olein and olive oil (both high in oleic acid) have shown that palm oil (olein) and olive oil have similar beneficial effects on blood cholesterol.

*OO = Olive Oil  
PO = Palm Olein
**Value Addition through Food & Nutrition: Smart Balance**

**Net Sales of Smart Balance (US$ Million)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (US$ Million)</td>
<td>99</td>
<td>137</td>
<td>176</td>
</tr>
</tbody>
</table>

**Percentage of Smart Balance Share in the US Margarine/Spread Sector**

- **Best Seller in the USA**
- **AHA recommended blend of 1:1:1 sat:mono:poly**
- **Helps improve cholesterol ratio**
Novel Frying Oil from Palm: NoveLin

Premium Cooking Oil
- IV > 60
- Good Cold Stability (0°C for more than 5 hours)
- Suitable for temperate climate
- High content of natural antioxidants (extended frying time)
- Blend of palm olein and soft oil
- Free of Trans Fatty Acid
Value Addition through Food & Nutrition: Palm Oil-based Trans-free Margarine Formulations
Palm-based Cheese Analogue – palm oil and palm kernel oil fractions can substitute milk fat in cheese analogue.

Palm-based Ice Cream – palm oil is suitable due to its narrow plastic range with high solid at low temperature.
Value Addition through Palm Phytonutrients: Phytonutrients from Palm Biodiesel

For every 1 tonne of methyl esters burnt as fuel, we also burn away:

- 0.6 kg Carotenoids
- 0.8 kg Vitamin E
- 0.5 kg Phytosterols
- 0.4 kg Squalene
- 0.05 kg Coenzyme Q
- 0.06 kg Phospholipids
Value Addition through Palm Phytonutrients: Phytonutrients from Palm Biodiesel

- Palm Vitamin E (up to 95% concentration)
- Carotenes (up to 95% concentration)
- Coenzyme Q (0.3% concentration)
  - concentrated by 300 folds
- Sterols (up to 95% concentration)
- Squalene (up to 50% concentration)
- Phospholipids (0.1% concentration)
Value Addition through Palm Phytonutrients

**Tocotrienols**
- Antioxidant properties
- Cholesterol lowering properties
- Anti-cancer activities
- Neuroprotective properties
- Immune regulation

**Carotenoids**
Pro-vitamin A—solution to vitamin A deficiency
- Anti-cancer effects
- Anti-oxidant
- Stimulation of the immune system
- Cardiovascular protection
- Prevention of cataract
Value Addition through Palm Phytonutrients

Red Palm Oil/Olein

- Palm Oil/Olein with high content of α and β-carotene
- The only vegetable oil containing both natural carotene and tocotrienols
- Suitable for shallow frying and salad dressing
Fighting Blindness with Palm Carotenes
Value Addition through Palm Phytonutrients

Water-soluble Phytonutrients from Palm Oil Mill Effluent

PHENOLICS (2.4%)
- Vitamins
- Fruit acids
- Fruit sugars

A tremendous opportunity to leverage on the 45mil tons of POME produced annually in Malaysia

Waste to Wealth to Health
BIOLOGICAL ACTIVITIES OF OIL PALM PHENOLICS

- Antioxidant
- Anti microbial
- Anti atherogenic
- Anti cancer
- Anti diabetic
- Anti hypertensive
- Anti inflammatory
- Memory enhancing
- Anti obesity
- Anti spasmodic
- Anti thrombotic
- Anti allergenic
- Anti ulcer

*In vitro, whole animal and microarray studies*
Value Addition through Palm Phytonutrients: Shikimic Acid

- OPP contains 1% shikimic acid
- Substrate for synthesising tamiflu
- Current source is star anise from China
- An opportunity for the oil palm industry to enter shikimic acid market
- Oil palm phenolics- largest potential source of shikimic acid in the world
Palm Oleochemicals Downstream Products

- MES-Based detergents/cleaning products
- Decorative panels
- Personal care products
- Transparent soap
Strategies for Enhancing Sustainability

• Environmental Policies and requirements
• Implementation of Good Agriculture Practices (GAP)
• Implementation of Codes of Practices (CoPs)
• MPOB LCA Studies
Environmental Requirement: Well Regulated Industry

**Land Matters:**
- National Land Code 1965
- Land Acquisition Act 1960

**Environmental Matters:**
- Environmental Land Conservation Act 1960 revised in 1989
- Quality Act 1974 (Environmental Quality) (Prescribed Premises) (Crude Palm Oil) Regulation 1977
- Environmental Quality (Clean Air) Regulation 1978
- Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 1987

**Labour and Employee Matters:**
- Labour Law
- Workers’ Minimum Standard of Housing & Amenities Act 1990
- Occupational Safety & Health Act 1977

**Pesticide Use:**
- Pesticides Act 1974 (Pesticides Registration) Rules 1988
- Pesticides (Licensing for sale & storage) Rules 1988
- Pesticides (Labeling) Regulations 1984
- Factories & Machinery (Noise Exposure) Regulations 1989

**Wildlife Matters:**
- Protection of Wildlife Act 1972
Technology and Good Agricultural Practices (GAP) to Reduce GHG Emissions

- Optimisation of fertilizer inputs
- Accumulation of soil carbon in replanting
- Recycling of oil palm biomass
- Implementing zero burning
- Planting of leguminous cover crops
- Integrated Pest Management
GAP – Zero Burning Policies

Zero burning technique
- recycling of biomass in plantation

Total biomass available 100 t/ha
- contains significant pool of nutrients
  642kg N, 58kg P, 1384kg K and 156kg Mg
Palm Fruit Factory

- Total utilisation of the oil palm fruit to produce palm oil puree in addition to crude palm oil and palm kernel.
- Palm oil puree is a new energy food source containing a balanced diet of essential macro and micro nutrients of both lipid- and water-soluble components.

Environmental Friendliness of Palm Fruit Factory

- Zero emission and significant reduction of greenhouse gas (GHG) emission through methane avoidance at palm oil mills.
- Production of palm oil puree reduces 20 million tonnes of GHG per year.
- Compliance with stringent regulatory requirements of <20 ppm biochemical oxygen demand (BOD) of discharge from palm oil mill effluent.
MPOB Codes of Practice

1. Code of Good Nursery Practice for the Oil Palm Nurseries
2. Code of Good Agricultural Practice for the Oil Palm Estates and Small Holdings
3. Code of Good Milling Practice for Palm Oil Mills
4. Code of Good Refining Practice for Palm Oil
5. Code of Good Crushing Practice for Palm Kernel Crushers
6. Code of Good Practice for the Handling, Transport and Storage of Products from the Oil Palm
Importance of the LCA Study to the Oil Palm Industry

- Data from the study provide a reference for stakeholders of the Malaysian oil palm industry to improve environmental performance
- Fulfill environmental regulations relating to trade of climate sensitive products
- Engaging in LCA is a key element for gaining credibility on sustainable claims
MPOB LCA Study

• A cradle-to-grave case study of Malaysian oil palm products (from palm cultivated on mineral soil) including the production and use of palm biodiesel as transport fuel has been completed by MPOB and the report accepted by an external review panel.

• Results have been published in the International Journal of Life Cycle Assessment and Journal of Oil Palm Research.
## GHG Emissions of Major Vegetable Oils

<table>
<thead>
<tr>
<th>GHG emission</th>
<th>Refined Palm Oil (MPOB study)</th>
<th>Refined Rapeseed Oil*</th>
<th>Refined Soybean Oil*</th>
</tr>
</thead>
<tbody>
<tr>
<td>tonne CO$_2$eq/tonne oil</td>
<td>1.11</td>
<td>1.35</td>
<td>1.70</td>
</tr>
</tbody>
</table>
| | 0.63 (Biogas capture) | }
European Union Renewable Energy Directive
## GHG Emission Savings from Selected Biofuels

<table>
<thead>
<tr>
<th>Biofuel Feedstock</th>
<th>GHG emission savings (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Typical</td>
</tr>
<tr>
<td>Palm oil biodiesel (process not specified)</td>
<td>36</td>
</tr>
<tr>
<td>Palm oil biodiesel (process with methane capture at oil mill)</td>
<td>62</td>
</tr>
<tr>
<td>Soybean oil biodiesel</td>
<td>40</td>
</tr>
<tr>
<td>Rapeseed oil biodiesel</td>
<td>45</td>
</tr>
<tr>
<td>Sunflower seed oil biodiesel</td>
<td>58</td>
</tr>
</tbody>
</table>
Calculation of GHG Emission Savings*  
(Based on MPOB Data)

<table>
<thead>
<tr>
<th>Palm biodiesel pathway</th>
<th>GHG emission savings (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palm oil biodiesel (Without biogas capture)</td>
<td>50</td>
</tr>
<tr>
<td>Palm oil biodiesel (With biogas capture)</td>
<td>71</td>
</tr>
</tbody>
</table>

* Based on methodology as stipulated under EU Directive on the Promotion of the Use of Energy from Renewable Sources (2009/28/EC)
Renewable Fuel Standard Program (RFS 2)
# Life Cycle GHG Thresholds Specified in EISA (Percent reduction from 2005 baseline)

<table>
<thead>
<tr>
<th>Fuel Category</th>
<th>GHG threshold (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable fuel*</td>
<td>20</td>
</tr>
<tr>
<td>Advanced biofuel</td>
<td>50</td>
</tr>
<tr>
<td>Biomass-based diesel</td>
<td>50</td>
</tr>
<tr>
<td>Cellulosic biofuel</td>
<td>60</td>
</tr>
</tbody>
</table>

*Note: The 20% criterion generally applies to renewable fuel from new facilities that commenced construction after 19 December 2007*
Current Status

• Palm biodiesel has yet to be approved as a feedstock for biodiesel - pending re-analysis by EPA

• MPOB has provided data required by EPA for the re-analysis of palm-based biodiesel

• MPOB/MPOC continues to engage with EPA through MPOB/APOC Regional Office in Washington to monitor the development of RFS 2

• At the invitation of Honourable YB Minister of MPIC, EPA will be visiting Malaysia end Oct for a discussion and site visits to plantations and mills.
New Externalities Impacting Competitiveness

• Externalities can change competitiveness equation
• E.g. Differential export taxes on crude products and refined product by Indonesia affects competitiveness of Malaysian downstream palm products
• Non-tariff trade barriers disguised as sustainability requirements

Addressing such dynamics of the oil palm industry correctly is the key to enhancing competitiveness and ensuring survival of the Malaysian oil palm industry
Conclusion

- Continuous innovation through R&D efforts is critical
- Enhanced productivity, value-addition and sustainability strategies are vital to the oil palm industry
- Projected to increase Gross National Income (GNI) from RM 57 billion (18.9 billion USD) in 2009 to RM 178 billion (58.9 billion USD) by 2020
- Palm oil will continue to be an integral part of the oils and fats industry
Thank You for your kind attention

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