Future prospects for palm oil in the 21st century:

Biological and other challenges

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Introduction

- **In 2006, palm oil supplanted soybean oil as the major globally traded vegetable oil.**
- **Despite breeding advances, plantation yields have only shown modest improvements in established centres of cultivation, but worldwide production of palm oil has continued its steady increase.**
- **This is largely due to the conversion of additional land to plantations in countries as far apart as Papua New Guinea, Indonesia and Columbia.**

Introduction

- In 2006, palm oil supplanted soybean oil as the major globally traded vegetable oil.
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- This is largely due to the conversion of additional land to plantations in countries as far apart as Papua New Guinea, Indonesia and Columbia.
- **Thanks to its year-round harvestability and multi-decade productive lifetime, the oil palm cropping system has unique advantages over annual oil crops such as soybeans, rapeseed or sunflower.**
- **Oil palm has only just begun to benefit from modern high-tech breeding and selection techniques.**

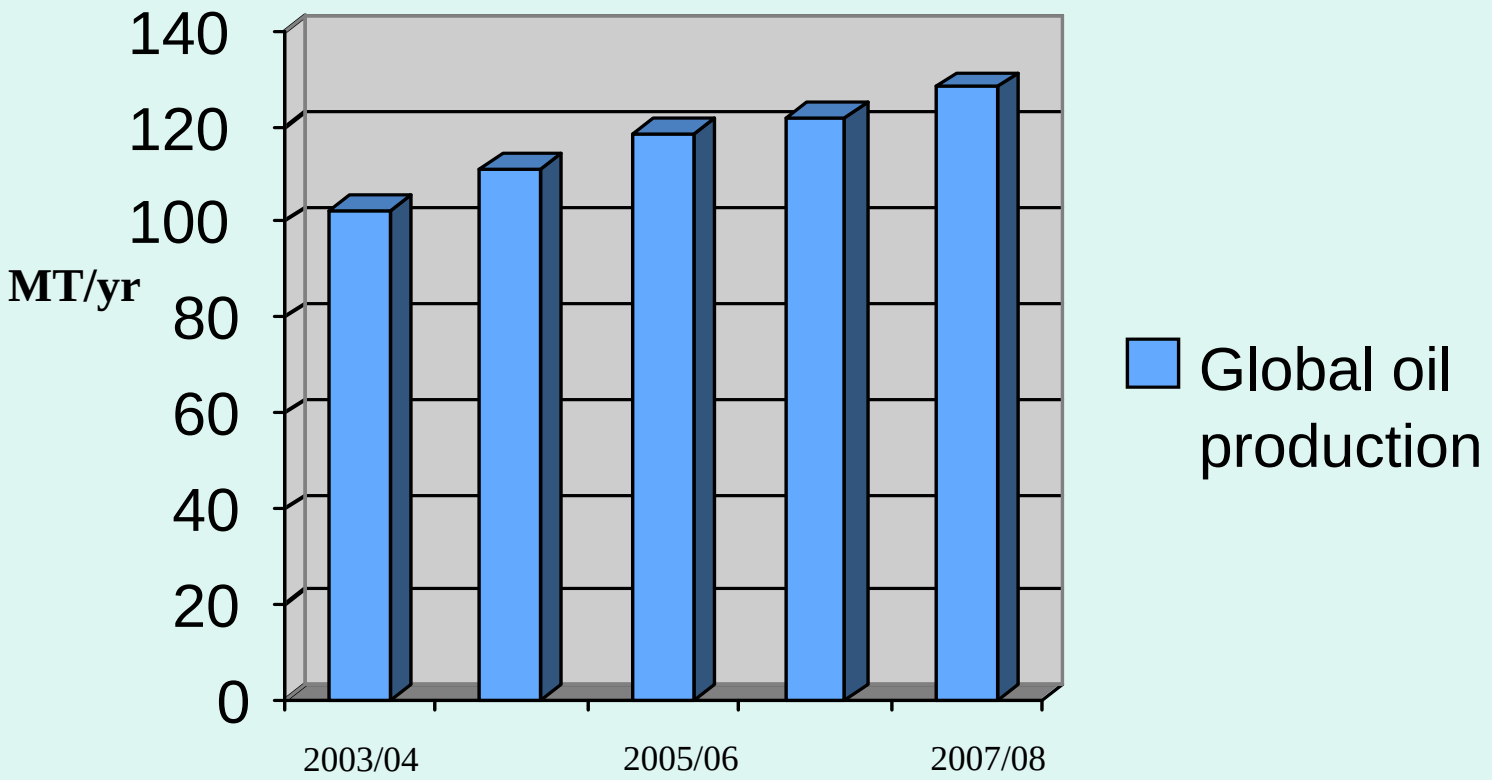
Global trends

- Economic downturn:
- Biofuels:
- Population growth:
- Climate change:
- Environment:
- Petrochemicals:

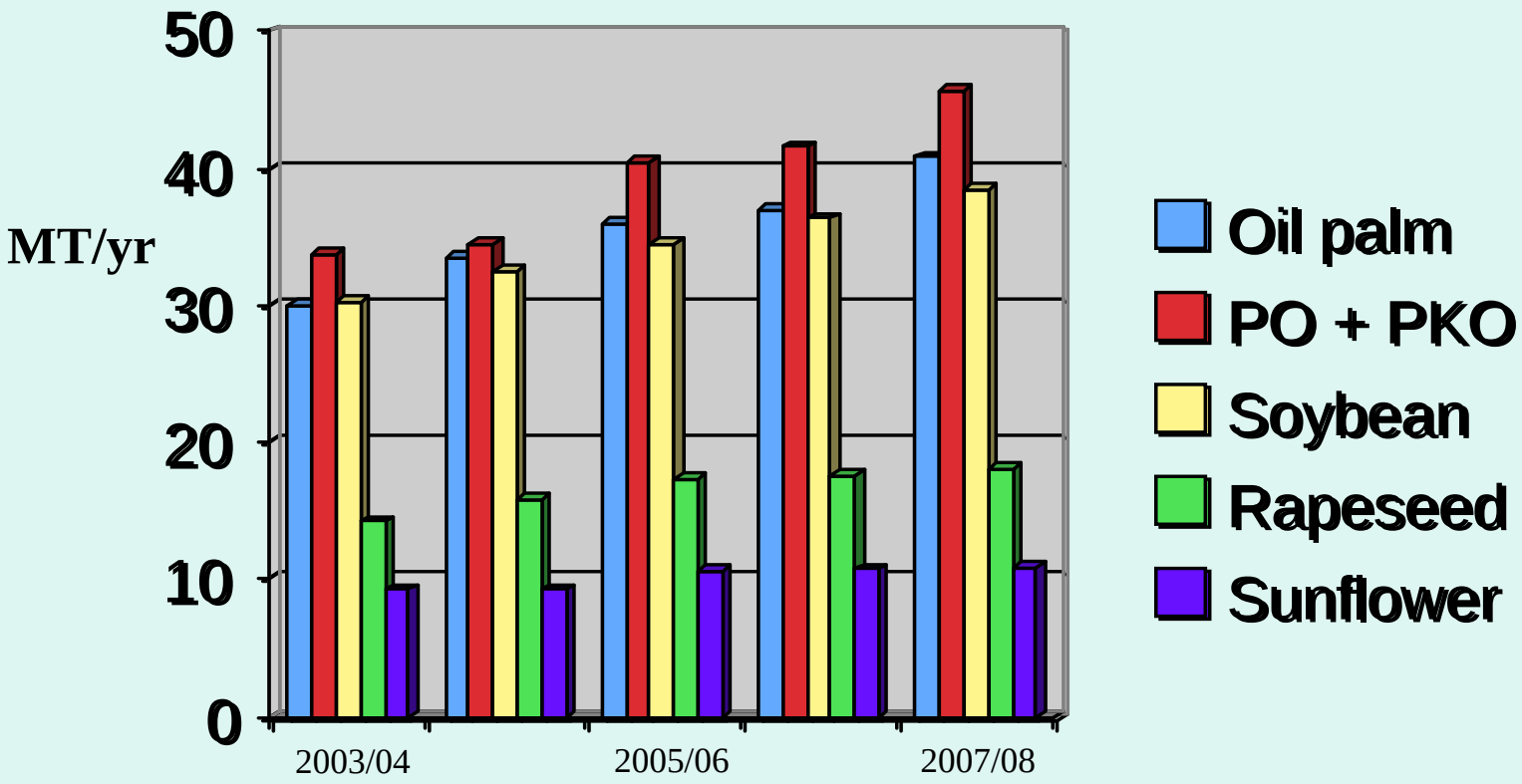
Global trends

- **Economic downturn:** R&D -ve foods +ve
- **Biofuels:** foods -ve transient distraction
- **Population growth:** foods ++ve
- **Climate change:** pests & diseases -ve unpredictable
- **Environment:** expansion -ve efficiency & sustainability
- **Petrochemicals:** no future oleochemicals ++ve

Continuing buoyant production in crop oils sector



Oil palm as the global leader



Biological challenges

- **Yield enhancement:**
- **Manipulation of fatty acid quality for different downstream applications:**
- **Pest and disease control:**
- **Addressing sustainability agenda:**
- **Bio-environmental audits and action plans:**

Biological challenges

- **Yield enhancement: currently <4 T/ha, future max >18 T/ha?**
- **Manipulation of fatty acid quality for different downstream applications: currently 16:0/18:1, future 60-80% 18:1 etc**
- **Pest and disease control: focus on surveillance & non-chemical methods**
- **Addressing sustainability agenda: minimise inputs**
- **Bio-environmental audits and action plans: eg peatlands**

Biotechnological tools

Advanced breeding technologies

- Transgenesis (genetic engineering or GM)
- Mass clonal propagation
- Hybrid creation
- DNA marker assisted selection
- Genomics

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These technologies have created unprecedented opportunities for radical steps forward in redesigning the architecture and biological performance of the oil palm plant

Segmentation

- *Per capita* consumption of vegetable oils is still increasing across the world, with increasing uses for food and biofuels

- These factors are leading to an increased **segmentation** in the marketplace for vegetable oil production and utilisation

Segmentation

- *Per capita* consumption of vegetable oils is increasing across the world, with increasing levels of affluence, and a greater awareness of the nutritional benefits of plant-based oils

- These factors are leading to an increased **segmentation** in the marketplace for vegetable oil production and utilisation

- On the one hand, there is a slowing demand for cheap, edible **commodity oils**, such as soybean or palm, from the emerging economies of Eastern Asia

- On the other hand, in developed economies, there is a slowing demand for **biodiesel**, which is mainly sourced from food-grade palm and rapeseed oils

- **Is high oleic palm oil the answer?**

High oleic - low PUFA

- the multi-purpose oil crops of the future

High oleic oils

- **Cheap but ‘healthy’** commodity oils
- High **monounsaturate** content (olive oil, Mediterranean diet *etc*)
- Do not require hydrogenation (***low trans***)
- Suitable for **non-food** use, *eg* lubricants (low oxidation)

GM High-oleic oils

- Very high oleate (65-90%+), v low PUFA (<5%)
- Several transgenic (GM) lines have been developed but not commercialised:
- These line are based on antisense or RNAi technologies

- Rapeseed/canola (89%)
- Indian mustard (73%)
- Soybean (90%)
- Cottonseed (78%)

Non-GM High-oleic oils

- Very high oleate (65-90%+), v low PUFA (<5%)

- Many non-GM commercial lines already developed:

- Rapeseed/canola (75%) - [LN 3%]
- Soybean (83%) - [LN 3%]
- Sunflower (80-90%) - [LN <1%]
- Safflower (75%) - [LN <1%]
- Olive (75%) - [LN <1%]

(Palm (55-60%) - [LN <15%])

Some commercial High oleic oils

- NuSun™ sunflower (65%) used by P&G for Pringles chips (200k T)
- Vistive™ soybeans (80%) from Monsanto
- Natreon™ canola (75%) from Dow
- Nutrium™ sunflower (75%) sunflower from DuPont/Pioneer/Bunge

Strategies for oil modification

- **Both GM and non-GM strategies are viable and can be cost-effective for many oil modifications**

- **Most (but not all) companies currently chose the non-GM route due to adverse market signals for GM**

GM oil palm – some like it HOT

(high oleic transgenic)

- **HOT is currently under development in Malaysia**

  [Ravigadevi et al (2002) Genetic manipulation of the oil palm-Challenges and prospects, *The Planter* **78**, 547-562]

- **BUT - non-GM palm oil varieties @ 55%+ oleic could also be available in the near future**

- **Both strategies should be pursued vigorously**

High oleic palm oil

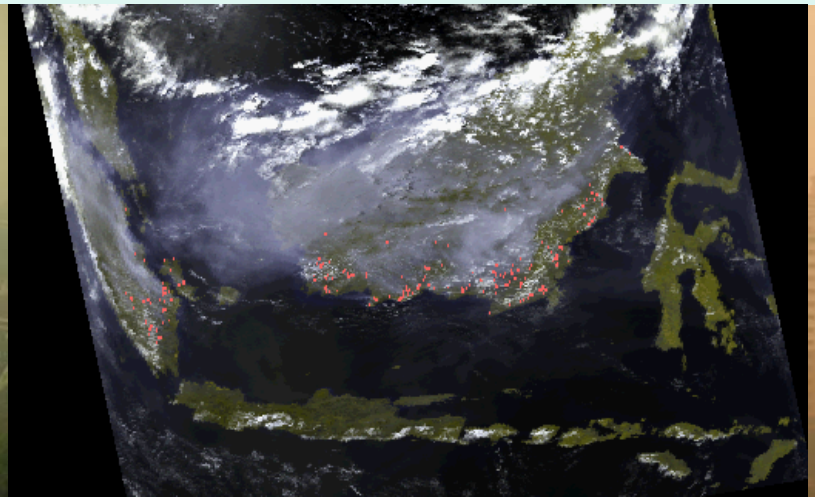
The environment

- **Bio-environmental audits and action plans**
- **Environmental context of oil palm cultivation encompasses numerous complex areas of science and policy making**
- **Encouraging plantation biodiversity in a way that is consistent with maintaining sustainable levels of production**
- **Management of the conversion of tropical peatlands and other sensitive habitats to plantations while minimising avoidable release of greenhouse gases or other adverse environmental impacts.**

Challenges for oil palm

- **Developers**
- Environmentalists
- Sluggish innovation
- Biodiesel

The Flames of Extinction: Forests burning in Borneo



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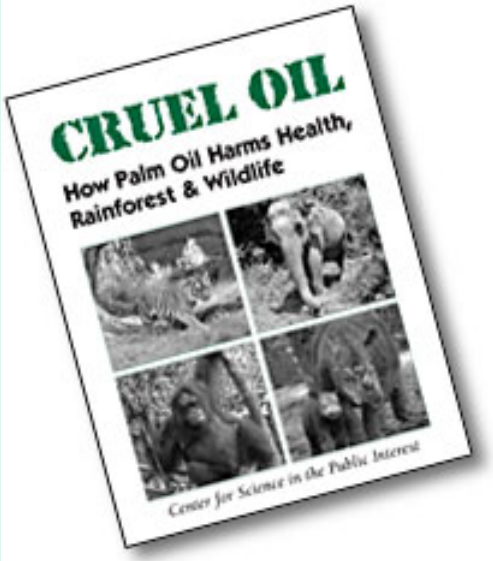
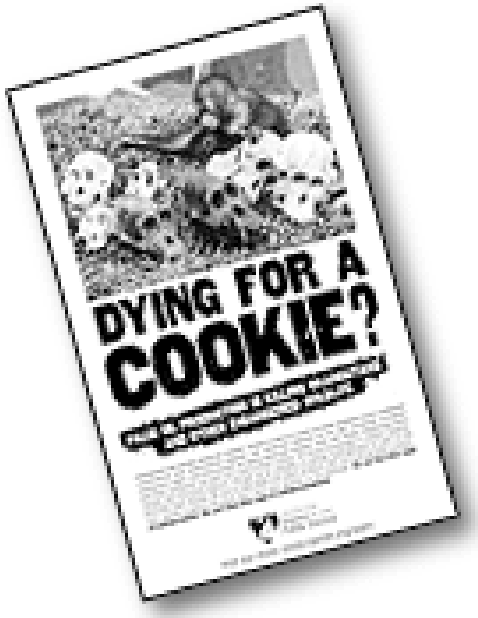


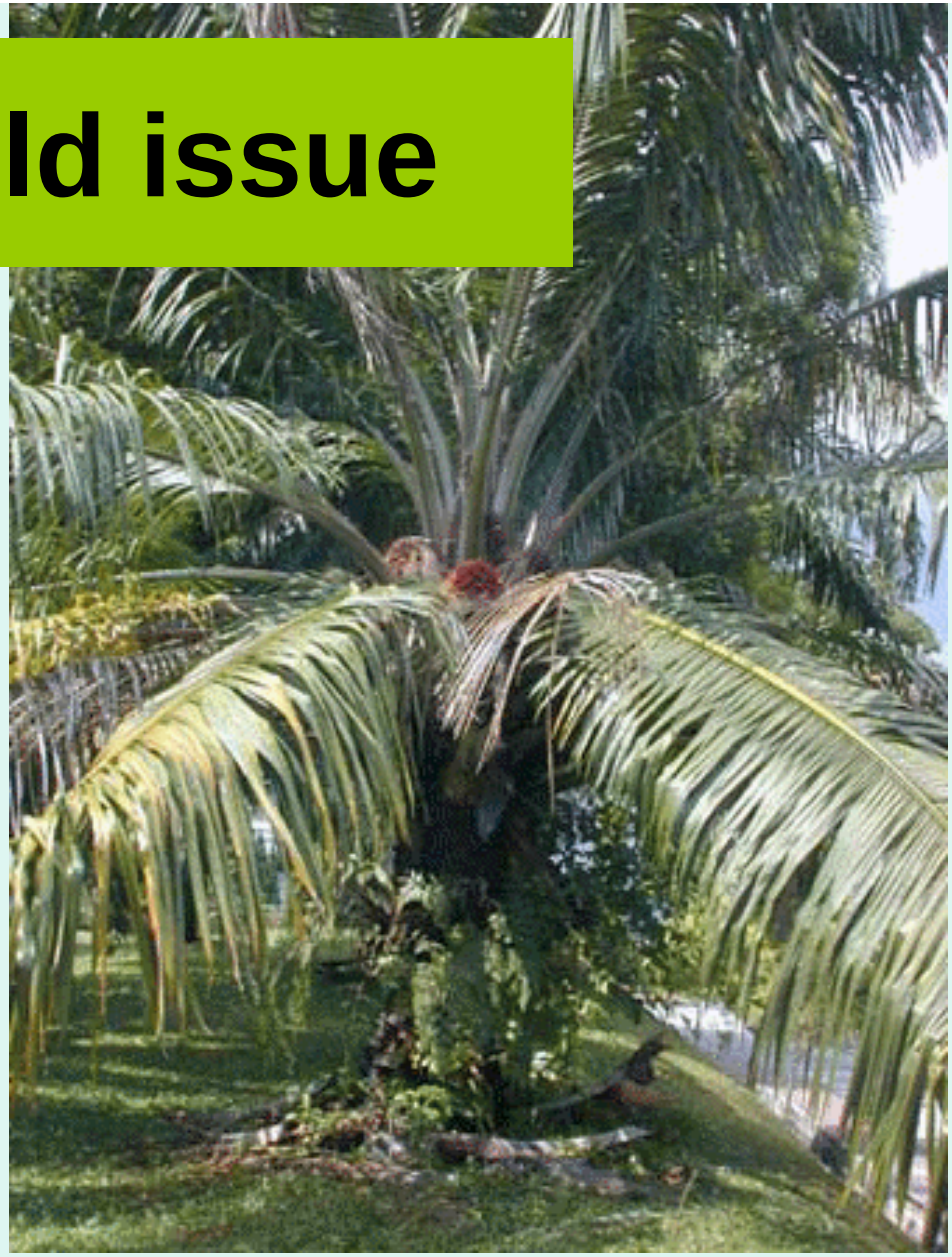


CRUEL OIL
HOW PALM OIL HARMS HEALTH, RAINFOREST AND WILDLIFE

Crop management

- **Translation of biological improvements into reality on all plantations (commercial & smallholder)**
- **Management of plantations – disseminating best practice, improving extension services, re-skilling labour force**
- **Implementation of best practice in propagation, husbandry, harvesting, and processing of the crop**
- **Underperformance in this area is shown by the relative stagnation of average plantation yields at well under 4 t/ha over the past 15 years**
- **This is despite the development of much higher-yielding genotypes and their effective cultivation by some of the more exemplary growers.**

The yield issue



Soybean/Canola/Sunflower: 1 T/ha

Oil palm: 3 to 10 T/ha

potentially < 20 T/ha

Oil palm - an emerging giant

- 3 to 10-fold higher yield than temperate oilseeds
- Year-round cropping
- Plantations last 25+ years (no annual sowing)
- Low labour costs
- Emerging mechanisation
- Considerable unexplored genetic potential
- Room for improved management systems
- Good prognosis for future yield gains and potential for product diversification

Some challenges for oil palm

- **Environmental concerns**
- **Sluggish innovation (e.g. yield)**
- **Biodiesel**
- **Slow pace of genetic oil modification whether via GM and non-GM methods**

Some take-home messages

- **We are moving into an increasingly uncertain period**
- **Economic dislocation and climatic changes are translating into:**
- **unpredictable shifts in public policy (e.g. biofuels)**
- **rapid shifts in global demand for (and hence prices of) commodities such as crops**
- **Therefore it will be crucial for the oil palm sector to maintain an efficient R&D operation in biology and other sectors so that this uniquely versatile crop can maintain, and possibly extend, its global pre-eminence in the future.**

Healthy vegetable oils

Palm oil - the healthy vegetable oil

Thank you for your attention