



Biofuels and Commodity Markets – Palm Oil Focus ¹

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Abstract:

In the last few years, demand for ethanol and biodiesel derived from grains, vegetable oils, sugar and other crops or derived products has risen sharply, reaching a level where the entire agricultural sector and its markets are being affected. The assessment of the consequences of rising biofuel demand for agricultural production, trade in agricultural commodities and agro-based industries has moved to the centre of attention. This paper aims to shed some light on the implications of growing biofuel demand in one particular area, the global palm oil economy. First, general factors determining the sector's past development as well as its medium term outlook are presented. Then information on the commodity's potential as fuel or feedstock for biodiesel production is provided. The main repercussions of current trends in European Union biofuel production on the palm oil sector are discussed and the commodity's prospects as biofuel feedstock at both the domestic and global level are reviewed. In this context, also the issue of sustainability in oil palm cultivation is looked into.

1. The development of the palm oil sector

In this section some key facts regarding the crop, its industry and its markets are presented.

Global palm oil production and trade have risen steeply and continuously from the 1970s onward (see annex [figure 1](#)). A comparison of the rise - over the last ten years - in world palm oil production and trade with that of other oils and fats, evidences the above average growth rates achieved by palm oil (see [figure 2](#)). Consequently, the share of palm oil in global vegetable oil production has more than doubled over the last twenty years (see [figure 3](#)). This development has been accompanied by a strong rise in the share of palm oil in global vegetable oil trade (see [figure 4](#)); also the share of palm oil in global consumption has grown significantly (see [figure 5](#)).

It is interesting to compare the developments in palm oil with those of its main competitor, soybean oil. Regarding production, [figure 6](#) shows that, since the year 2005, global palm oil output is matching that of soy oil, whereas for trade, global shipments of palm oil surpassed those of soy oil in the mid 1970s and, today, palm oil exports exceed soy oil shipments by almost two times.

¹ The paper is based on a presentation made at AgraInforma conference “The Impact of biofuels on commodity Markets”, held in Brussels on 24-25 October 2006.

² The views expressed in the paper are those of the author and so should not be attributed to FAO or its members. The mention or omission of specific organizations and their products does not imply any endorsement or judgement by FAO.

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Another outstanding feature of palm oil is its very high trade-to-production ratio, which refers to the amount of global production that enters trade. As depicted by [figure 7](#), the ratio for palm oil by far exceeds that observed for other oils and fats, oilseeds and other crops in general. Also the geographical pattern needs mentioning: today, just two countries - Malaysia and Indonesia - account for roughly 90% of both global production of and global trade in palm oil.

There are a number of factors which explain the remarkable expansion of palm oil during the past decades:

- first, palm oil yields - measured in terms of oil produced per ha per year - by far exceed those of other vegetable oils, as illustrated in [figure 8](#);
- second, palm oil production costs are low when compared to other oilcrops. Comprehensive analysis conducted by LMC shows that of all vegetable oils palm oil has the lowest per unit production costs, followed by soy oil, with 20% higher costs; the ranking continues with sunflower oil, coconut oil and finally rapeseed oil, which has the highest production costs. It should be noted here that labour costs weigh strongly on palm oil's overall production costs; in fact, with regard to labour productivity the performance of palm oil is relatively weak;
- third, the oil palm industry seems to have benefited from a favourable economic environment and policy setting; in the two main producing countries, government presence tends to be relatively strong and, from the beginning, the industry has enjoyed (and continues to do so) indirect and direct protection in various forms; furthermore, the industry has been successful in attracting domestic and foreign investors, and a high level of efficiency can be noted throughout the sector. From the industry's inception, the following key areas have received priority attention: research and development, general infrastructure and shipping facilities, processing for domestic value addition, vertical integration and sector-financed marketing and trade promotion programmes;
- fourth, the high level of market concentration (i.e. only two main producing countries and a limited number of big players in each country) has facilitated the control and continuous advancement and modernization of production, trade, technological development, etc.;
- and finally, compared to other oilcrops, palm oil milling is relatively independent from by-product markets: high-value palm kernel oil is traded on a separate market (the market for lauric oils) and palmkernel meal production and trade are relatively small.

However, the success story of palm oil also seems to be associated with a number of drawbacks such as: (i) a strong concentration of agricultural resources as opposed to sector diversification; (ii) a high level of vulnerability to weather changes; (iii) a strong dependence on export markets; and (iv) increasing concerns regarding the social and environmental sustainability of production expansion.

Notwithstanding these constraints, the palm oil sector can be considered a highly performing industry and palm oil that enjoys a strong market position. As illustrated by [figure 9](#), palm oil has been by far the most price competitive vegetable oil in the global market for the last twenty years. Vis-à-vis its main competitor - soy oil - palm oil has been traded at a considerable discount in most years (see [figure 10](#)). As a result, today palm oil is consumed world-wide; it is the vegetable oil with the highest level of market penetration, and many nations (including large countries such as China and India) depend heavily on palm oil imports.

Factors that explain the interest of the global market place in palm oil include the following: (i) a high level of substitutability with other soft oils; (ii) a high melting point and a low content of trans fatty acids, which are of special interest to the food industry; and (iii) the fact that a number of negative health attributes originally associated with palm oil were proven to be wrong.

A closer look at past and current price trends reveals the following: the industry has witnessed a long-term, steady decline in the world price of palm oil (from 1950 to 2005, expressed in 2005 real terms). [Figure 11](#) shows the more recent development of prices - from 1999 until today and compares the same to the long run trend. It emerges that, since 2003-2004, prices have been quite consistently above the long-term trend. The timing involved leaves little doubt: the new demand for vegetable oil

for biodiesel production has had a major influence on the recent strengthening of prices; and the biofuel driven surge in the price of rapeseed and its oil has lifted vegetable oil prices in general. Although strengthening along with the other oils, palm oil has remained the lowest priced vegetable oil.

As far as the relationship between world palm and soy oil prices is concerned, attention needs to be drawn to the following two points:

- first, the impact of biodiesel demand on the two markets differs: biodiesel-driven soybean crushing inevitably generates surplus meal supplies, which lead to downward pressure on meal prices and thus reduced crush margins for soybeans; palm oil production is not subjected to such mechanisms due to the limited amounts of meal by-products generated;
- second, trade policies play a role: the discount of palm oil over soy oil is also determined by India's tariff policies. India is a major buyer of both oils, but maintains a strong tariff preference for soy oil. To make up for the disadvantage, palm oil must be sold at a certain discount. The development of the palm oil price discount at the global level is therefore closely dependant on changes in India's import tariffs.

2. The medium term outlook for vegetable oils and palm oil in particular

This section refers to the latest available medium term projections (2005-2015) for the vegetable oil sector prepared by FAO and OECD as well as by FAPRI. According to these projections, global vegetable oil demand, supply and trade are projected to rise by around 30% between today and the year 2015. However, annual growth rates (see [figure 12](#)) are anticipated to be less high than during the last ten years, especially with regard to global trade. During the outlook period, the group of developing countries is expected to be the main motor behind growth, due to sustained population and per caput GDP growth and because of persistently low per caput consumption levels among developing nations.

It needs to be mentioned here that the above demand projections only partly and tentatively include rising demand for biodiesel, the reason being that modelling domestic and global demand for biofuel represents a very complex task. Furthermore, it should be noted that possible future changes in national policies - e.g. in the area of biofuel production and consumption - have not been considered in the projections.

Palm oil - and this means in particular Malaysia and Indonesia - appears to be well placed to satisfy the projected expansion in total vegetable oil demand and a further consolidation of the palm oil sector's leadership in the global marketplace can be expected.

[Figure 13](#) illustrates likely developments in the global pattern of supply. The dominant position of palm oil in total vegetable oil output is expected to remain unchanged and may strengthen slightly. With regard to the pattern of trade (see [figure 14](#)), the share of palm oil is anticipated to grow further, approaching 70% in the year 2015.

With regard to the two leading producers of palm oil, in or around 2009, Indonesia is expected to overtake Malaysia production-wise; and towards 2015 Indonesia is also anticipated to become the world's leading exporter of palm oil. Indonesia's advancement is going to be possible thanks to the country's ample land and labour resources.

As to the price levels implied in the anticipated expansion of the vegetable oil sector, the projections of FAO-OECD, which refer to vegetable oil prices as a whole, indicate that there should be a moderate long-term rise in nominal prices - or a progressive slight weakening if expressed in real terms (see [figure 15](#)). FAPRI's price projections for individual, major oils seem to indicate a similar price path (see [figure 16](#)).

It is important to note that, in the medium to longer term, the palm oil sector could be facing a number of challenges. The sector's future growth and competitiveness appears to be conditioned by the following factors:

- first, as depicted by [figures 17 to 19](#), oil palm growers have been confronted with a stagnation or marginal growth in yield levels over the last 20 years; data from Malaysia reveal very weak improvements in yields measured in terms of (i) tons of fresh fruit bunches per ha, (ii) tons of palm oil per ha, as well as (iii) palm oil extraction rates;
- second, also labour productivity - measured in terms of hectares per total numbers of labourers or area harvested per harvester - has not improved over the last 5-10 years; in the absence of mechanized harvesting methods, labour costs continue to weigh considerably on overall production costs;
- third, there has been no significant reduction in overall production costs over the past 10-20 years - much in contrast to other oilcrops (notably soybean and sunflower) where considerable cuts have been achieved;
- fourth, in Malaysia, expansion in area cultivated with oil palm is expected to slow down due to scarcity of land. Malaysia also suffers from a scarce and increasingly expensive labour force. By contrast, land and labour pose less constraints in Indonesia; however, in Indonesia, costs of establishing new plantations should rise with the gradual enforcement of legislation that imposes environmentally sustainable expansion and cultivation methods;
- finally, there is the possibility of increased competition - in the longer term - from emerging producers in West Africa, East Africa, other Asia, as well as South and Central America.

3. Biofuel based on palm oil and other feedstock

For energy generation, palm oil can be burned directly as fuel, used as raw material for biodiesel production or employed in various intermediary forms.⁴ Commercial production of biodiesel from palm oil has started or is about to start in a number of countries in Asia, led by Malaysia. Currently, virtually the entire product is sold on the respective domestic markets, where it competes with conventional (fossil) diesel - generally without further support (i.e. detaxation or similar measures). Mandatory blending is under discussion in several of these countries.

With regard to future production prospects for palm oil based biodiesel in the region, the following points emerge:

- based on local and other sources, biodiesel production capacity in Asia is going to expand rapidly over next few years - mostly oriented towards the export market;
- assuming that all the currently planned and authorized biodiesel plants come on stream, production capacity could reach 3-4 million tons in Malaysia and 2 million tons in Indonesia. For the medium term, the Malaysian and Indonesian governments have announced their official target of allocating each 6 million tons of palm oil annually to biodiesel production per year - an amount that corresponds to about half of today's national output;
- whether future global import demand for biodiesel is going to match these levels remains to be seen (see next section); a look at the EU's prospective import demand raises some doubts in this regard;
- it is therefore possible that considerable excess production capacity is about to be installed in Asia.

In general, biofuel can be produced from a large number of agricultural commodities. First, there is the group of conventional or 'first-generation' biofuels which use grains, roots and tubers and vegetable oils as feedstock. Today, global biofuel consumption is dominated by ethanol which is derived primarily from sugar, maize and other starchy crops. Biodiesel using vegetable oils as feedstock comes only second. Ethanol feedstock and biodiesel feedstock compete with one another at

⁴ Note that the focus on palm oil implies that energy generation from other parts of the oil palm and of the milling process is not going to be treated here.

the national and international level - based on production and marketing costs, which, in turn, can be heavily influenced by government support measures. Continuous technological progress and frequent changes in national policies make it difficult to determine the viability and prospects of biofuel production from different feedstock.

Then there are the so called 'second generation' biofuels, the production of which at commercial scale is still at an infancy stage. Synthetic fuels (gas-to-liquid and carbon-to-liquid), cellulosic biomass based fuel and hydrogen fuel fall into this category. Due to their high quality and cleanness, possible uses of these fuels are vast; furthermore production of these fuels does not entail competition for land or with crops that are traditionally used as food. Private and public interest in these biofuels is strong and investments in and support for their development are rising. Fuel production per se is reported to be relatively cost effective; but capital costs for the required industrial plants continue to be prohibitively high. Once these fuels become more competitive, the market for biofuels is expected to undergo further changes and conventional bioethanol and biodiesel could lose their current appeal.

In this context the position of palm oil based biofuel can be described as follows. On purely technical grounds, the majority of vegetable oils are suitable for biodiesel production; the level of profitability depends on production costs and other economic parameters. There is general consensus that - in the absence of subsidies - palm oil is by far the most competitive vegetable oil for the production of biodiesel. Nonetheless, to date the use of palm oil as biodiesel feedstock has been rather modest; current estimates indicate the following shares at the global level:

<i>biodiesel produced from</i>		
- palm oil	1	%
- rapeseed oil	84	%
- sunflower oil	13	%
- soybean and other oils	2	%

The reason for the dominant role of rapeseed oil - a relatively high priced feedstock - is to be found in the high level of public support provided in EU countries where rapeseed oil from domestic sources represents the main feedstock for biofuel production. In fact, in the absence of public support, rapeseed based biodiesel should not be competitive, even on a long term basis.

First studies have been conducted to calculate country and feedstock specific threshold prices indicating at which level of fossil fuel prices biofuel production becomes economically viable; based on two such studies, the following ranking of different raw materials for biofuels emerges (indicating increasing threshold prices or decreasing economic viability, at conditions prevailing in 2005/06):

	<i>feedstock</i>	<i>reference country</i>
1 st	sugar cane	Brazil
2 nd	cassava	Thailand
3 rd	palm oil	Malaysia
4 th	maize	USA
5 th	sugar beet	EU
6 th	rapeseed oil	Canada
7 th	rapeseed oil	EU
8 th	wheat	EU or USA
9 th	synthetic fuel (BtL)	-

The overview shows that palm oil ranks high compared to other vegetable oils as well as grains. Furthermore, it can be noted that the threshold price of a given feedstock can vary depending on where it is produced; in fact, the threshold prices obtained for, respectively, Canadian and European rape oil differ significantly.

4. Biofuel consumption in the European Union – linkages with the global oilseed and vegetable oil market

The EU - one of the world's main biofuel consuming regions - has witnessed strong growth rates in biofuel production in the last ten years (see [figure 20](#)). The bulk of biofuel demand is met by biodiesel produced from domestically grown rapeseed. To date no or only minimal quantities of biofuel have been imported. Current levels of biofuel consumption and production differ considerably between member countries, with the highest degree of market penetration found in those countries where producers of biofuel enjoy high levels of direct and indirect public support.

Various forecasts are available regarding the rise of biofuel production and consumption in the EU over the next years - all of them subject to a high degree of uncertainty as it is not possible to accurately predict future levels of biofuel blending (resulting from voluntary or, possibly, mandatory regulations) as well as the level of public support granted to producers of biofuel and biofuel feedstock in member countries.

This paper refrains from providing estimates and presenting alternative scenarios for future biofuel consumption in the EU; instead, attention is drawn to two specific issues that are of particular relevance for global trade in vegetable oil:

- first, the increasing absorption of domestically produced rapeseed oil for biodiesel uses has led to a considerable gap in EU food oil supplies, resulting in increased import demand;
- second, various projections of future EU biofuel consumption seem to imply a need to produce biodiesel from imported raw material as opposed to local sources. While such assessments may not be in line with the current expectations of EU Commission, they do seem to reflect current sentiments in the global market and help to explain the on-going investment in export oriented biofuel and biofuel feedstock production in a number of countries.

With regard to filling the EU's growing gap in food oil supply, a rough quantification of the deficit shows the following: over the last 3-4 years, oil imports for food - carried out to compensate for rapeseed going to biodiesel - have increased by a total of about 2.5 million tons, significantly exceeding historic growth rates. Sourcing such additional amounts of vegetable oil on the world market is not a trivial affair and, in fact, has led, in the last 2-3 years, to considerable price rises at the global level, especially with regard to sunflower oil. The EU's additional medium to long term import requirements are tentatively estimated at 1.0 and 1.5 million tons by 2010 and 2015 respectively.

Possible sources at the international level include the following:

- sunflower oil: however, availabilities of that oil are rather limited as shown by its recent and still on-going price surge;
- soybean oil: world export availabilities of this oil are more abundant, but EU consumers tend to reject GM soyoil for food use;
- palm oil: EU palm oil imports have already doubled during the 2000-2006 period, mostly to substitute for rapeseed oil diverted from food to fuel uses; the potential for further growth of palm oil imports for food use seems to be uncertain considering the oil's limited applications in the food industry.

In view of the constraints identified above (with respect to filling future gaps in EU food oil supplies), it appears questionable whether the diversion of domestic rapeseed oil into fuel uses is going to continue expanding at the current pace.

A closer look at the second issue, that is the possibility of importing biodiesel feedstock or biodiesel itself into the EU, also reveals some constraints. First, a rough attempt to quantify the EU's possible import requirement: depending on various assumptions, annual import requirements during the period 2010-2015 are estimated to move in the range of 1-4 million tons of biodiesel (or equivalent amounts of oilseeds or vegetable oil to be used as feedstock). If low biofuel blending rates and a gradual reduction in national subsidies are assumed, this estimate could be narrowed down to an additional import requirement of 1.0 and 1.5 million tons by 2010 and 2015 respectively.

Possible forms of supply include the importation of (i) oilseeds, to be crushed and turned into biodiesel, (ii) vegetable oils for processing into biodiesel, and (iii) biodiesel, for direct blending with fossil fuels. As to possible sources of supply the following picture emerges: globally, the number of countries getting prepared to produce biodiesel from locally produced vegetable oils and fats is expanding quickly, partly encouraged by some form of government support. However, in many of these countries, policies tend to be geared towards supplying the domestic fuel market so as to promote renewable energy use or reduce fossil fuel imports. Brazil and the United States, for example, are both major exporters of soya beans and oil for food uses; however, as far as biofuel feedstock goes, national policies encourage production for the domestic market rather than for exportation. Similarly, rapeseed exporters such as Canada and Australia seem to prefer satisfying demand for food purposes as opposed to fuel uses. And with regard to developing countries, their export potential is generally limited due to the absence of export incentive measures, poor transport and shipping infrastructure and other constraints. At this moment, the main exceptions and thus possible suppliers of biodiesel or biodiesel feedstock to the EU appear to be Argentina (soy oil) and Malaysia and Indonesia (palm oil). All three countries have significant exportable surpluses over and above their internal biodiesel demand. Although concrete policies and strategies for the exportation of biodiesel or biodiesel feedstock still need to be formulated in these countries, some export measures are in place to favour the exportation of processed, value-added products and refined oils or biodiesel could benefit from these measures.

As to the treatment of imports into the EU, the current situation is as follows. With regard to do border measures, no particular import barriers apply: when imported for industrial uses, tariffs on oilseeds and oils as well as on biodiesel are close to zero. However, a number of technical requirements are applied in the market, posing considerable hurdles:

- most, importantly, in the EU, biodiesel use has always been geared towards rapeseed-biodiesel; consequently, biodiesel from other oilcrops, including soy and palm, does not comply with official EU standards which have been designed to fit rapeseed;
- diesel from other feedstock tends to be technically inferior and may require some modifications of car engines; in particular, conventional palm oil biodiesel cannot be used in cold climates.

As modifications in the EU's technical standards in favour of alternative biofuel feedstock may not come forward quickly, suppliers like Malaysia, Indonesia and Argentina may have no choice but to scale down their expectations regarding the EU's import demand and to adapt as quickly as possible to the EU's technical requirements.

5. Related issues on sustainable production

As production of biofuels from agricultural commodities is expanding, concerns about social and environmental implications are also rising. Introduction of biofuel crops on existing arable land implies competition with other crop uses - especially food purposes - and requires the use of intensive cultivation methods; and where expansion of production involves opening up of new land there is the risk of moving into areas with fragile, marginal land or high-value forests.⁵

⁵ The case of oil palm is discussed here to further illustrate the issue - although these issues are not unique to oil palm; in fact, other crops, including annual, temperate zone crops, are confronted with similar problems.

Overall, palm oil appears to be well suited for biodiesel production - for use in producing countries and potentially also for import into deficit countries such as the EU. Growing demand for biodiesel can therefore be expected to trigger further expansion in palm oil production. However, concerns about the environmental and social sustainability of the sector's further expansion are growing among civil society groups, policy makers and market players alike. In particular, continued expansion of cultivation in South East Asia (i.e. the region with the highest growth potential) is reported to potentially result in

- conversion of large areas of forest with high conservation value,
- threats to biodiversity, wildlife and ecosystems,
- use of fire for land preparation, leading to adverse climatic effects,
- social conflicts between local communities and external players.

The merits of the above listed perceived threats associated with expanding oil palm cultivation shall not be discussed here. Instead attention is drawn to concrete repercussions on markets. In the EU, palm oil imports - especially when for non-food uses but also in general – are increasingly facing image problems. Consumer groups are voicing concerns about the sustainability of current palm oil production methods and the industry and policy makers are under pressure to respond to these consumer sentiments.

An interesting initiative in this regards is - the 'Roundtable on Sustainable Palm Oil'. The RSPO was established in 2004 with the goal to promote the production and use of sustainable palm oil products. This goal is to be achieved through the development, implementation and verification of credible global standards. The initiative is enjoying a growing membership that now includes major stakeholders from all parts of the commodity chain in both, producing and consuming countries. Recently, RSPO has issued a set of comprehensive principles and criteria for sustainable palm oil production and it is now working on the actual application of the principles. Attention is being given to the principles' adoption and implementation in individual producing countries as well as to the specific requirements of smallholder palm oil production. As the end goal is to show to palm oil consumers and customers that the product they are using has been produced in a sustainable manner, another key issue is certification and traceability. Various possibilities of managing the supply chain and achieving traceability of sustainably produced palm oil are currently being explored.

Still outstanding challenges include the full engagement of policy makers, with a view to obtain formal recognition. Furthermore, greater international support and coordination by neutral inter-governmental technical agencies could be helpful. Overall, the palm oil initiative seems to be yielding interesting results and lessons that could be applied also to other commodity sectors. Further progress in this field could help reducing current obstacles to international trade in palm oil earmarked for biofuel production.

ANNEX: Figures

Fig 1 : Global palm oil production and trade

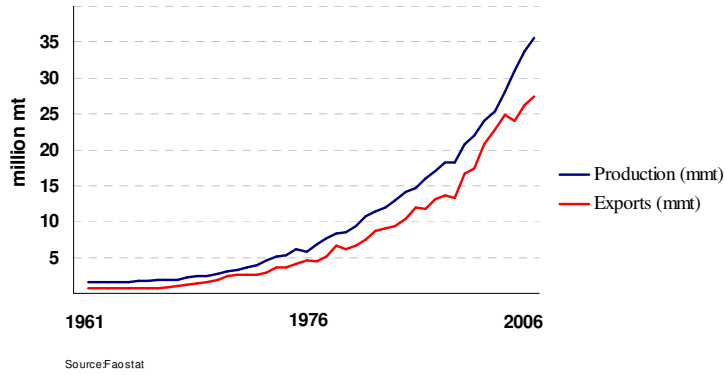


Fig 2 : Expansion of palm oil versus other oils/fats

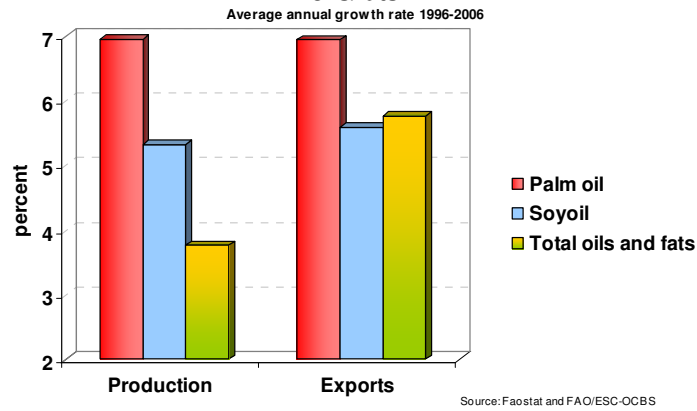


Fig 3 : Global vegetable oil production pattern, 1983 vs. 2003

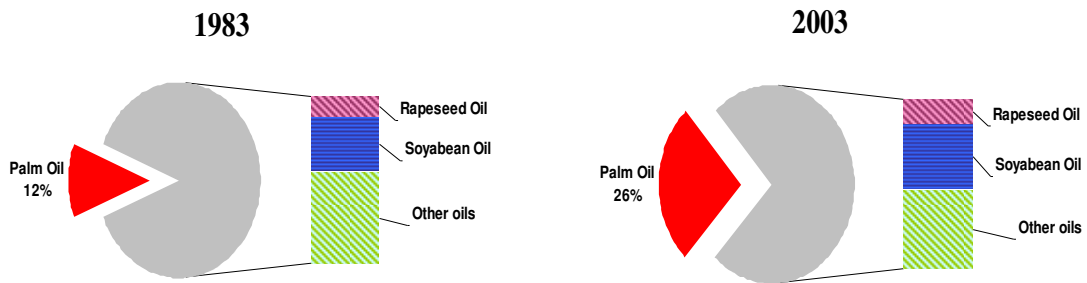
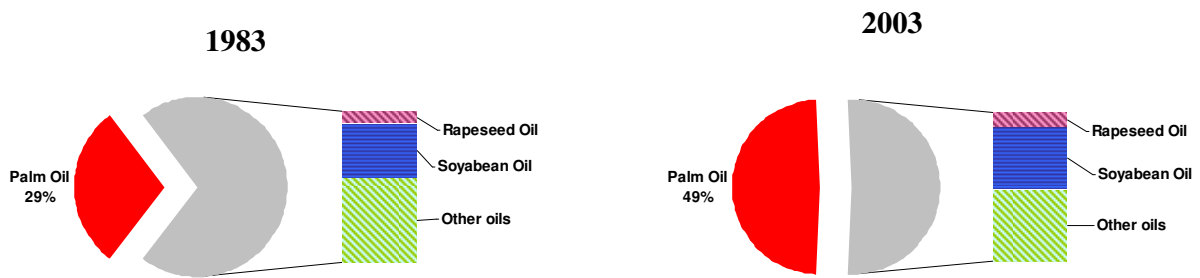
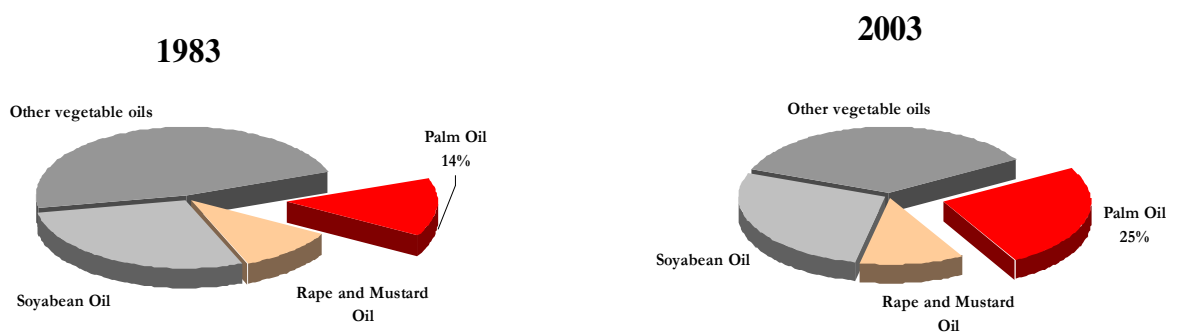


Fig 4 : Global vegetable oil trade pattern, 1983 vs. 2003



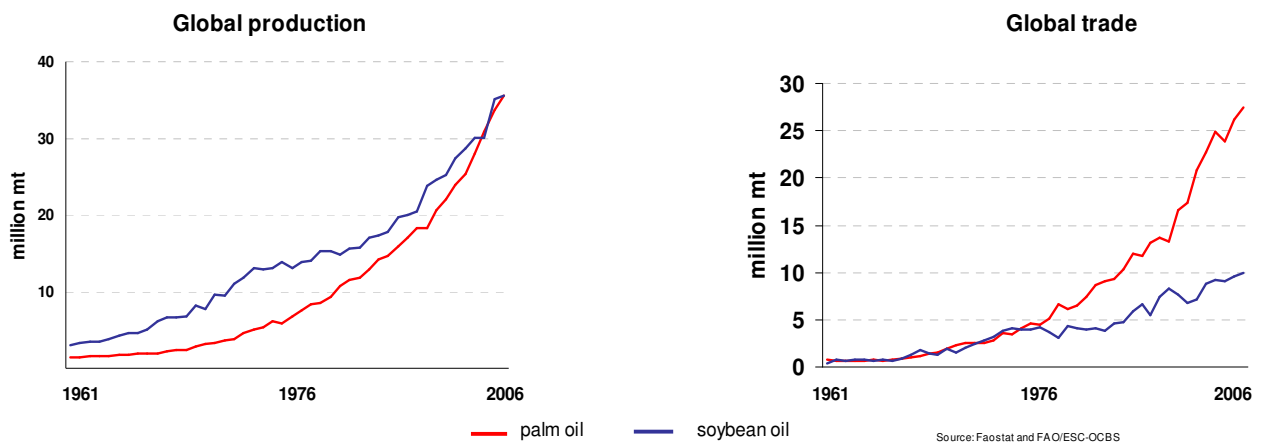
Source: Faostat

Fig 5 : Global vegetable oil consumption pattern, 1983 vs. 2003



Source: Faostat

Fig 6 : Palm oil vs. soy oil - global production and trade



Source: Faostat and FAO/ESC-OCBS

Fig 7 : Global trade-to-production ratio

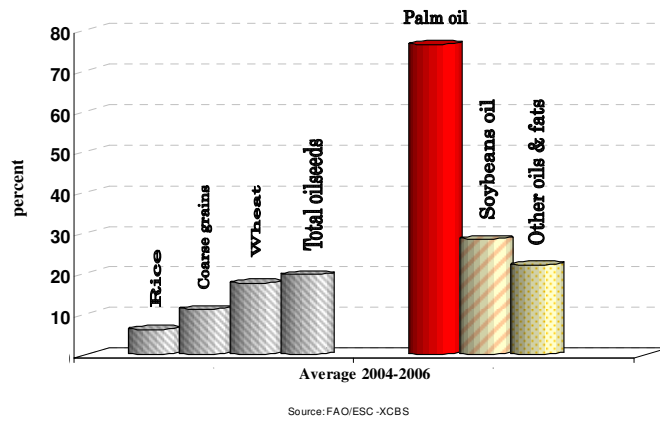


Fig 8 : Oilcrop yields

oil per ha per year, 2004-2006 average

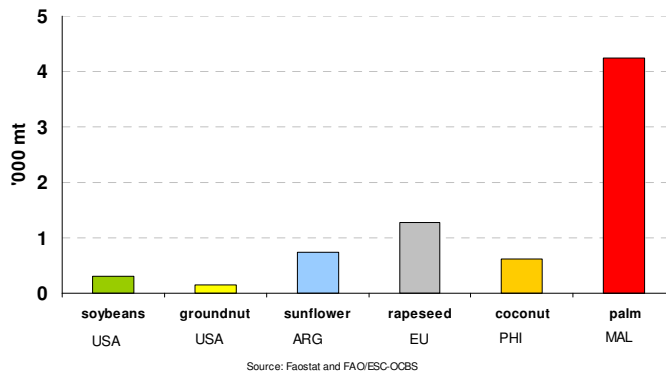


Fig 9 : World prices for selected vegetable oils (nominal)

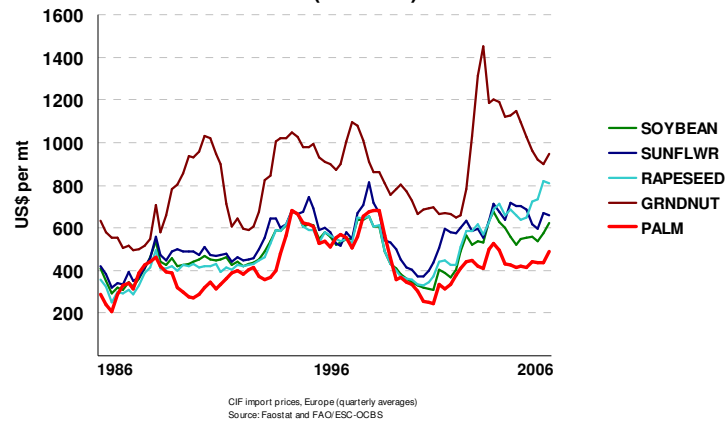


Fig 10 : Palm oil vs. soy oil - price discount / premium

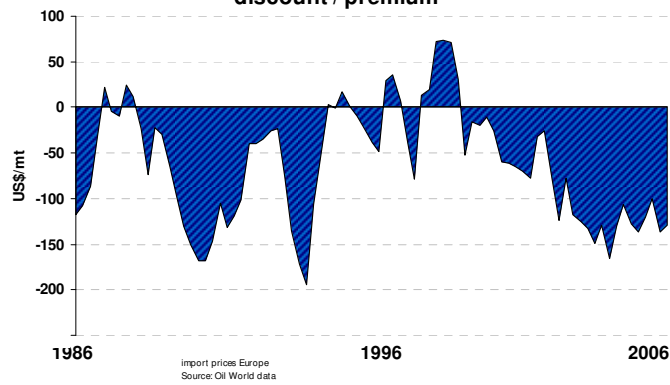


Fig 11 : Palm oil price 1999 - 2006

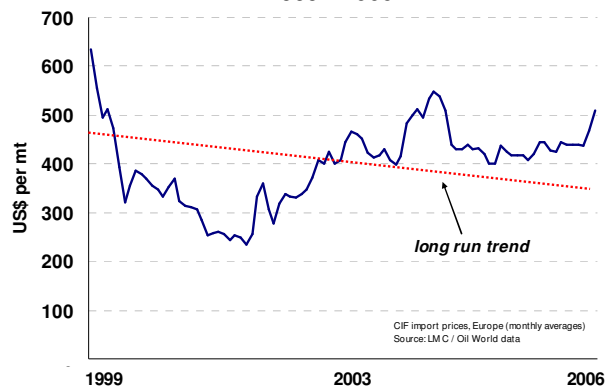


Fig 12 : Global vegetable oil market (average annual growth rate)

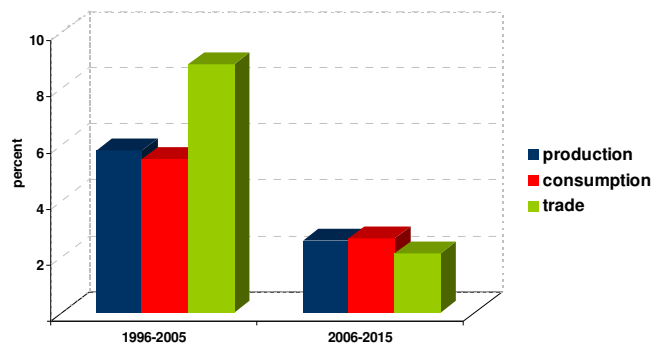
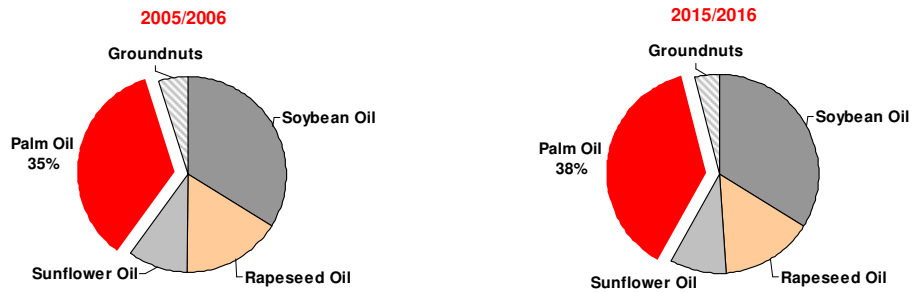
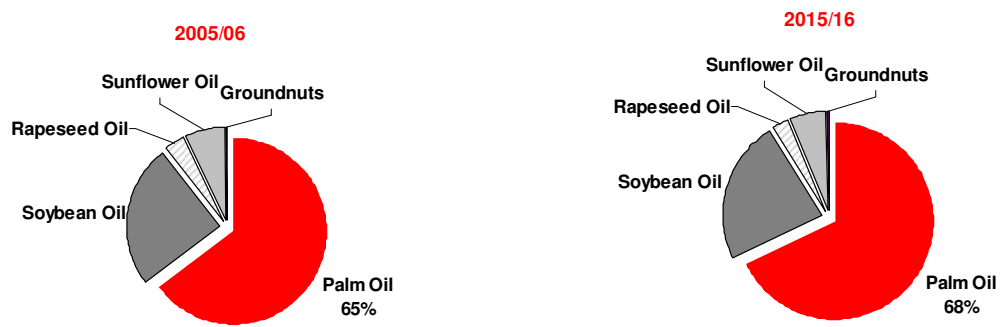


Fig 13 : Global vegetable oil supply pattern, 2005/06 versus 2015/16



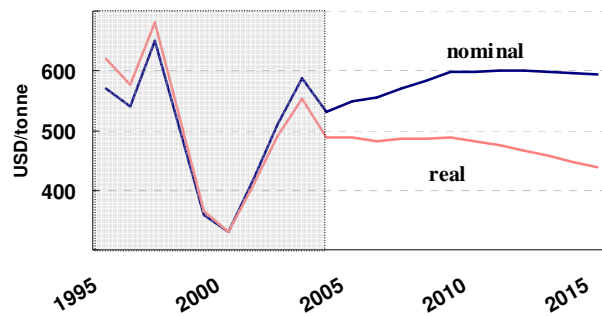
Source: FAO data

Fig 14 : Global vegetable oil trade pattern, 2005/06 versus 2015/16



Source: FAO data

Fig 15 : Vegetable oil price projection, FAO



Weighted average import price, Europe
 All prices deflated by the USA GDP deflator with 2000=1
 Source: OECD and FAO Secretariats

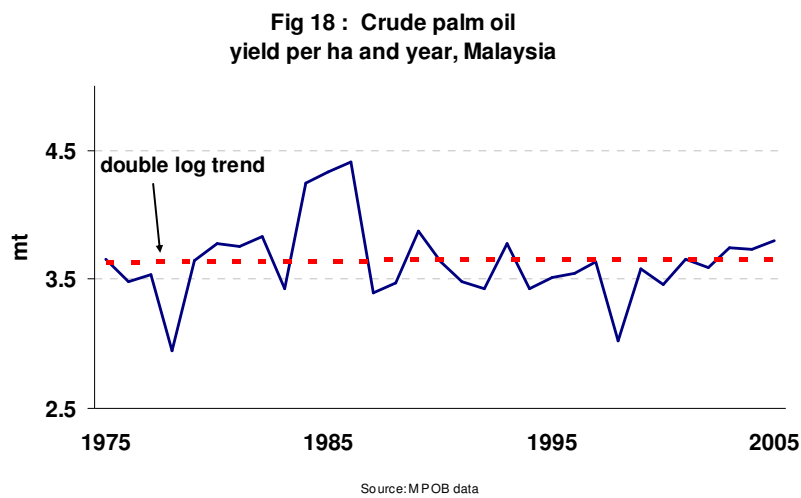
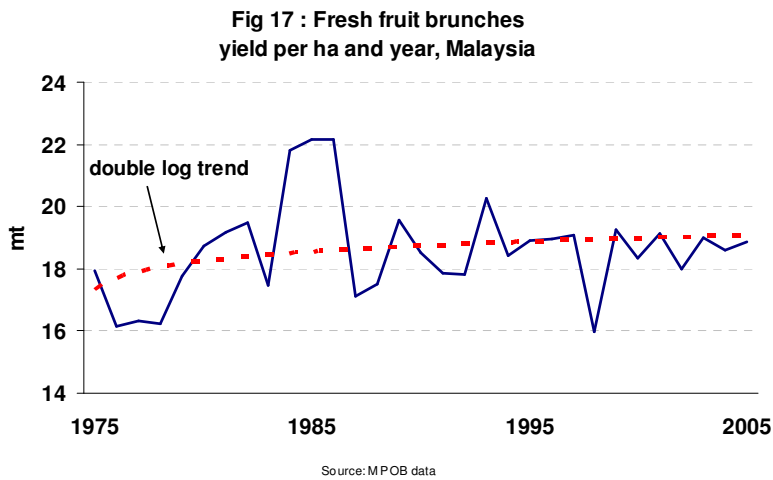
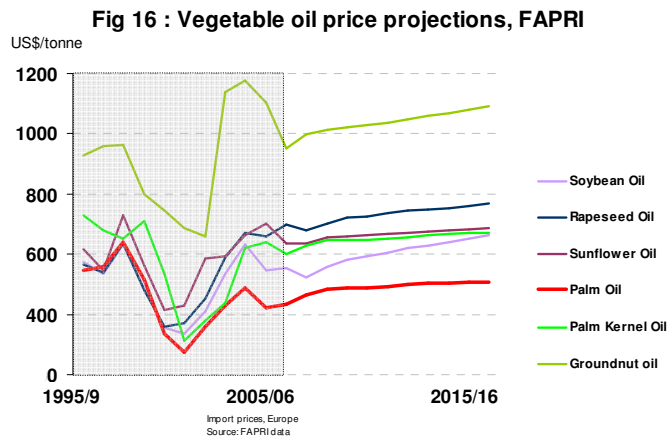
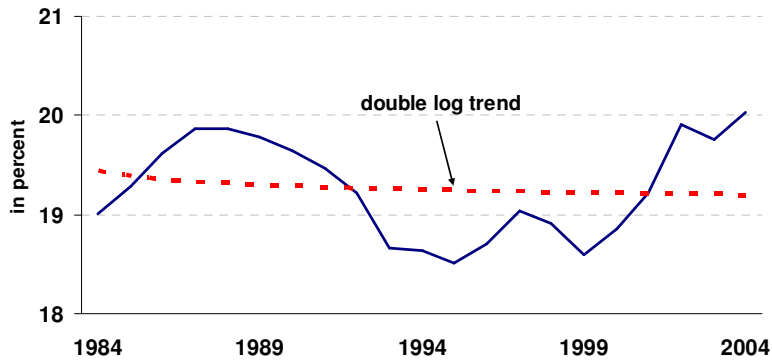
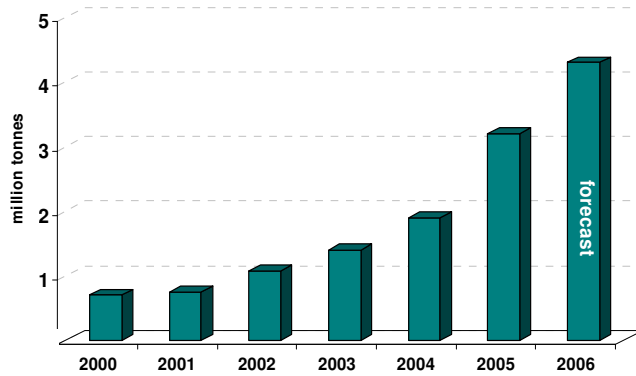


Fig 19 : Palm oil extraction rate, Malaysia



Source: MPOB data

Fig 20 : European Union (25) biodiesel production



Source: EBB and own estimates