The oil palm: Controversies and research challenges

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Sustainability in the public debate

A Recipe for Forest Destruction

Don’t Palm Us Off
The Four Oil Palm Truths

1. Demand for palm oil will continue to increase in response to a growing and increasingly affluent global population.

2. Oil palm is one of the most profitable land uses in the humid tropics.

3. Oil palm plantations store more carbon than alternative agricultural land uses.

4. Native biodiversity within oil palm plantations is far lower than the natural forests they often replace.

### 8 Principles for Growers to be RSPO Certified

<table>
<thead>
<tr>
<th>Principle Number</th>
<th>Principle Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Commitment to transparency</td>
</tr>
<tr>
<td>2</td>
<td>Compliance with applicable laws and regulations</td>
</tr>
<tr>
<td>3</td>
<td>Commitment to long-term economic and financial viability</td>
</tr>
<tr>
<td>4</td>
<td>Use of appropriate best practices by growers and millers</td>
</tr>
<tr>
<td>5</td>
<td>Environmental responsibility and conservation of natural resources and biodiversity</td>
</tr>
<tr>
<td>6</td>
<td>Responsible consideration of employees, and of individuals and communities affected by growers and mills</td>
</tr>
<tr>
<td>7</td>
<td>Responsible development of new plantings</td>
</tr>
<tr>
<td>8</td>
<td>Commitment to continuous improvement in key areas of activity</td>
</tr>
</tbody>
</table>

Robust and credible Principles & Criteria need a Science-based approach
Sustainability addresses research

- Poverty alleviation
- People’s rights
- Workers’ rights
- Land grabbing
- Public policies
- Ethical investments
- Public/Private Partnership

- Agroecology
- Breeding
- Waste management
- Precision Agriculture
- Best agricultural practices
- GreenHouse Gas mitigation
- Integrated Pest Management
- Environmental services

ECOLOGICAL INTENSIFICATION

- Agroecology
- Breeding
- Waste management
- Precision Agriculture
- Best agricultural practices
- GreenHouse Gas mitigation
- Integrated Pest Management
- Environmental services
An original model for Biologists

A perennial Monocot

*Arecaceae*

Two cultivated species

*Elaeis guineensis*

*Elaeis oleifera*

Interspecific hybrid

Two different oils

Palm oil (palmitic)

Kernel oil (lauric)
An original model for Agronomists

• The oil factory
  • Almost 10X productivity compared to other oil crops
  • Two different oils for different uses
  • A non-GMO virgin oil

• The robust fellow
  • Adaptable to many different cropping systems
  • No systematic use of pesticides

• The biomass factory
  • Outstanding photosynthetic capacity
  • High productivity of aboveground/underground biomass
  • Impact on soil biology and structure
  • Bunches account for 5% only of total biomass
An original model for social studies

 ✓ Which prerequisites for efficient poverty alleviation?
   • Where, when, how and how much?

 ✓ Which model?
   • Nucleus/Estate
   • Agroindustrial
   • Outgrowers

 ✓ Which role for multi-stakeholders initiatives?
 ✓ A role for Governments?
 ✓ Which standards: RSPO, MSPO, ISPO ...
 ✓ Social impacts on the long term (FELDA, Malaysia)
The oil palm literature boom

Published peer-reviewed articles on oil palm. Source Web of Science
Spatially explicit scenario analysis for reconciling agricultural expansion, forest protection, and carbon conservation in Indonesia

Lian Pin Koh¹ and Jaboury Ghazoul

Institute of Terrestrial Ecosystems, Eidgenössische Technische Hochschule (ETH) Zürich, WSL Zürich, Switzerland

Palm oil is the world’s most important vegetable oil in terms of production quantity. Indonesia, the world’s largest palm-oil producer, plans to double its production by 2020, with unclear implications for biodiversity conservation. We present a spatially explicit scenario of oil-palm production and evaluate its effects on biodiversity and land use. We simulate the effects of oil-palm expansion on biodiversity and land use by comparing three scenarios: (1) a business-as-usual scenario, (2) a scenario where expansion proceeds from degraded lands, and (3) a scenario where expansion proceeds from primary forests. We find that the latter scenario results in a greater decrease in biodiversity and land use change, indicating the importance of protecting primary forests.

Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease¹–⁵

Patty W Siri-Tarino, Qi Sun, Frank B Hu, and Ronald M Krauss

Regulatory Mechanisms Underlying Oil Palm Fruit Mesocarp Maturation, Ripening, and Functional Specialization in Lipid and Carotenoid Metabolism¹[W][OA]

Timothy J. Tranbarger²*, Stéphane Dussert³, Thierry Joët, Xavier Argout, Marilyne Summo, Antony Champion, David Cros, Alphonse Omore, Bruno Nouy, and Fabienne Morcillo

Global Food Security

Oil palm expansion transforms tropical landscapes and livelihoods

Jeffrey Sayer³*, Jaboury Ghazoul⁵, Paul Nelson⁴, Agni Klintuni Boeddihartono⁶
• Quantify the effect of habitat complexity in maintaining biodiversity, ecosystem function and ecosystem services within oil palm

• Develop novel experimental approaches for partitioning the effects of habitat structural complexity and aspects of biodiversity on ecosystem functioning

• Predict and model optimal cover of understory and epiphyte vegetation in oil palm plantations so as to maximise biodiversity and economic profitability through ecosystem services.
Stability of Altered Forest Ecosystems (SAFE) Project (2010-2020)

SAFE is slated to be the world’s largest ecological experiment both in terms of size and breadth of ecological processes.

A major contribution to sustainable palm oil management and the conservation of biodiversity,

A major contribution to sustainable plantation management, the implementation of the Roundtable on Sustainable Palm Oil (RSPO) guidelines and the conservation of biodiversity in agricultural landscapes.
The **Socially and Environmentally Sustainable Oil palm Research (SEnSOR)**

An integrated multi-disciplinary research programme designed to fill key knowledge gaps in testing and developing the RSPO’s Principles and Criteria for sustainability in oil palm agriculture.

1. Soil and Water
2. Greenhouse Gases and Air Quality
3. Biodiversity
4. Participatory Processes and Rights
5. Livelihood
SPOP : Sustainable development of Palm Oil Production
Designing strategies from improved knowledge on oil palm cropping systems

• To generate knowledge and toolkits aimed at assessing economical, environmental and human impacts of various different oil palm farming systems

• To assess the sustainability of present farming systems and to propose improved systems

• To involve farmers and stakeholders into the research protocol, through the implementation of participative methods

• To implement multi-agents modelling
The PALMINET web platform was launched in 2011 by the international network on sustainable palm oil indicators coordinated by Cirad.

- to inform stakeholders,
- to pool research and share experience
- to foster the creation of indicators and tools for sustainable development.
- to encourage new partnerships
Having an impact (1)

An appropriate combination of breeding and BAP strategies

North Sumatra (no water deficit)
Côte d’Ivoire (- 340 mm/year)

1.2%/year
55 kg/year
In Latin America, Bud Rot (PC) is controlled by developing interspecific *E. oleifera* × *E. guineensis* hybrids.
Adapting oil palm quality to markets

<table>
<thead>
<tr>
<th>Fatty Acid</th>
<th>High Oleic Palm Oil</th>
<th>Palm Oil</th>
<th>Olive Oil</th>
<th>Soybean Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lauric</td>
<td>C12:0</td>
<td>0,13</td>
<td>0,35</td>
<td></td>
</tr>
<tr>
<td>Mlaistic</td>
<td>C14:0</td>
<td>0,80</td>
<td>1,2</td>
<td></td>
</tr>
<tr>
<td>Palmitic</td>
<td>C16:0</td>
<td>27,7</td>
<td>42</td>
<td>13</td>
</tr>
<tr>
<td>Stearic</td>
<td>C18:0</td>
<td>2,8</td>
<td>5,4</td>
<td>3</td>
</tr>
<tr>
<td>Oleic</td>
<td>C18:1</td>
<td>55,0</td>
<td>40</td>
<td>71</td>
</tr>
<tr>
<td>Linoleic</td>
<td>C18:2</td>
<td>11,4</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Linolenic</td>
<td>C18:3</td>
<td>0,4</td>
<td>0,2</td>
<td>1</td>
</tr>
</tbody>
</table>

Results from *E. guineensis X E. oleifera* hybrids in Hacienda la Cabaña, Colombia
An environmentally and economically efficient composting

Composting reduces needs for mineral fertilizers of 15%

It improves both soil fertility and structure.

ENVIROMENTAL SERVICES

DIRECT

FERTILISERS BILL
ORGANIC MATTER
C SEQUESTRATION

INDIRECT

N LEACHING
N₂O EMISSIONS
CO₂ EMISSIONS
### Mitigating GHG emissions

#### Global project - 3 palm plants

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2020</th>
</tr>
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<tbody>
<tr>
<td><strong>Palm plants</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milling (T FFB/year)</td>
<td>295,000</td>
<td>438,000</td>
</tr>
<tr>
<td>POME flow (m$^3$/year)</td>
<td>231,500</td>
<td>344,700</td>
</tr>
<tr>
<td>COD load (T/year)</td>
<td>15,400</td>
<td>22,900</td>
</tr>
<tr>
<td><strong>Methanization systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biodigester capacity (m$^3$)</td>
<td>37,500</td>
<td>37,500</td>
</tr>
<tr>
<td>Methan captured and used (m$^3$/year)</td>
<td>3,645,900</td>
<td>5,382,600</td>
</tr>
<tr>
<td>Diesel/Kerosene savings (l/year)</td>
<td>2,946,600</td>
<td>4,059,800</td>
</tr>
<tr>
<td><strong>GHG reduction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH$_4$ and N$_2$O avoided (T CO$_2$ eq./year)</td>
<td>40,500</td>
<td>59,800</td>
</tr>
<tr>
<td>Diesel/Kerosene savings (T CO$_2$ eq./year)</td>
<td>9,400</td>
<td>13,900</td>
</tr>
<tr>
<td><strong>Economics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment costs(5%, 9years) k€</td>
<td>5,453</td>
<td>8,460</td>
</tr>
<tr>
<td>Savings k€</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O&amp;M costs k€</td>
<td></td>
<td></td>
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<tr>
<td>Net profit k€</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


12 m$^3$ methane per ton FFB

15 m$^3$ methane per m$^3$ POME

Methane captation by biodigestion: A pilot project in Africa
People do not know what they should know ...
Take home messages

- Improving sustainability requires **multidisciplinary and collaborative research**
- Public awareness has pushed **new approaches and new actors** into the sector
- **Large scale projects** based on Public/Private partnership are emerging
- Results are getting more **published and recognized**
- Research provides a shared basis to **certification processes**
- There is a need for education and **capacity building on sustainability**
- Scientists must jump into the arena of the **public debate**
Thank you for your kind attention

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