elobio

Biofuel policies for dynamic markets

Induced market disturbances related to biofuels

Report D2.2 of ELOBIO subtask 2.3

Intelligent Energy Europe

Induced market disturbances related to biofuels

Report of ELOBIO subtask 2.3

Authors

Luc Pelkmans, VITO
Kris Kessels, VITO
Tjasa Bole, ECN

Partner / Institute

VITO - Flemish Institute for Technological Research
Unit Transition Energy & Environment
Boeretang 200
BE-2400 Mol
Belgium

Contacts main author:

Tel. +32 14 33.58.30
Fax +32 14 32.11.85
luc.pelkmans@vito.be

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Executive summary

The ELOBIO project aims at the development of low-disturbing policy options, enhancing biofuels while minimising the impacts on e.g. markets for food, feed, and biomass for power and heat. This report shows the result of task 2.3 of the project. In this task the status of knowledge of induced market disturbances of biofuels towards feed, food and other markets are described.

Increasing biofuel production has significant impacts on agricultural markets, including the trade in agricultural commodities, either due to pure market forces and/or policy decisions. There are also other linkages between food and biofuel production, including the competition for land and for other production inputs. The effect of an increasing supply of by-products of biofuel production also affects other markets, but then in a different way, such as those for animal feed where import of soymeal can be replaced by local rapemeal.

In recent years the worldwide production and consumption of biofuels has grown rapidly. Bio-ethanol and biodiesel are the main biofuels, with ethanol reaching a production level of 66 billion litres in 2008 (mainly concentrated in the United States and Brazil), and biodiesel reaching a production level of 15 billion litres in 2008 (mainly concentrated in Europe, but markets in North and South America are emerging).

Current biofuels are derived from existing agricultural commodities, which differ by region. In the United States the main feedstock for ethanol is corn, biodiesel in the US is mostly produced from soybean oil. Brazil uses sugarcane to produce ethanol, for its emerging biodiesel production they mostly rely on soybean oil. Europe produces its biodiesel primarily from rapeseed oil, ethanol is mostly produced from wheat or sugar beet. South-East Asia is considering using palm oil for biodiesel, however amounts used are still modest.

Looking at the business case for biofuels, feedstock costs are the most significant item in biofuel production, ranging from 50 to 80% of total production costs. Another major cost component is energy (in agriculture, process energy and transport/distribution). Both feedstock and energy prices have increased sharply in 2007-2008, so profitability of the biofuels sector was getting tight or even negative in some cases, despite of supportive policies.
The outlook for global biofuels in the future will depend on a number of interrelated factors, including the future price of oil, availability of low-cost feedstocks, sustained commitment to supportive policies by governments, technological breakthroughs that could reduce the cost of future generation biofuels and competition from unconventional fossil fuel alternatives.

Food versus fuel?

Agricultural commodity prices have increased tremendously in the past years. Between mid 2006 and mid 2008 most agricultural commodity prices have actually doubled or tripled (expressed in US$/tonne). Several causes seem to have played a role at the same time:

- increase of crude oil prices from 50 to over 140 $US per barrel,
- decrease of the value of the US dollar, as most markets are traded on this currency,
- speculation by the financial sector in agricultural commodities ("self-fulfilling prophecy" of increasing prices). This also seems to be linked to the low value of the US dollar,
- export restrictions in certain countries as a response to expected global shortages e.g.

some countries banned exports,
- growing economies in Asia, with increasing demand for energy and food, and changing diets (e.g. increased consumption to meat),
- low crop yields in certain regions due to bad weather circumstances (e.g. Australia in 2006-2007 whose grain harvest fell more than 50%),
- decrease of stocks in the past years (not controlled by governments anymore, but by commercial parties who have interest in increasing prices),
- growing demand for biofuels.

Since summer 2008, commodity prices have dropped again. Again different causes have played a role, but now in the other direction: the worldwide financial crisis has lowered energy demand and economic growth rates in emerging countries, reducing prices of crude oil and other commodities; crop production was again at normal level (while 2006 and 2007 were exceptionally bad, especially in Australia), so stocks could be filled again; speculative markets have reduced with the financial crisis.

Nevertheless through the introduction of biofuels, there is now a direct link between agricultural commodity prices and crude oil prices. Thus, if crude oil prices remain high, in the long run, biofuel feedstock prices will experience an upward pressure as well. If we continue to rely on biofuel feedstocks that are used directly to produce food or that are produced on land that would be producing food, then we will strengthen the direct link between crude oil prices and food prices. There may be some disagreement about the magnitude of the impact on food prices from biofuels, but there is no disagreement that there is an impact.
Different studies have attempted to quantify the future price impact of biofuels on commodity markets. None of the studies predicts structural price effects of the magnitude of the price peak of agricultural commodities we have witnessed in the past two years. The effects predicted are of the order of a few percents to a maximum of some 75% in the case of a very high share of total transport fuels coming from biofuels in all major transport fuel consuming countries, supposing the agricultural production system does not respond to this additional demand. All studies point out that a combination of factors contribute to the rise of commodity prices. It is very hard to quantify the separate impacts. Besides, the impact on world prices is also commodity specific: vegetable oils, cereals and sugar, for example, respond differently.

We looked at typical cases where biofuel markets had possible interference with food and feed markets. Cases considered are corn, wheat and sugarcane for ethanol; rapeseed, palm oil and soybean oil for biodiesel.

Corn for ethanol in the United States:
The United States accounts for roughly 40% of world corn production, and is also the world's dominant corn exporter (55-60% of global corn trade), followed by Argentina and Brazil. While the U.S. dominates world corn trade, exports only account for a relatively small portion of U.S. corn use (about 20%). This means that corn prices are largely determined by supply and demand relationships in the U.S. market, and the rest of the world must adjust to prevailing U.S. prices. As a result, the amount of corn grown in the United States and the share of corn used for domestic consumption versus exports, has significant impact on international corn prices.
Corn use for ethanol represented 28% of USA corn production in 2008. Nevertheless the availability of US corn for food, feed or export markets has not diminished so far with rising

corn production. There was however an indirect effect in 2008, causing a lower production of soybean, as grains and soybeans can be grown on the same land (and soybean was less attractive for the US farmer because of higher corn prices). So there was indeed an import increase of soybean to the US, and a diminishment of stocks.

Corn and wheat for ethanol in China and the EU:
In the rest of the world (outside the US), the use of grains for ethanol is rather low. About 2.6% of European wheat production was used for ethanol production in 2008. This has an insignificant effect on availability of EU wheat for food, feed or export markets as most of the increase is covered by yield increases and extra land availability in East Europe.
In China 1.5% of Chinese grain production (mainly corn) was used for ethanol in 2007-2008. While this number is also marginal, in response to high food prices, the government in 2007 suspended new ethanol projects based on edible grains, including any plans to expand existing plants.

Sugarcane for ethanol in Brazil
Brazil uses some 50% of its sugar cane output to produce fuel ethanol, both for domestic use and export. The impact on the sugar market is presently limited due to the current global sugar surplus. Brazil has no fundamental feedstock problems as it has ample space to extend its sugarcane production (outside rainforest regions). Nevertheless there are some concerns for this expansion. The expansion could happen on degraded grass planes, but there is a risk that fields in the natural Cerrado area or surroundings could be claimed for sugar cane expansion. Furthermore there could be indirect effect that extensive livestock breeding would shift to the north.

It is cheaper to produce ethanol from sugarcane in Brazil, than to produce it from corn in the US or wheat in the EU. The energy balance also is much more positive. This gives Brazil a competitive advantage worldwide. The country is currently the only major exporter of bioethanol.
In the past, there seemed to be a price link between sugar, ethanol and petrol. However since 2006, sugar prices have behaved differently from the crude oil prices and the link is less pronounced. On the contrary, the price of sugar determines the price of ethanol on world markets. The result is that high feedstock prices of grains are making ethanol production from these feedstocks less profitable, especially in Europe. So higher subsidies and import tariffs would be needed to compete with Brazilian ethanol.

Vegetable oil for biodiesel
In the past decades there has been a steady growth in the use of vegetable oils, with a prominent role for palm oil, soybean oil and rapeseed oil. While there is a growing role for industrial and biofuel use, food still accounts for 60% of the annual growth of vegetable oil use in the past 5 years. Worldwide about 9% of worldwide vegetable oil production is used to produce biodiesel.

Rapeseed oil for biodiesel in Europe
Europe has been the main player in biodiesel for a long time. Biodiesel was promoted in the 1990s, mostly to offer alternative outlets for agriculture, which was facing overproduction at that time. The bulk of biofuel demand in Europe is met by biodiesel produced from domestically grown rapeseed. About 65% of its vegetable oil production is used for biodiesel in 2008. The reason for the dominant role of rapeseed oil is to be found in the tradition of producing rapeseed, its technical properties, and the high level of public support provided in EU countries. The increasing demand from the biodiesel sector is tightening the EU's

vegetable oil balance, making feedstock imports for biodiesel production necessary. There are also imbalances on the market, e.g. with imported subsidized biodiesel from the US ('B99'), undermining the competitiveness of the European biodiesel industry. With the discussion on sustainability of biofuels, and increasing prices of biodiesel feedstocks, the biodiesel market in Europe is somewhat stagnating currently.

Soybean oil for biodiesel in North and South America

Only in recent years (mainly from 2005) other regions in the world started to introduce biodiesel in their diesel markets. Until 2005 industrial use of soybean oil was marginal. After 2005 its industrial use is growing, mainly for biodiesel production in the USA and South America. Soybean oil use for food still grows at the same time. Biodiesel producers in South America benefit from a large exportable soy oil surplus, part of it is also targeting export to the European market.

While soybeans are not the most efficient crop solely for the production of biodiesel, their common production and use for food products has led to soybean biodiesel becoming the primary source for biodiesel in the US. Soybean producers have lobbied to increase awareness of soybean biodiesel, expanding the market for their product.

Prices of soybean and soybean oil have increased very fast between mid 2007 and mid 2008. Nevertheless it should be mentioned that prices were very low between 1998 and 2006.

Palm oil for biodiesel in South-East Asia

Global palm oil production and trade have risen sharply and continuously from the 1970s onward. Around 80-85% of worldwide palm oil is produced in Indonesia and Malaysia, and most of it is exported to the rest of the world for food purposes. The global use of palm oil for food has actually doubled in the past 8 years. Since 2003 industrial applications are also growing, this may be partly related to biodiesel production, partly to other oleochemical applications. It should be stated that less than 3% of worldwide palm oil production is currently used for biodiesel production.

Palm oil might be the beneficiary from the expected biodiesel shortfalls in EU as demand for rapeseed oil exceeds supply. Ultimately, the relative prices of crude and vegetable oil, along with subsidy and trade policies in the United States and the European Union will determine the size of Indonesia's and Malaysia's export markets and, in turn, the investments in oil palm plantations. As there is strong opposition in Europe against the use of palm oil for biodiesel (as a link is made to deforestation), it is very likely that palm oil use for biodiesel will be limited through sustainability requirements,

Conclusions

Biofuel policies were often blamed as the primary reason for the commodity price increases in 2007-2008. Nevertheless things should be put into perspective and it is clear that combination of factors have contributed to the rise of commodity prices.

When looking at the amount of feedstock currently used for biofuel production, we can state that biofuels use significant commodity shares of sugar cane in Brazil, corn in the USA and vegetable oil (rapeseed) in the EU. While the sugar market currently seems less linked to energy prices, worldwide markets of corn and vegetable oils were noticeably influenced by the recent growth of biofuels. For the other commodities the effect should be marginal or indirect, although larger impacts may be seen in the future when biofuel shares go up to levels in the order of 10%.

For the possible conflict between food and fuel, land use is also mentioned as an important parameter. Nevertheless this should also be put into perspective: total worldwide land used for biofuel feedstocks was around 20 million hectares in 2007 (most in USA, Brazil and EU). This compares to a total use of agricultural land of 1500 million hectares worldwide. Growth of land use for biofuels or bio-energy should not necessarily lead to reduced availability of agricultural land - increased prices could even trigger more efficient use of agricultural land.

1 Introduction

The current market introduction of biofuels coincides with significant price increases on other commodity markets. However it is not clear to what extend biofuels really cause an increased demand for raw materials and thus an important price impact for all alternative applications of these raw materials. While the introduction of biofuels will have a positive impact on some of the related markets and negative on others, the magnitude of this impact needs to be analysed in more detail. Although at this stage, the European biofuel industry does not seem to be a threat to global food production, real concerns exist to what might happen in the future if the current biofuels expansion rates persist. Future growth rates must take due account of the feedback loops that exist between the profitability of biofuel production and feedstock cost, as well as a number of uncertainty factors that will affect the availability and price of raw material for everyone. Such factors include physical aspects of production (land availability, yields, crushing capacities), market factors (e.g. concentration, price elasticity of demand, availability of substitutes), governmental interference (subsidy levels) and international trade agreements.
It is important to avoid policy-induced market disturbances as these can become a major barrier for industry and public support for biofuels. The ELOBIO project aims at the development of low-disturbing policy options, enhancing biofuels while minimising the impacts on e.g. markets for food, feed, and biomass for power and heat. This report shows the result of task 2.3 of the ELOBIO project. In this task the status of knowledge of induced market disturbances towards feed, food and other markets will be described. Possible market interferences of various biofuels and feedstocks for biofuels will be described in general and some cases will be treated in more depth, documented with market figures.

In a next stage of the ELOBIO project - that is outside the scope of this report - the outcomes of the initial study will be used as input for stakeholder-supported development of low-disturbing biofuels policies, using model-supported assessment of these policies' impacts on food & feed markets, as well as model-supported analysis of the relations between the biofuels policies and ligno-cellulosic markets.

2 Induced market disturbances: general

Increasing biofuel production either due to pure market forces and/or policy decisions has significant impacts on agricultural markets, including the trade in agricultural commodities. There are also other linkages between food and biofuel production, including the competition for land, but also for other production inputs. The effect of an increasing supply of by-products of biofuel production also affects other markets. In this section an overview is given of the evolution of biofuel production. Next the possible implications of biofuel introduction on world food and feed markets will be described.

2.1 Introduction: biofuel production

Worldwide production of biofuels is growing rapidly (see Figure 1). Rising world fuel prices, the growing demand for energy, and concerns about global warning are the key factors driving interest in renewable energy sources and in bioenergy in particular.

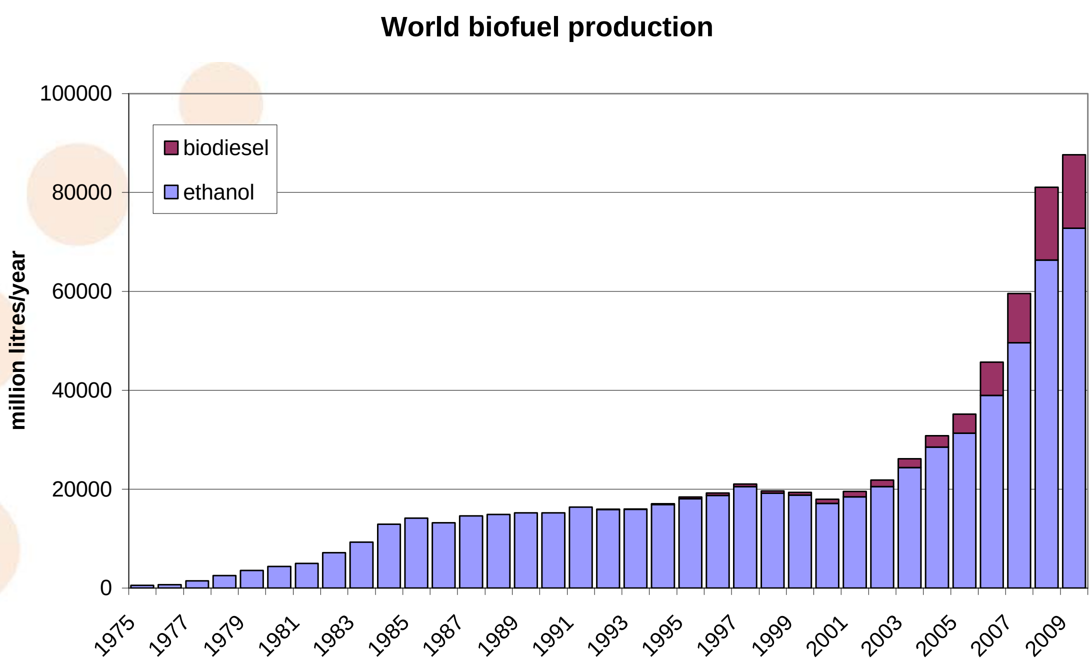

Figure 1: World biofuel production (2009 values are projected), data derived from [F.O.Licht's, 2009]

The production of ethanol and biodiesel is highly concentrated.
Global production of ethanol as fuel was around 66 billion litres in 2008. Of that amount, about 90% was produced in Brazil and the United States (see Figure 2). Brazil uses sugarcane as feedstock, while the United States primarily uses corn.
In addition, about 14.7 billion litres of biodiesel were produced in 2008, of which more than 54% was produced in the European Union (see Figure 3). Rapeseed oil is the main feedstock in this case.

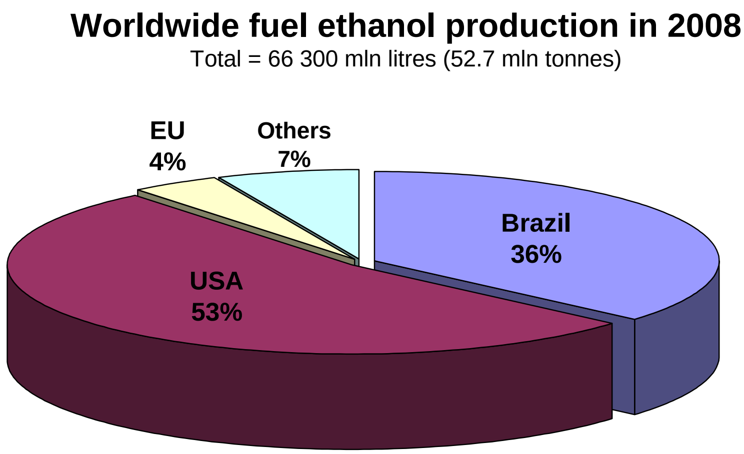

Figure 2: World fuel ethanol production (2008)
data derived from [F.O.Licht's, 2009]

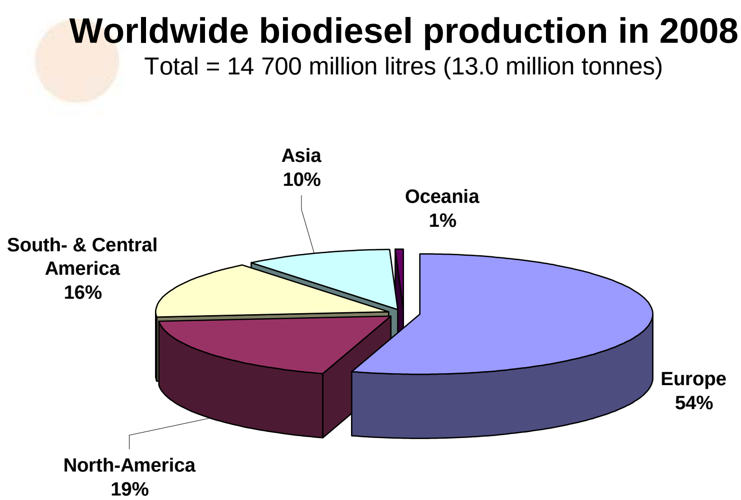

Figure 3: World biodiesel production (2008)
data derived from [F.O.Licht's, 2009]

The outlook for global biofuels will depend on a number of interrelated factors, including the future price of oil, availability of low-cost feedstocks, sustained commitment to supportive policies by governments, technological breakthroughs that could reduce the cost of second-generation biofuels and competition from unconventional fossil fuel alternatives.

Feedstock costs are the most significant cost of biofuel production, ranging from 50-60% for ethanol up to 80-90% for biodiesel [Wiesenthal et al, 2007] in Europe. Another major cost component is energy, which may account for as much as 20% of biofuel operating costs in some countries. The sale or productive use of by-products on the other hand contributes to a biofuel plant's profitability [USDA 2007a].

The following table gives an overview of the most important biofuel producing countries with an indication of the feedstocks used and the amount of biofuels produced.

Table 1: Overview biofuel production and main feedstocks used for selected countries.

Country	**Feedstocks for**		**2008 production (million litres/yr) –** Source: F.O.Licht's	
	Ethanol	**Biodiesel**	**Ethanol**	**Biodiesel**
Brazil	Sugarcane	Soybean, (palm oil, Castor seed)	24 200	1 165
United States	Corn	Soybean, (recycled fats and oil)	34 968	2 693
EU	Wheat, other grains, sugar beet, wine alcohol	Rapeseed, (sunflower, soybeans, recycled fats and oil)	2 822	7 998
China	Corn, wheat, (cassava, sweet sorghum)	Used and imported vegetable oils, Jatropha	1 900	153
Canada	Corn, (wheat, straw)	Animal fat, vegetable oils	950	100
India	Molasses, sugarcane	Jatropha, imported palm oil	350	23
Thailand	Molasses, cassava, sugarcane	Palm oil, used vegetable oil	322	466
Indonesia	Sugarcane, cassava	Palm oil, Jatropha	/	398
Malaysia	/	Palm oil	/	227

2.2 Implications for world food and feed prices

The recent development of the biofuel industry coincides with significant increases in prices of basic commodities such as food and feed. World market prices for major agricultural commodities such as grains and vegetable oils have risen sharply in the last years (see Figure 4). Simultaneously, the biofuel industry has been developing fast, claiming more crops as feedstock for the production of biofuels. These two developments raise questions about the impact of biofuel production on world food and feed markets.

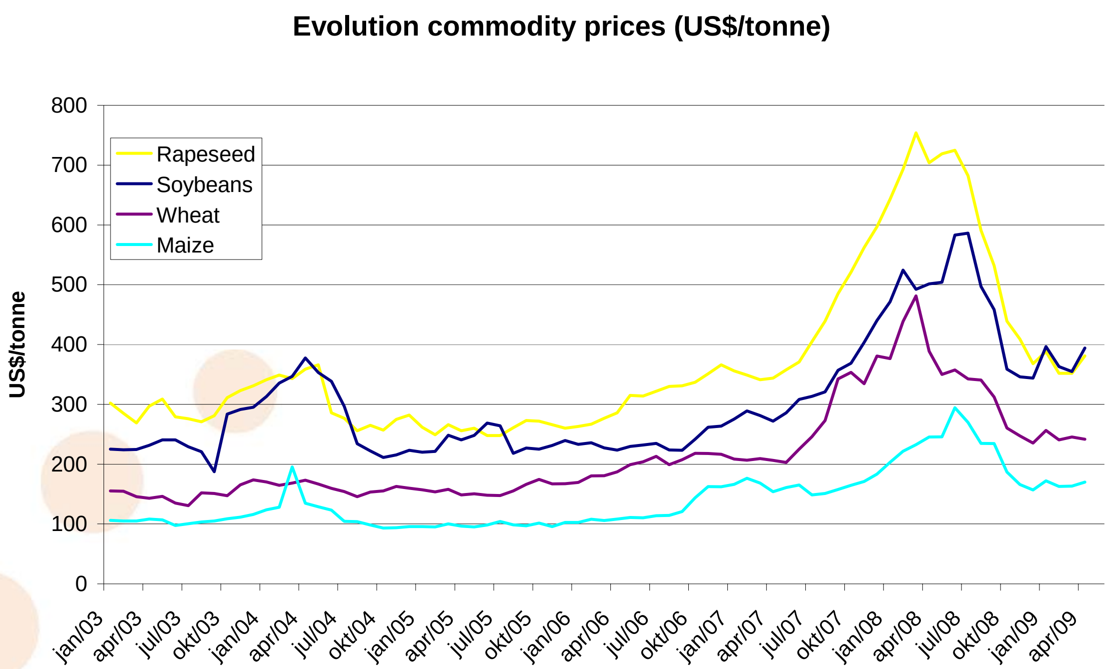

Figure 4: Evolution commodity prices.
data derived from [FAOSTAT, 2009]

Potential demand from energy markets can be large enough to influence the agricultural sector. The size of the influence will depend on how much agricultural produce becomes a competitive source of energy in the overall energy market. At current energy prices, some agricultural feedstocks have already become competitive sources of energy, at least under certain production environments. As a consequence, demand for these feedstocks has expanded and already supports prices for these commodities. Where demand was particularly pronounced as in the case of cane-based ethanol, biofuel demand has created a quasi intervention system and an effective floor price for agricultural commodities – sugar in this case. In some countries, policy incentives to use and/or produce biofuels further added to the demand for agricultural produce and lowered the costs of biofuel production to a point where many otherwise uncompetitive feedstocks became economically viable in the energy market. [FAO 2007b]

2.2.1 Historical evolution of agricultural commodity prices

An important point to stress is that world market prices for agricultural commodities has systematically dropped since the 1980s. This is illustrated in the following figure, which shows the evolution of the IMF food commodities index (January 1992 = 100). Nominal agricultural prices (effective prices) has systematically dropped between 1980 and 2002. Expressed in real prices (corrected for inflation), this means that agricultural prices have actually been halved in this period.

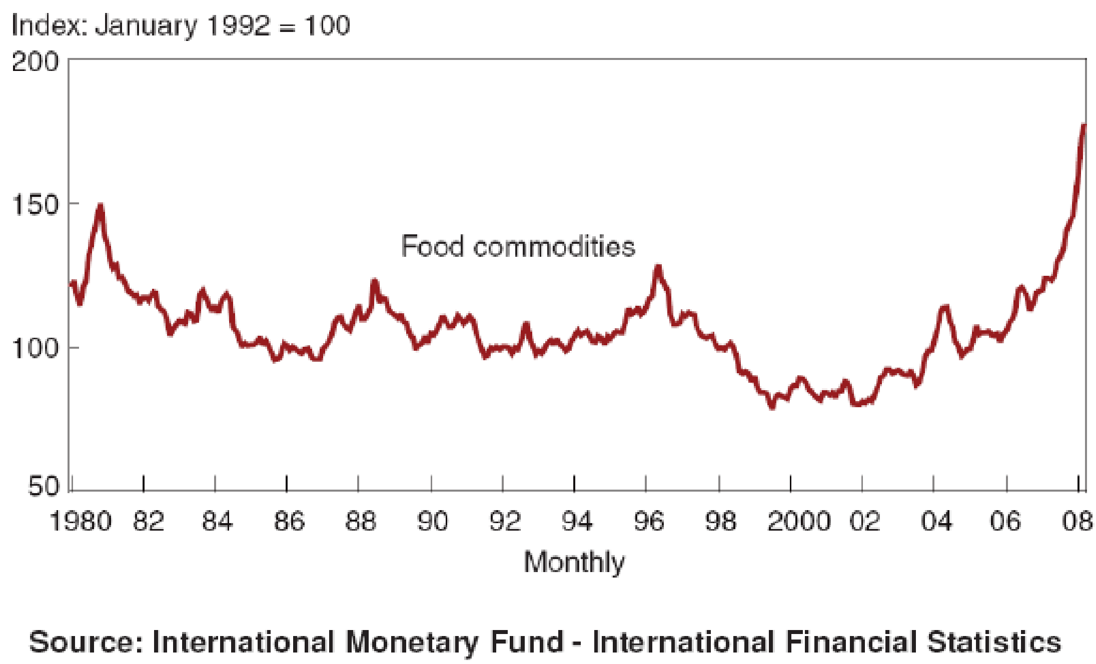

Figure 5: Evolution IMF food commodities index

There are several reasons for this trend, from an increase of scale in agriculture, more intensive farming with higher yields, lower energy costs in the 1980s and 1990s, but also the agricultural subsidy programmes in the EU and the US (with excess production being dumped on the world markets) have contributed to this. In many developing countries it became hardly competitive to grow crops on their agricultural lands, and agricultural policy was often neglected (e.g. in Africa) and no investments were done in agriculture. Countries with an attractive potential for agriculture became food importers in stead of exporters. This is clearly visible in the trade balance of agricultural commodities of the least developed countries (LDC), which evolved from a surplus in the 1960s and 1970s to a large import need. For these countries food security is a real problem when food prices are rising, specifically because the expenditure for food can amount to 50-80% of their income [FAO, 2008].
So this creates an important dilemma. On medium to long term an increase of agricultural commodity prices could give opportunities for local agriculture in developing countries and therefore contribute to the further development and growth of these countries [FAO, 2008]. On the other side a food price increase will be very tough for the poorest, specifically on the short term.

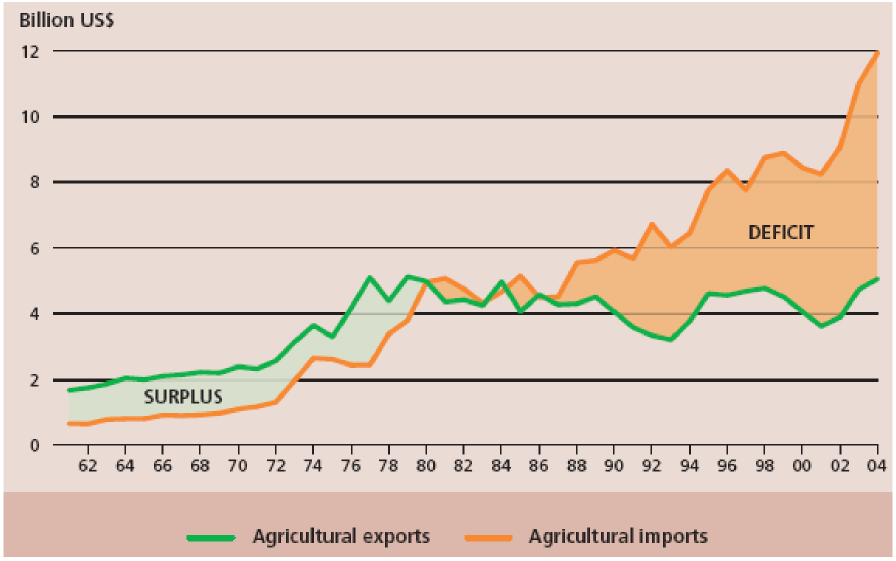

Figure 6: Trade balance of agricultural commodities in the Least Developed Countries (LDC)
[FAO 2008, The State of Food and Agriculture – Biofuels: prospects, risks and opportunities]

In the past years agricultural commodity prices have increased strongly, actually at the same time – but still to a lesser extend - as energy prices. In 2008 average agricultural prices were in real terms back at the level of the 1970s, which means a doubling between 2002 and 2008 (in the same period energy prices have more than tripled).

2.2.2 Factors determining the impact on world food and feed markets

The growing biofuel market represents a new source of demand for agricultural commodities and attributes to the price increase of agricultural commodities. However these price impacts are not straightforward and depend on the market under investigation.

The impact on feedstock markets depends on following factors [ECN 2008]:

- *Relative feedstock consumption:* how much of the total feedstock available is claimed by the biofuel industry ?
- *The purchasing power of the biofuel sector:* the biofuel industry is often a price-taker in food markets which are often highly concentrated with clear market leaders who set the price of the inputs;
- *Responsiveness* of the feedstock (agricultural) sector *to market signals*: in a completely free market situation, farmers should respond to global increases in prices for agricultural commodities by increasing their production. However, output increases have been hampered by export-limiting measures adopted by governments of some important agricultural exporters;
- *Availability of substitutes*: many basic agricultural commodities are highly substitutable among themselves, which means industries will turn to cheaper of the many options, when the one they normally consume increases in price.

Possible price impacts by biofuels on food production costs cannot be directly translated to an increase in consumer prices. Following factors should be taken into account [ECN 2008]:

– The *relative share of feedstock costs in retail price:* what is the share of agricultural input costs in food retail prices?
– *Elasticity of demand:* how will the demand for food respond to changes in prices.

These factors will be taken into account in the cases described in section 3 'Induced market disturbances: cases'.

2.2.3 Factors contributing to the recent increase in food prices.

The above analysis indicates that only part of the recent increase in food prices can be explained by the biofuel industry. There are also other factors at play; these include [USDA 2008a]:

- *Reduced agricultural R&D:* reduced agricultural research and development by governmental and international institutions may have contributed to the slowing growth in crop yields.
- *Increasing agricultural costs of production:* agricultural production costs have risen, especially for energy related inputs such as fertilizer, fuel and pesticides.
- *Higher demand for agricultural commodities:* over the last decade, strong global growth in average income combined with rising population has increased the demand for food, particularly in developing countries.
- *Declining value of the U.S. dollar:* as the dollar loses value relative to the currency of an importing country, it reduces that country's cost of importing. Since the United States is a major source of many agricultural commodities, foreign countries' imports of commodities from the United States began to rise. This put upward pressure on U.S. prices for those commodities.
- Further, since the world price of major crops are typically denominated in U.S. dollars, the depreciation of the dollar also raises prices (measured in dollars).
- *Adverse weather conditions:* adverse weather reduced crop production in some countries, resulting in lower production and contributing to the increase in the price of these commodities.
- *Speculative players entering commodity markets:* after the downturn of financial markets, the interest of hedge funds and sovereign wealth funds has turned to agricultural commodity markets over the last years. By pouring considerable financial resources into agricultural markets they significantly increased their liquidity and thus volatility.
- *Policies adopted by some exporting and importing countries to mitigate their own food price inflation:* the raise in commodity prices caused domestic food prices at the consumer level to rise in many countries. In response to rising food prices, some countries began to take protective policy measures designed to discourage exports. The objective was to increase domestic food supplies and restrain increases in food prices. However, such measures typically force greater adjustments and higher prices onto global markets.

2.2.4 Overview studies on the impact of biofuels on commodity markets.

Through the introduction of biofuels, there is now a direct link between commodity prices and crude oil prices. Thus, if higher crude oil prices are with us to stay, then in the long run, biofuel feedstock prices and oil prices will be interlinked. If we continue to rely on biofuel feedstocks that are used directly to produce food or that are produced on land that would be producing food, then we will strengthen the direct link between crude oil prices and food prices. There may be some disagreement about the magnitude of the impact on food prices from biofuels, but there is no disagreement that there is an impact [Iowa State University 2008].

Different studies have attempted to quantify the price impact of biofuels on commodity markets. It is very hard to quantify the separate impacts. All studies point out that a combination of factors contribute for the rise of commodity prices. Besides, the impact on world prices is also commodity specific.

An overview of the results of different studies is given in the table below:

Table 2: Summary studies estimating price impacts of biofuels on agriculture commodities [ECN, 2008]

Source **(ECN 2008 / ENVIRONMENT 2007 / …)**	**Region**	**Scenario**	**Price impacts**
EC 2007: EC DG Agriculture and Rural development, *'The Impact of a minimum 10% obligation for biofuel use in the EU-27 in 2020 on Agricultural Markets'*, 2007	EU-27	10% biofuels by 2020	+ 3-6% on 2006 cereal + 8-10% rapeseed + 15% sunflower seed
Purdue University 2007 a: Banse, M. et al, *'Impact of EU Biofuel Policies on World Agricultural and Food Markets'*, Paper Submitted for the GTAP Conference, Purdue University, 2007	EU	11% biofuels by 2010	+2% cereals +6% sugar +8% oilseeds
Iowa State University 2006 a: Elobeid, A. et al, *'The Long-Run Impact of Corn-Based Ethanol on the Grain, Oilseed, and Livestock Sectors: A Preliminary Assessment'*, Centre for Agricultural and Rural Development, Iowa State University, Briefing Paper 06-BP 49, 2006	US	20% biofuels by 2015	+58% corn
OECD 2006: OECD, *'Agricultural Markets Impacts of Future Growth in the Production of Biofuels'*, 2006	US, Canada, EU, Brazil	10% biofuels by 2014	+ 60% sugar + 4% cereals +2% oilseeds +20% vegetable oil
IFPRI 2007: Msangi S. et al, *'Global Scenarios for Biofuels: Impacts and Implications'*, International Food Policy Research Institute, 2007	China, US, EU, India, Brazil	20% biofuels by 2020	+25-40% corn +40-65% sugar +15-30% wheat + 40-75% for oilseeds
FAO 2006 a: Schmidhuber, J., *'The Long-Term Outlook for Food and Agriculture'*, FAO Expert Meeting 5 on Bioenergy Policy, Markets and Trade and Food Security, 2006.	World	Not spec.	+2,8% on corn (for every additional 10 mio t of corn used for ethanol)
IFPRI 2006: Rosegrant, W. et al, *'Biofuels and the Global Food Balance'*, IFPRI, December 2006	World	4% US gasoline replacement by biofuels, 20% elsewhere, up to 58% in Brazil (biodiesel in EU, ethanol	+41% Corn +30% Wheat +76% Soy (oilseeds) +66% Sugar (sugarcane)

		elsewhere), no technology improvement, projected to 2020.	+135% Cassava
		Same as above, but with cellulosic technology online by 2015, and crop productivity improvement to 2020.	+23% Corn +16% Wheat +43% Soy (oilseeds) +43% Sugar (sugarcane) +54% Cassava
FAPRI 2005: FAPRI, *'Implications of Increased Ethanol Production for U.S. Agriculture'*, August 2005.	US	7 billion US produced ethanol use, 7.5 billion gallon biodiesel and bioethanol imports by 2012, projected from 2012 to 2015, relative to baseline	+5.4% Corn +1.7% Wheat -0.2% Soy +4.2% Sorghum
Iowa State University 2006 b: Elobeid, A. et al, *'Removal of U.S. Ethanol Domestic and Trade Distortions: Impact on U.S. and Brazilian Ethanol Markets'*, Iowa State University, October 2006 (Revised)	US	Long run oil price of $60 per barrel with the U.S. using 30 billion gallons of ethanol, projected to 2015, relative to baseline	+58% Corn +20% Wheat -42% Soy (meal) +20% Soy (oil)
USDA 2007 d: USDA, 'USDA Agricultural Projections to 2016', February 2007.	US	12 billion gallons of ethanol, 700 million gallons of biodiesel in the United States, projected to 2016	+65% Corn +33% Wheat +19% Soy -8% Sugar +64% Sorghum
FERRIS 2005: Ferris, J.N. et al, *'An econometric analysis of the impact of the expansion in the US production of ethanol from corn and biodiesel from soybeans on major agricultural variables, 2005-2015'*, Agriculture as a Producer and Consumer of Energy. Cambridge, MA: CABI Publishing, 2005.	US	5.7 billion gallons of ethanol, 300 million gallons of biodiesel in the United States by 2015, projected relative to baseline	+6% Corn -5% Soy (meal) +31% Soy (oil)
FAPRI 2006: FAPRI, *'Baseline Update for US Agricultural Markets'*, June 2006.	World	6.6 billion gallons ethanol in Brazil, 0.8 billion gallons ethanol in EU, 8 billion gallons in US, 4.9 mio ton rapeseed oil in EU, projected to 2015	+30% Corn +11% Wheat +2% Soy -21% Sugar +17% Palm oil
INRA 2007: Gohin, A., *'Impacts of biofuels on the European agriculture'*, INRA Rennes, September 2007	EU	Effect of incorporation of 5.75% of total fuel consumption by 2010; **benchmark value:** European agriculture benchmark for 2015 without national and Community steps in favour of biofuels, **deviation value:** incorporation of 5.75% of total fuel consumption by 2010 (expressed in percentages in relation to the benchmark)	570 $/T / + 47,9% Rape oil 129 $/T / - 12,4% Rape meal 546 $/T / + 33,9% Soya oil 207 $/T / - 4,3% Soya meal 548 $/T / + 38,9% Palm oil 128 $/T / + 11,3% Soft wheat 96 $/T / + 0,6% Corn 245 $/T / + 42,6% Rapeseed 263 $/T / + 34,2% Sunflower 281 $/T / + 0,1% Sugar-(beet) (benchmark value / deviation value)
FAO 2007 b: Schmidhuber, J., *'Biofuels:*	World	An additional 10 million	+13,6% Sugar

An emerging threat to Europe's Food security?', FAO, May 2007.		tonnes of Sugar, corn and soybeans used for biofuels	+4,2% Corn +7,8% Vegetable oils -7,6% Protein +2,0% Wheat +1,4% Rice +0,4% Beef -2,0% Poultry

None of the studies predicts structural price effects of the magnitude of the price peak of agricultural commodities we have witnessed in the period 2007 – mid 2008. The effects predicted are of the order of a few percents to a maximum of some 75% in the case of a very high share of total transport fuels coming from biofuels in all major transport fuel consuming countries, supposing the agricultural production system does not respond to this additional demand.

At the time of the high prices a number of studies have attempted to quantify to what extend biofuels were responsible for the price increases of agricultural commodities [FAO, 2008b]. This resulted in figures varying from 5%, 30% [IFPRI, 2008] even up to 75% [World Bank, 2008] of the price increase, although it should be stressed that the last two studies just accounted the effect of speculation to biofuels, which can be questioned looking at the short term effects we have experienced in the period 2007-2008.

2.2.5 Share of biofuel feedstocks in the commodity markets

It is not really clear to what extend biofuels really cause an increased demand for raw materials and thus an important price impact for all alternative applications of these raw materials.

To put things into perspective, we looked into the market shares of several commodities used for biofuel production. These are 2008 figures, derived from F.O.Licht's World Ethanol and Biofuels Report (April 14, 2009).

Grains for ethanol fuel

Worldwide about 98 million tonnes of grains (mainly corn and wheat) were used to produce fuel ethanol in 2008. This represents 5.6% of the total worldwide grain production (compared with roughly 4.5% in 2007). It has to be emphasized that this share represents the gross grain consumption of fuel ethanol. If the co-products, which are sold on the animal feed markets, are taken into account, the net grain consumption would be 4% in 2008.
There are important regional differences, both in feedstock used, and in the uptake of these commodities for biofuels.

- 87.4 million tonnes of corn were converted to ethanol in the USA, which represents 28% of US corn production in 2008. Nevertheless the availability of US corn for food, feed or export markets has not diminished so far, as corn production in the US rose from 268 million tonnes in 2006 up to 331 million tonnes in 2007. There is however an indirect effect, causing a lower production of soybean in 2007, as grains and soybeans can be grown on the same land and soybean was less attractive for the US farmer because of higher corn prices. Production of soybean in the USA fell from 87 million tonnes in 2006 to 70 Million tonnes in 2007 (about 15% of which are used for biodiesel production). So there was indeed an import increase of soybean to the US, and a diminishment of stocks. For 2008 soybean production has gone up again to 80 million tonnes (because of higher soy prices), at the expense of corn production.

- 3.9 Million tonnes of wheat were used for ethanol in the EU27 in 2008, representing 2.6% of European wheat production. This has an insignificant effect on availability of EU wheat for food, feed or export markets as most of the increase is covered by yield increases and extra land availability in East Europe.
- In China 4.3 Million tonnes of grain (mainly corn and wheat) were used for ethanol, representing 1.5% of Chinese grain production. While this number is also marginal, in response to high food prices, the government in 2007 suspended new ethanol projects based on edible grains, including any plans to expand existing plants. Investment will be focussed on ethanol from cassava, sorghum and sugarcane.

Sugarcane & sugar beet for ethanol

Worldwide about 328 Million tonnes of sugar feedstocks (sugarcane, sugar beet & molasses) were used for ethanol in 2008, with Brazil being the most important player (96% of worldwide fuel ethanol derived from sugar).

- 302.5 Million tonnes of sugarcane and 11.9 Million tonnes of cane molasses were used in Brazil in 2008 to produce ethanol. This represents 55% of Brazil's sugarcane production. Brazil has no fundamental feedstock problems as it has ample space to extend its sugarcane production (outside rainforest regions), although there are some concerns on where the expansion would take place, and possible indirect effects. The impact on the sugar market is presently limited due to the current global sugar surplus.
- The EU27 used around 6.8 Million tonnes of sugar beet and 0.09 Million tonnes of beet molasses to produce ethanol in 2008. This represents about 5% of sugar beet output, which has marginal effect on worldwide (and EU) sugar markets.

Vegetable oils for biodiesel

Worldwide about 11.5 Million tonnes of vegetable oils (rapeseed, soy, palm oil) were used for biodiesel production in 2008. This represents 9 % of worldwide vegetable oils market (11% when considering exclusively rapeseed, soy and palm oil).

- The EU27 is the main player using 6.7 Million tonnes of vegetable oil (mainly rapeseed) in 2008 for biodiesel production. This represents around 65% of its vegetable oil production (50% in 2007). The increasing demand from the biodiesel sector is tightening the EU's vegetable oil balance, making feedstock imports for biodiesel production necessary. There are also imbalances on the market, e.g. with imported soy-based biodiesel from the US ('B99'). Especially the German biodiesel industry has important difficulties, as there is a concurrent reduction of tax advantage of pure biodiesel, which used to represent a biodiesel consumption of 1.7 million tonnes in 2007 (user incentive to use B100 disappears).
- North and South-America together used 3.3 Million tonnes of vegetable oils (mainly soy) to produce biodiesel in 2008. This represents 11.7% of their total vegetable oil production, up from 2.8% in 2006. Biodiesel producers in South America benefit from a large exportable soy oil surplus, part of it is also targeting export to the European market.
- In Asia and Australia some palm oil is used to produce biodiesel, however in 2008 this was limited to 1.2 Million tonnes of palm oil (= 3% of palm oil production). Despite important expansion plans of the biodiesel industry in Southeast Asia, the outlook for palm oil based biodiesel in 2007-2008 was dampened through high vegetable oil prices.

This may change in the future as prices have gone down again, however, in Europe especially, there is already strong opposition to use palm oil for biodiesel for sustainability reasons (deforestation risk).

As a conclusion we can say that biofuel production uses significant commodity shares of sugar cane in Brazil, corn in the USA, rapeseed in the EU and the use of soy for biodiesel in South and North America is also growing to significant portions. For the other commodities the effect should be marginal (or indirect), although larger impacts may be seen in the future when biofuel share go up to levels in the order of 10%.
Especially between 2007 and 2008 there has been a huge demand increase from the biofuels sector, which may have added to speculative price effects on feedstocks.

2.3 Land use

2.3.1 Use of agricultural land for biofuels

The current use of agricultural land for biofuels is around 20 million hectares. The following table shows an overview of the main regions in 2007 [Trostle, 2008].

Table 3: overview of land used for biofuel crops [Trostle, 2008]

	Land use for biofuels		Total arable land (excl. grassland)	% of arable land
	million hectares			
	ethanol	biodiesel		
Argentina		0.73	28	2.6%
Brazil	3.0	0.45	59	5.8%
Canada	0.28		46	0.6%
China	0.97		143	0.7%
EU27	0.65	4.3	114	4.4%
United States	6.6	2.3	175	5.1%
TOTAL	11.5	7.78	1421 (world wide)	1.4%

Looking worldwide around 1.4% of arable land was used in 2007 for biofuel crops. This is mainly concentrated in Brazil (sugar cane), the United States (corn and soy) and Europe (rapeseed, wheat, sugar beet).

Below some more FAO statistics on the worldwide use of agricultural land (figures 2005). Worldwide there is 4917 million hectares of agricultural land, of which 1421 million hectares are classified as arable land. The main part is cultivated, although there are still vast amounts of this which are not used (set-aside). This strongly depends by region.
Worldwide there are about 140 million hectare of permanent crops (e.g. olive plantations in South Europe and palm oil plantations in South-East Asia). The rest of agricultural lands is classified as 'meadows and pastures'.

Table 4: overview of worldwide land distribution [FAOSTAT, 2009]

million ha	Agricultural land	a. arable land	b. permanent crops	c. Permanent grassland	Permanent forest	Other land use
World	4917.6	1421.1	140.5	3405.9	3952.0	4093.0
Africa	1145.9	213.1	26.2	906.6	635.4	1184.9
East Africa	301.7	55.8	6.5	239.4	160.4	143.2
Central-Africa	160.1	23.1	3.1	134.0	294.5	195.5
North-Africa	242.3	42.8	5.0	194.4	76.5	519.2
Southern Africa	168.2	16.5	1.0	150.7	29.4	67.9
West Africa	273.7	75.0	10.6	188.1	74.6	259.0
America	1203.9	365.1	29.1	809.7	1537.4	1157.1
US	414.8	174.4	2.7	237.6	303.1	198.3
Canada	67.5	45.7	6.5	15.4	310.1	531.7
Mexico	107.5	25.0	2.6	79.9	64.2	22.7
Brazil	263.6	59.0	7.6	197.0	477.7	104.6
Argentina	129.4	28.5	1	99.9	33.0	111.3
rest South America	188.3	20.8	5	162.5	320.8	134.5
Asia	1675.0	511.5	65.7	1097.8	571.6	844.0
Central Asia	283.6	31.6	0.7	251.2	12.0	91.0
China	556.3	143.3	13	400.0	197.3	179.1
Mongolia	130.5	1.2	0	129.3	10.2	15.9
India	180.2	159.7	10	10.5	67.7	49.4
Iran	47.6	16.5	1.6	29.5	11.1	104.1
Afghanistan	38	7.9	0.1	30.0	0.9	26.3
Pakistan	27.1	21.3	0.8	5.0	1.9	48.1
Indonesia	47.8	23	13.6	11.2	88.5	44.9
Thailand	18.6	14.2	3.6	0.8	14.5	18.0
other S-E Asia	48.6	29	14.3	5.3	100.9	52.7
Saudi-Arabia	173.7	3.5	0.2	170.0	2.7	38.5
Turkey	41.2	23.8	2.8	14.6	10.2	25.6
other West Asia	56.0	26.4	2.5	37.1	6.7	126.1
Europe	478.1	280.1	16.3	181.7	1001.4	729.4
North Europe	38.0	18.6	0.1	19.3	70.8	55.4
South Europe	39.1	32.3	10.0	26.9	45.4	15.1
West Europe	54.8	34.0	1.5	19.3	32.8	21.1
East Europe (excl Rus & Ukr)	59.1	40.9	2	16.1	33.9	16.9
Russia	215.7	121.8	1.8	92.1	808.8	613.7
Ukraine	41.3	32.5	0.9	8.0	9.6	7.1
Oceania	464.7	51.5	3.3	409.9	206.3	177.6
Australia	445.1	49.4	0.3	395.4	163.7	159.4
New Zealand	17.3	1.5	1.9	13.9	8.3	1.2

2.3.2 Potential of biomass for energy

Several potential studies have been performed to analyse the possibilities of bioenergy within the available land area, but also taking into account a number of waste streams that could be made available. The following order is usually applied:

(1) use of rest streams of forestry and agriculture, en organic waste;
(2) use of abandoned, marginal or degraded land for cultivation of energy crops;
(3) use of available arable land for energy crops (in equilibrium with food supply, and taking into account learning effects in agriculture);
(4) use of permanent grasslands for biomass production.

In 2008 a number of studies were analysed by a Dutch study [WAB, 2008]. The analysis was focussed at the relation between biomass potential results and the availability and demand for water, the production and demand for food, the energy demand, and the influence on biodiversity and agri-economic parameters. There was high variation in results. The highest biomass potential of 1500 EJ/yr (3 times the current global energy demand), calculated by [Smeets, 2007] is based on intensive and high technological development in agriculture. On the other side there was the conclusion of [Wolf, 2003] that biomass potential in 2050 is zero, starting from a pessimistic scenario: high population growth, high demand for food, and extensive agricultural production systems. Another study [Hoogwijk, 2005], assuming from the production of energy crops on abandoned and marginal land, and on unused grasslands, resulted in a potential between 300 and 650 EJ/yr, depending on efficiency trends in agriculture. The [WAB, 2008] study itself concluded in a range between 200 and 500 EJ/yr.

[Fritsche, 2009] presented the following indicative figure for the bioenergy potential, in relation to the world energy demand in 2030.

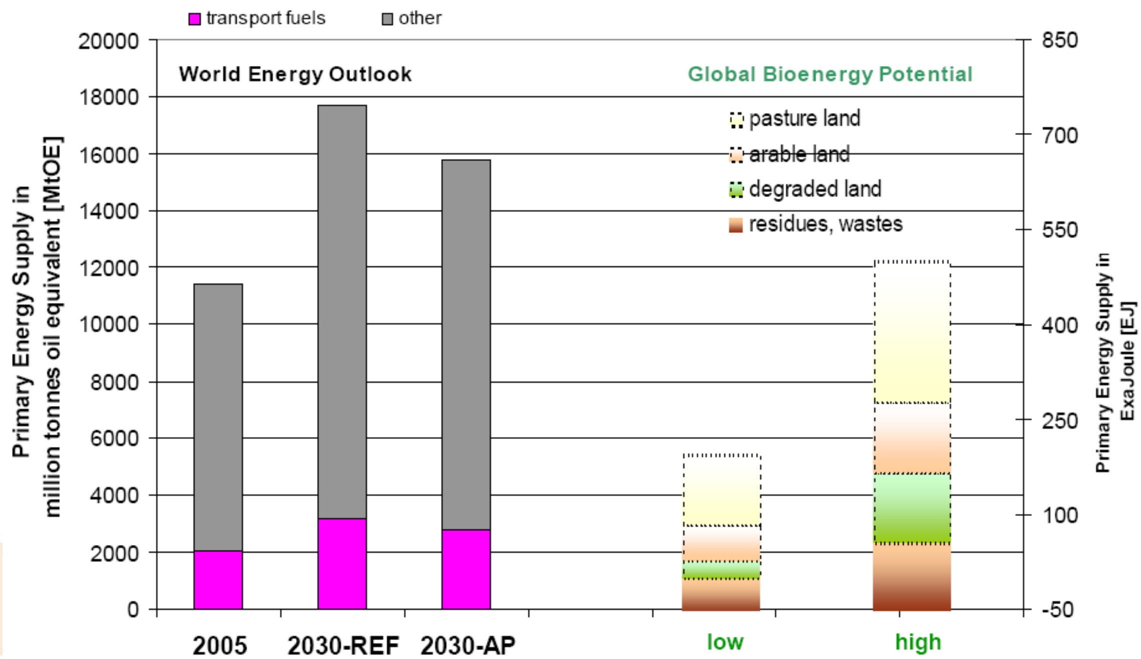

Figure 7: Indication of worldwide biomass potential [Fritsche, 2008]

3 Induced market disturbances: cases

In this chapter we will consider typical cases where biofuel markets had possible interference with food and feed markets. Typical cases are:
- sugarcane for ethanol in Brazil,
- corn for ethanol in the United States,
- grains (corn and wheat) for ethanol in China,
- soybean oil for biodiesel in the United States,
- palm oil for biodiesel in South-East Asia,
- rapeseed for biodiesel in Europe.

Figures of commodity production and trade are derived from United States Department of Agriculture, Foreign Agricultural Service http://www.fas.usda.gov/psdonline/psdQuery.aspx. The database was accessed in September 2008, and in July 2009 for the update.

3.1 Sugar versus ethanol

3.1.1 Sugar market

World sugar production has increased continuously in the past decades. There are two main sources for sugar: sugarcane and sugar beets. The figure below shows the global sugar production, divided between sugar from cane and beet. As can be seen, sugar production from beets remained quite stable since 1975, whilst sugar production from cane increased steadily over the years. In 2007, sugar from cane accounted for about 80% of global sugar production.

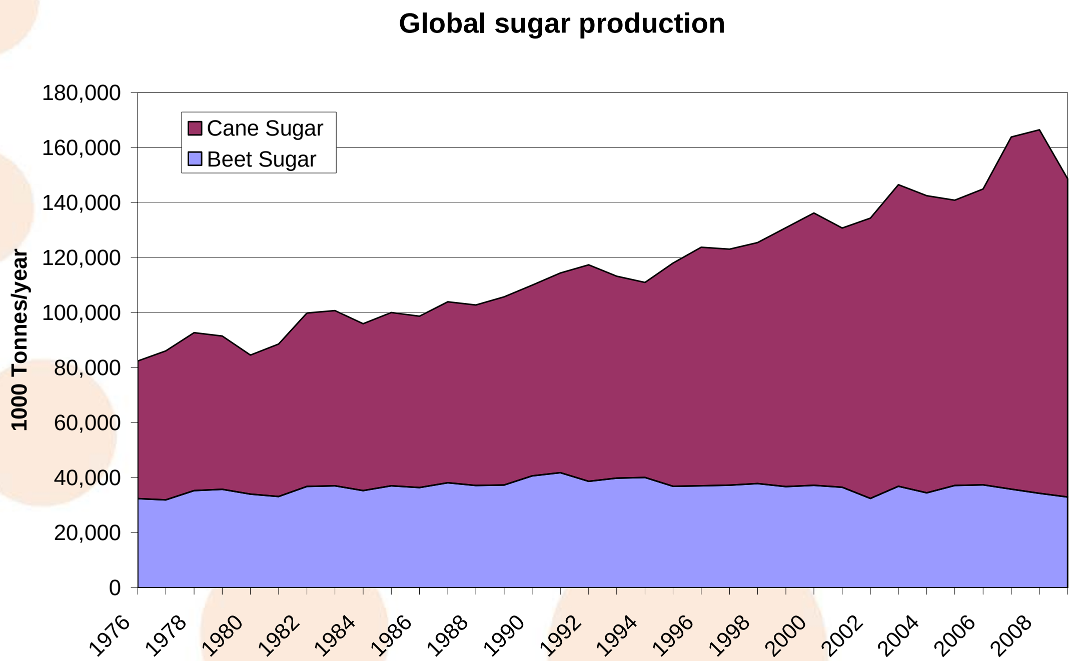

Figure 8: Global sugar production
Data derived from [USDA-FAS, 2009]

Figure 9 shows the world cane sugar production by country. The main producers are Brazil and India. Cane sugar production in Brazil reached about 32 million tons in 2007, or about 25% of world cane sugar production. India produces around 20% of world cane sugar, but this is primarily for the domestic market.

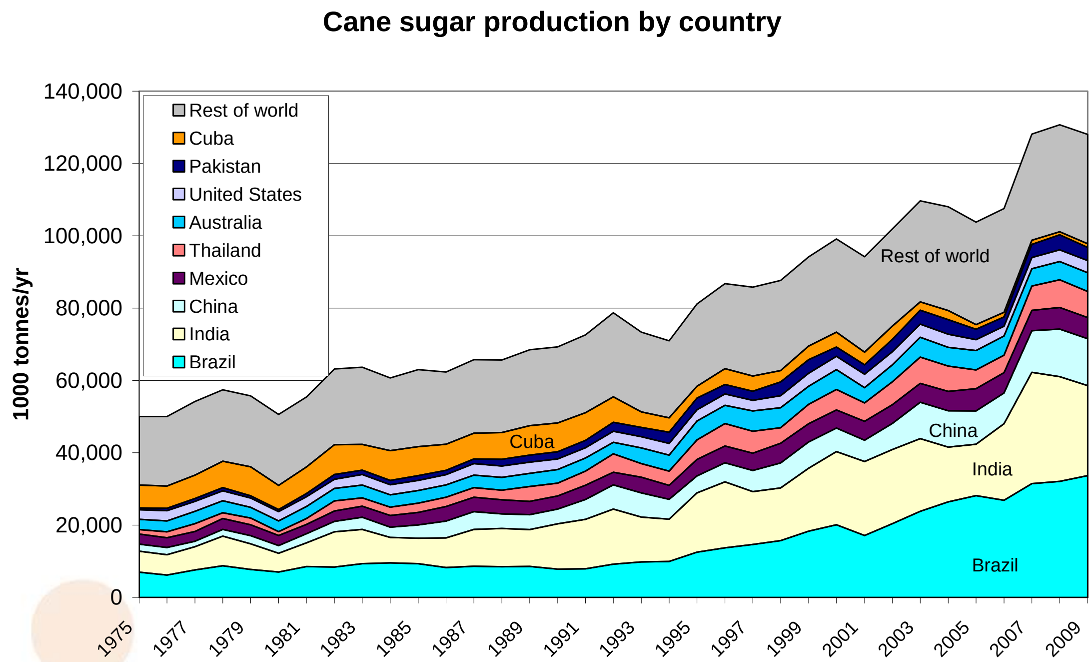

Figure 9: Cane sugar production by country
Data derived from [USDA-FAS, 2009]

Brazil exports about two third of its cane sugar production, and is thereby the world's largest exporter of sugar (raw and refined) (see Figure 10), so developments in Brazil significantly affect world sugar prices. In 2007, Brazil exported 21 million tons of sugar, accounting for about 40% of the world's sugar export.

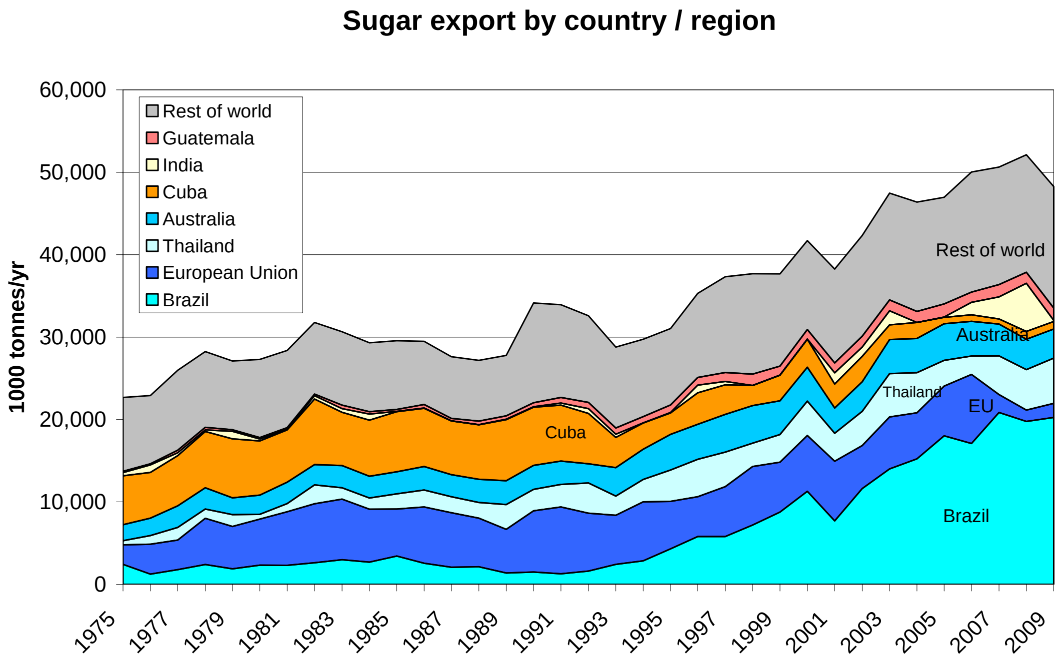

Figure 10: Sugar export by country / region
Data derived from [USDA-FAS, 2009]

3.1.2 Sugarcane versus ethanol: Brazil

Interest in biofuels initially came about in the late 1970s as OPEC reduced crude oil supply on the world market and fuel prices increased substantially. Brazil launched ethanol programs during this period. Brazil has been the world's largest producer of bioethanol for the past 25 years and has only recently been surpassed by the United States (see Figure 2 on page 16).

However, it is cheaper to produce ethanol from sugarcane, the resource used in Brazil, than to produce it from corn, the raw material currently used in the US. The energy balance also is much more positive for sugarcane based ethanol than for ethanol from corn.

The figure below (Figure 11) shows the evolution of fuel ethanol production in Brazil over time. Brazil uses some 50% of its sugar cane output to produce fuel ethanol, both for domestic use and export. The remaining 50% goes to sugar production for domestic consumption and for export. The country is currently the only major exporter of bioethanol.

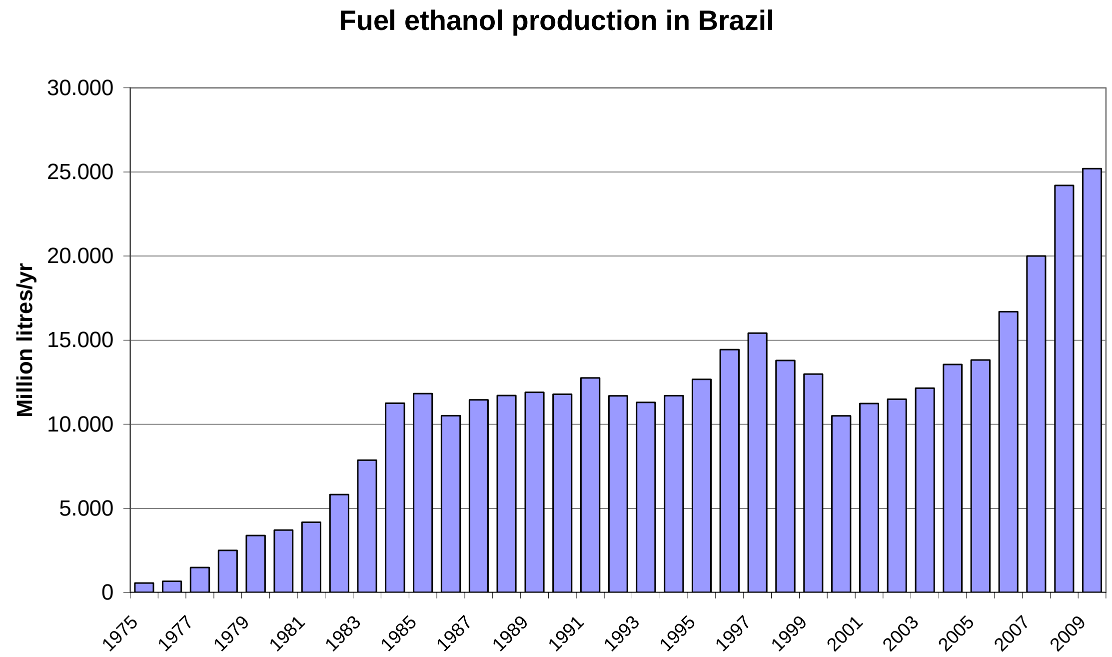

Figure 11: Brazil fuel ethanol production
Data derived from [F.O.Licht's, 2009]

The cumulative experience over the last 30 years of cane-based ethanol production has resulted in a steady decline in production costs. Ethanol in Brazil is considered to be competitive vis-à-vis traditional fossil fuels at oil prices of US$ 30-40/barrel, depending on the sugar price. Ever since oil prices broke through the US$30 per barrel in January 2004, oil and sugar prices moved up in tandem (see Figure 12 below). The main reason is that Brazilian ethanol producers became competitive in producing ethanol as a direct crude oil substitute at about US$35/barrel without requiring subsidies [FAO 2007a]. Oil prices above US$35/barrel make cane based ethanol thus competitive for the energy market and create the co-movement of energy and sugar prices.

As a result a growing number of sugar mills in Brazil divert a growing share of their cane conversion from sugar to ethanol production. This leaves less sugar (from the most important sugar exporter) to be exported to the world market and thus increases the price of sugar. The price link between sugar, ethanol and petrol is established and reinforced through the energy consumption side in Brazil. With a high and rising share of flexfuel cars that can consume any blend of petrol and ethanol in Brazil, consumers will choose pure ethanol or gasoline (containing 20-25% ethanol) according to changes in the relative prices of the two fuels. Taken together, complete market integration on the supply and demand side made prices of sugar and petrol move simultaneously until mid 2006. After a serious peak in 2006 (when prices more than doubled), sugar prices declined again in the second half of 2006. Recently sugar prices are on the rise again, but the following trend with crude oil is less pronounced.

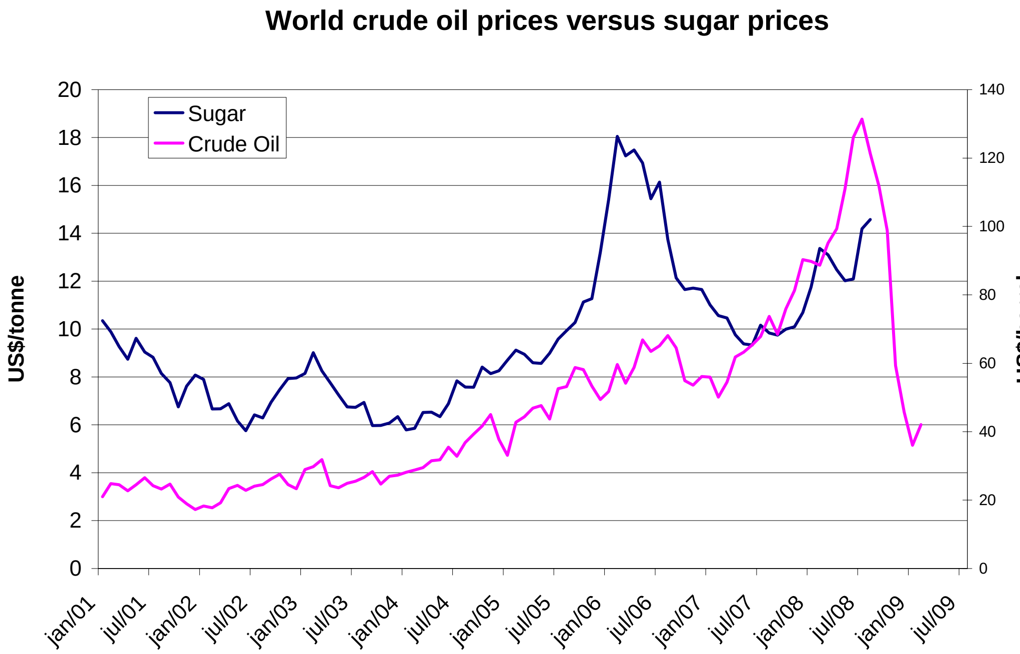

Figure 12: World crude oil prices versus sugar prices
Data derived from [FAOSTAT, 2009]

On the other side, the price of sugar determines the price of ethanol on world markets. The result is that high feedstock prices of grains are making ethanol production from these feedstocks less profitable, especially in Europe. So higher subsidies and import tariffs are needed to compete with Brazilian ethanol.

Brazil currently grows 7 to 8 million hectares of sugar cane. The organisation EMBRAPA (Brazilian Research Centre for Agriculture) conducts a study towards ‘National Agro-Ecological Zoning’ of the Brazilian area for growing sugar cane [Walter, 2009]. They analyse which areas qualify for growing sugar cane, taking into account a) soil quality and climate circumstances, b) topography, c) water availability, d) avoiding sensitive ecosystems, e) leaving space for other crops. The first results would show that 35 to 45 million hectares would be suitable to grow sugar cane. These areas are mainly situated in areas where most of the sugar cane production is already happening today (e.g. São Paulo, Paraná, Minas, Mato Grosso Sul and Goiás), so outside the Amazon area.
Nevertheless there are some concerns about this sugar cane expansion. According to JRC [Dufey 2004] the expansion could partly happen on degraded grass planes, but mainly the natural Cerrado or surrounding areas could be taken. As such the Cerrado does not have high carbon storage in the soil, but the area is very important in terms of biodiversity. There could also be indirect effects, like shifting extensive livestock breeding towards the north.

3.2 Grains versus ethanol

3.2.1 Corn market

Worldwide corn production has increased continuously in the past decade. The United States accounts for roughly 40% of world corn production (see Figure 13). Smaller fractions are produced in China and Brazil. The rest is more evenly distributed over the world.

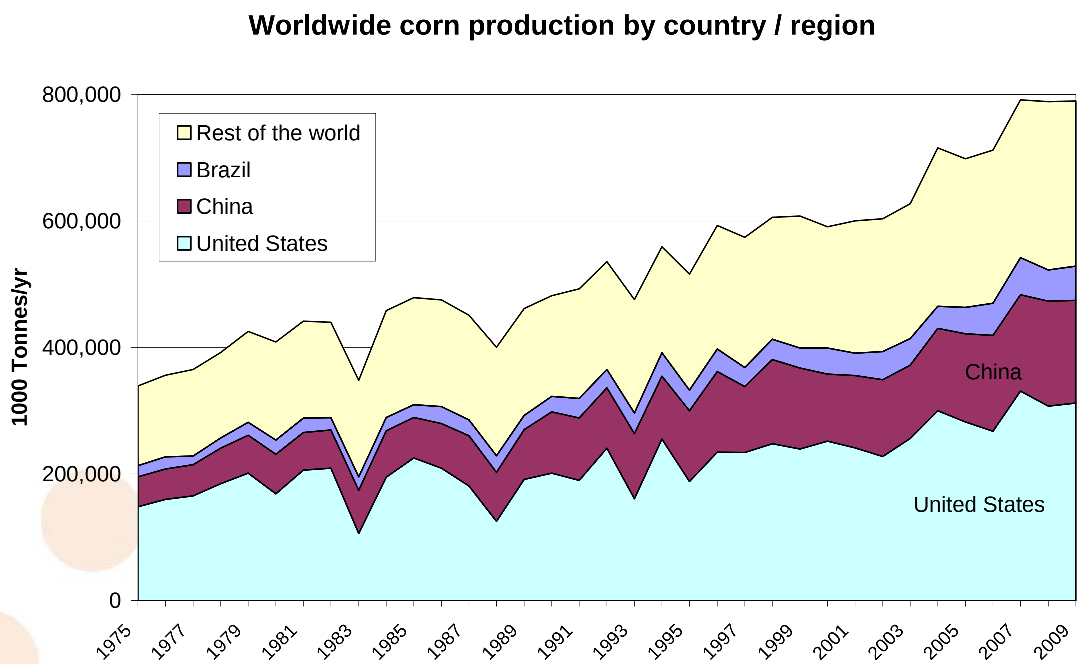

Figure 13: Worldwide corn production
Data derived from [USDA-FAS, 2009]

The United States is the world's dominant corn exporter, followed by Argentina and Brazil. The United States contributes 55-60% of total global trade in corn (see Figure 14).

When we take a closer look at the United States corn use (see **Error! Reference source not found.**), we see that corn is primarily used as an animal feed. So while the U.S. dominates world corn trade, exports only account for a relatively small portion of U.S. corn use (about 20%). This means that corn prices are largely determined by supply and demand relationships in the U.S. market, and the rest of the world must adjust to prevailing U.S. prices. As a result, the amount of corn grown in the United States and the share of corn used for domestic consumption versus exports, has significant impact on international corn prices.

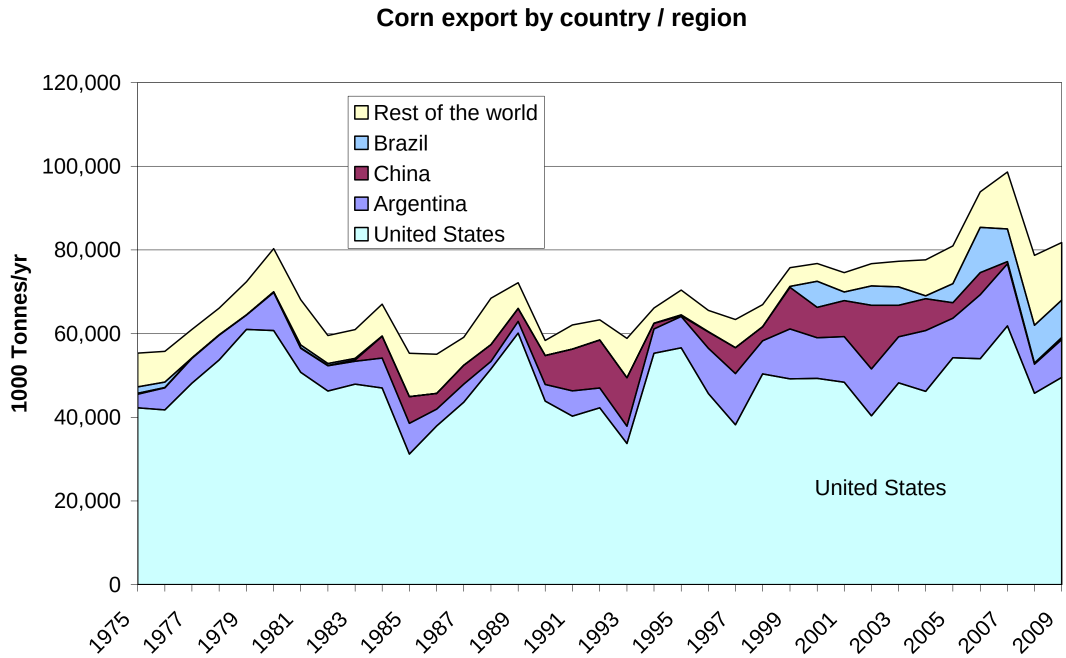

Figure 14: Corn export by country / region
Data derived from [USDA-FAS, 2009]

When we look at the import figures of corn, we see that Japan is the largest corn importer (see Figure 15). While producing almost no coarse grains, Japan is a very large meat producer, so the country is a steady buyer of corn, with attention to quality. South Korea is the second-largest importer of corn in the world. South Korea is a price-conscious buyer, willing to switch to feed wheat or other coarse grains, and ready to buy corn from the cheapest source. (USDA 2008 b)

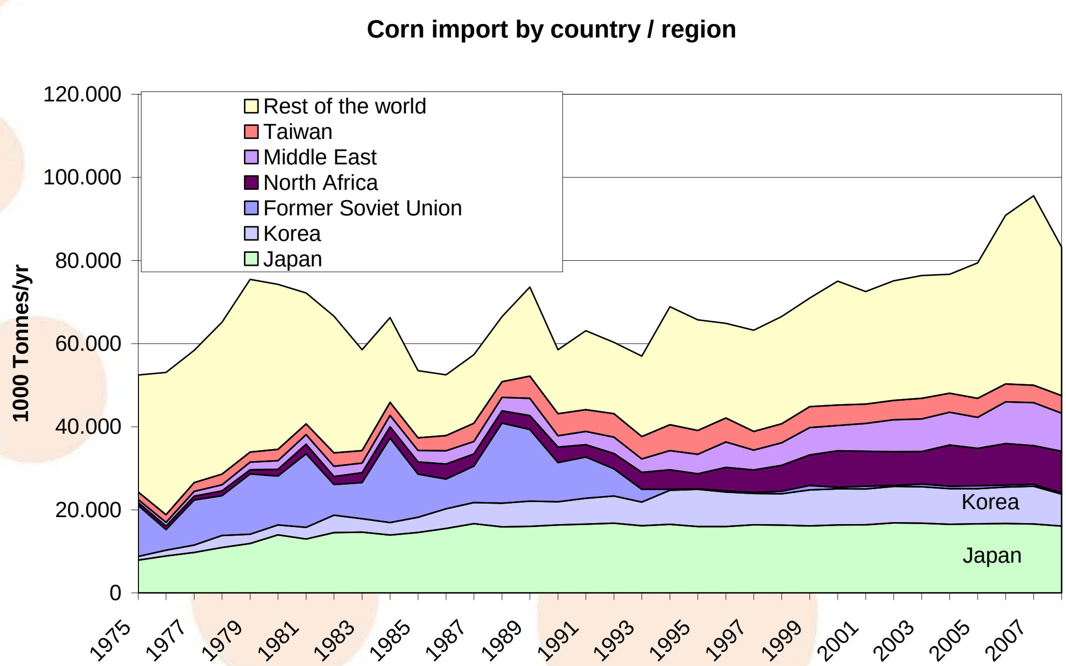

Figure 15: Corn import by country / region

Data derived from [USDA-FAS, 2009]

Foreign demand is not only dependent on importing countries' demand for feed ingredients but also those countries' internal policy changes that adjust prices and/or the availability of competing products. Coarse grains can often substitute for each other in feed use. Corn competes with other feed grains, as well as with wheat and non-grain feedstuffs such as cassava. This means that price changes in corn also have a spill-over effect to other commodities. [USDA 2008b]

3.2.2 Corn versus ethanol: U.S.

U.S. ethanol production began to expand rapidly in 2003. There were several incentives for expanding ethanol production: the increasing price of petroleum; concerns about the reliability of some traditional exporters; concerns about the pollution effects of methyl tertiary butyl ether (MTBE) and initial switching from MTBE to ethanol, and an environmental objective to increase the use of cleaner burning fuels. Ethanol production in the US rose from about 8 billion litres / year in 2002 to about 35 billion litres / year in 2008 (see Figure 16).

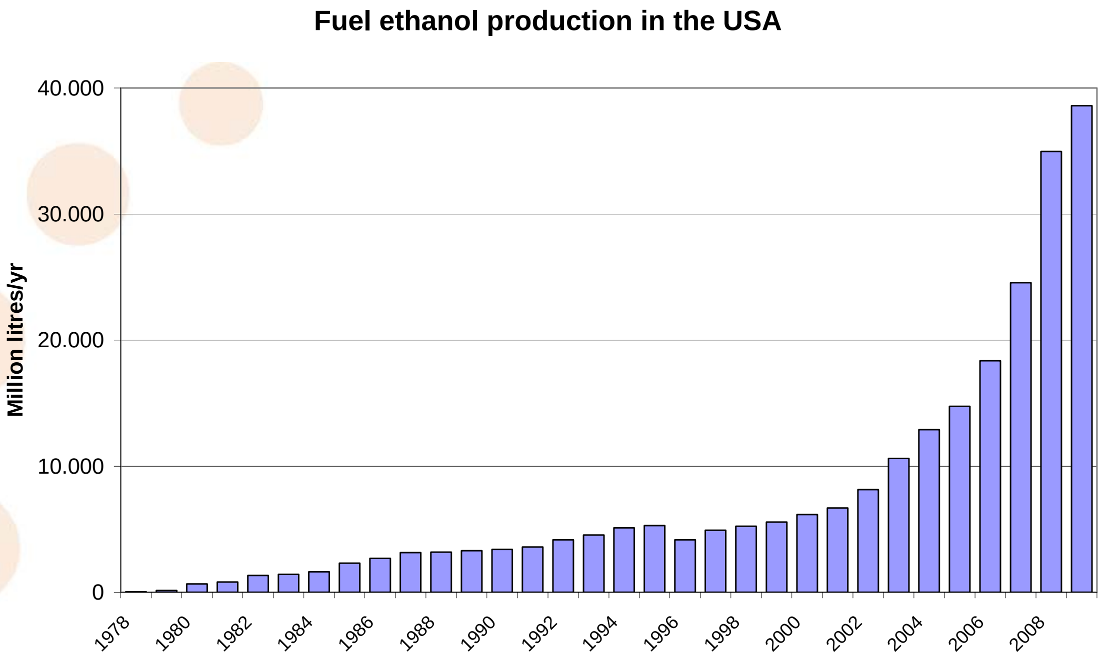

Figure 16: U.S. fuel ethanol production (2009 values are projected)
Data derived from [F.O.Licht's, 2009]

Ethanol's share in the overall gasoline market is growing, and its importance to the corn market is comparatively large. In 2009, ethanol (by volume) will represent about 7.5 % of motor vehicle gasoline supplies in the United States.

The U.S. uses corn as its primary feedstock to produce ethanol. In 2009 ethanol production will account for about 30% of total U.S. corn consumption, up from 10% in 2002 and 20% in 2007. This increase was facilitated because U.S. corn production rose in response to increased demand and prices, and, in general, other uses of U.S. corn (food, feed, non-ethanol industrial uses, and exports) also did not decline. As can be seen in the following figure corn used for ethanol has been increasing continuously over the past decade, but for the next decade it is expected to have a more modest, steady growth.

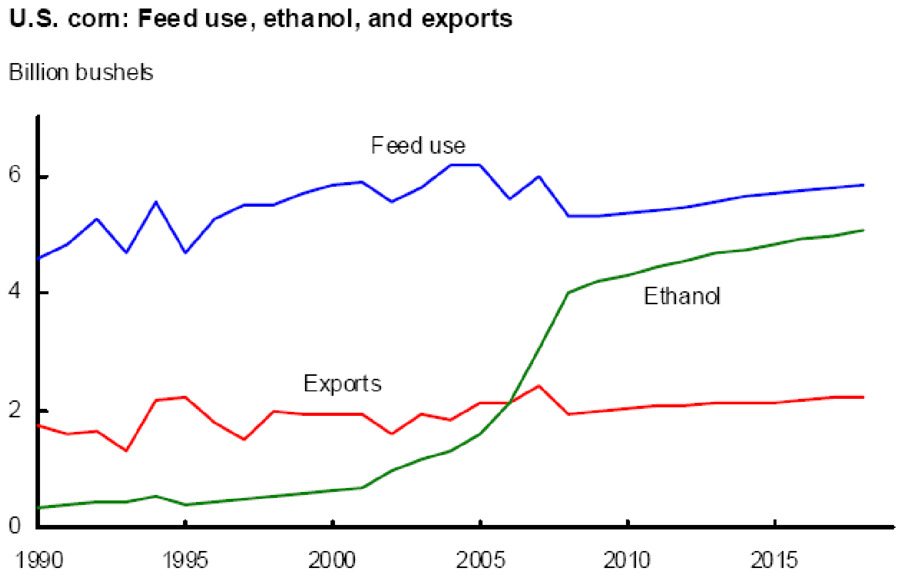

Figure 17: Comparison of the use of corn for ethanol, feed use, exports and projections towards 2020 [USDA, 2009]

The increase in U.S. ethanol production over the past years and the related significant changes in the structure of the U.S. corn market have had a pronounced impact on the world's supply and demand balance for total coarse grains. Importantly, since the United States is the world's largest corn exporter, some of the higher prices resulting from increased U.S. demand has spilled over onto world markets [USDA 2008a]. Corn prices rose from 107 US$ /tonne in the beginning of 2005 to 166 US$/tonne in the beginning of 2007 (see Figure 18), and further rising up to 290US$/tonne by mid 2008. Since then corn prices have dropped to 160 US$/tonne.

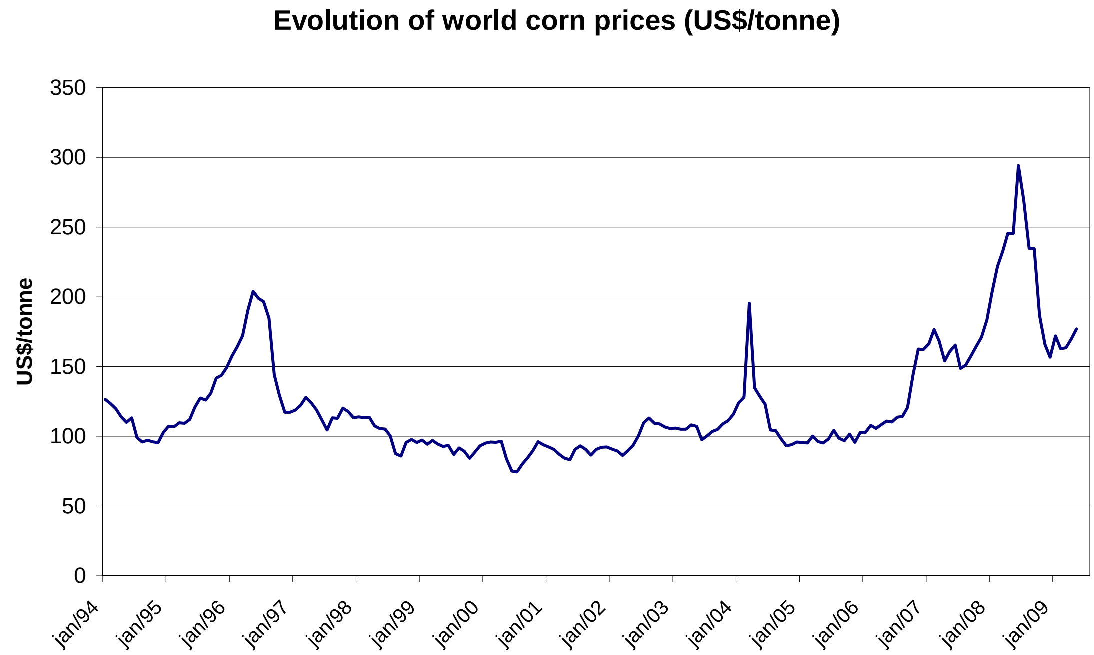

Figure 18: Evolution of world corn prices
Data derived from [FAOSTAT, 2009]

The United States Department of Agriculture has described the actual and expected effects of the expansion of the U.S ethanol market on the agricultural sector in a report [USDA 2007c]. These can be summarized as follows:

- *Direct effects for corn*

As the ethanol industry absorbs a larger share of the corn crop, higher prices for corn will intensify demand competition among domestic industries and foreign buyers of feed grains.

The increased use of corn for ethanol production and higher corn prices have important implications for *global trade and international markets*. The United States has typically accounted for 55 to 60% of world corn exports. With the ethanol expansion and higher prices, however, the U.S. share of global corn trade will drop.

Global adjustments to higher corn prices include *reduced foreign demand* and *increased foreign production*. Higher corn prices and producer returns also encourage other farmers to increase corn acreage.

On balance, increased use of corn to produce ethanol results in *higher prices*, which trigger reductions in other demands and increases in supplies to bring the corn market into equilibrium. In this new equilibrium, carryover stocks of corn are reduced, as the sector attempts to balance, through price signals, current use with future market needs. Lower stocks make the sector potentially *more volatile* and susceptible to market shocks such as a reduction in production due to drought.

- *Indirect effects on other crops*

With higher corn prices, relative prices among crops initially favour corn production over production of other crops. *Soybeans* compete most directly with corn and on the largest amount of land. Thus, much of the expansion in corn plantings comes from soybeans, and soybean plantings and production decline. With reduced production, soybean prices rise. As with corn, this reduces exports and carryover stocks for soybeans. Reduced production and higher prices for soybeans also bring higher prices for both *soybean meal* and *soybean oil*.

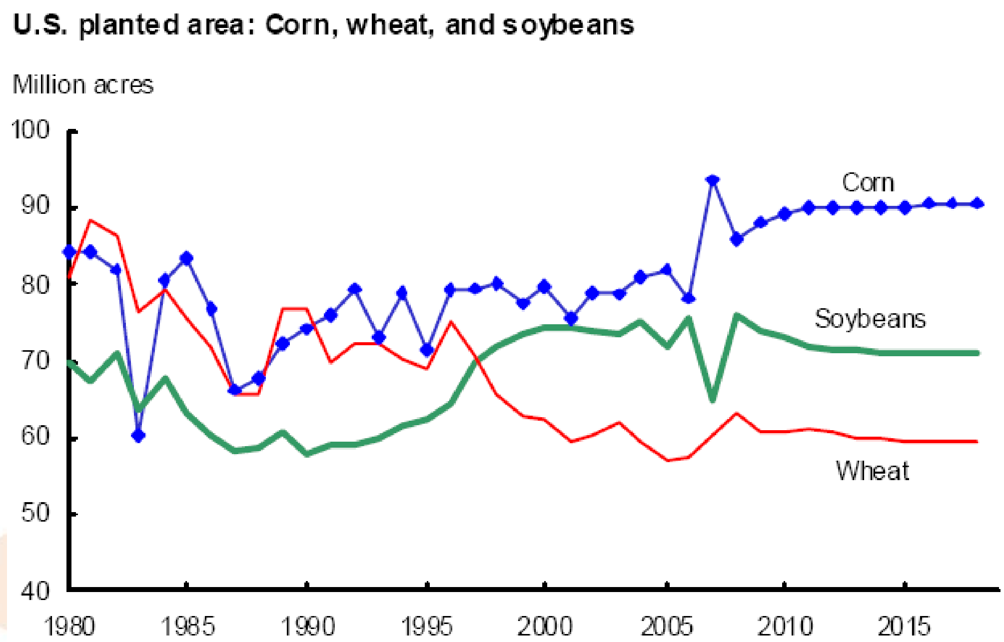

Figure 19: Comparison of the US planted area for corn, wheat and soybeans, and expectations up to 2020 [USDA, 2009]

Further contributing to higher soybean oil prices is its expanded use in the production of biodiesel, which results in a larger share of the value of soybeans deriving from soybean oil.

Plantings for crops that compete with corn or soybeans for acreage in some regions of the country are also likely to decline.

- *Livestock Production Reduced*

Higher corn prices affect the *livestock sector* because of corn's importance as an *animal feed*. Livestock feeding is the largest use of U.S. corn, typically accounting for 50-60% of the total. In response to higher corn prices, red meat production declines and growth in poultry output slows in the United States. Higher corn prices reduce the profitability of meat production, although the greater availability of distillers grains, a *by-product* of dry-mill ethanol production, partly offsets this effect as it can be used as livestock feed.

Effects are different across the livestock types due to differences in feed conversion efficiencies and the ability to use distillers grains in rations. With reduced production, prices for meats at both the producer and retail level rise, and per capita consumption will decrease.

[USDA 2007c, ENVIRONMENT 2007]

3.2.3 Wheat market

Europe, China, India, the United States, Canada and Australia are the most important wheat-producing regions, (see Figure 20). Over the past 10 years the EU accounted for 22% of global wheat production, China around 17%.

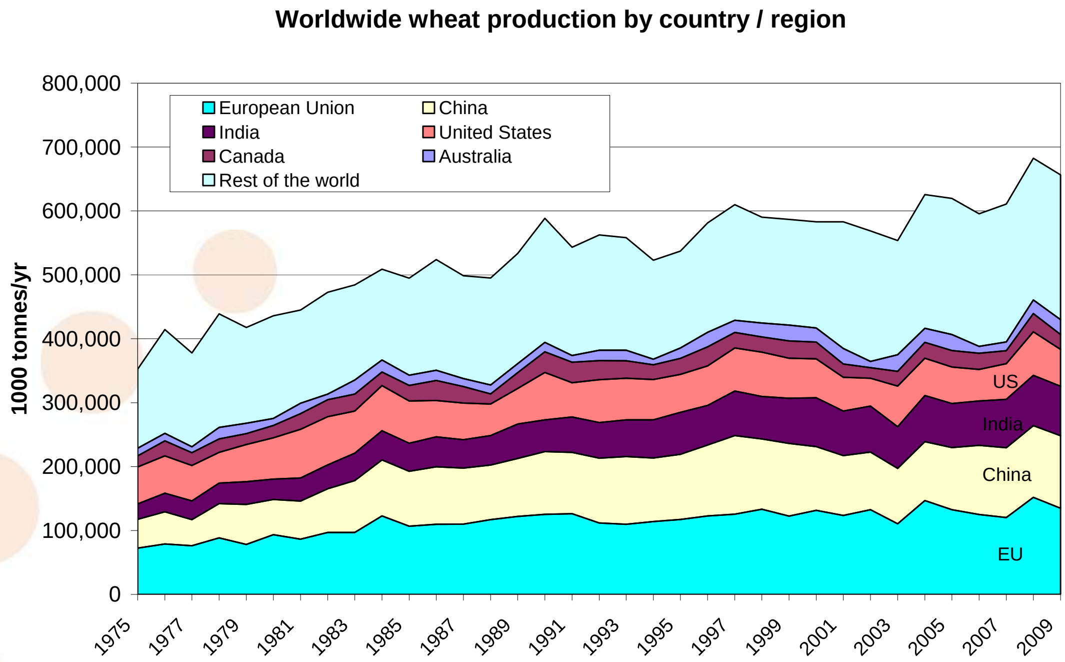

Figure 20: Worldwide wheat production by country / region
Data derived from [USDA-FAS, 2009]

Some regions are very sensitive to variations in climatic conditions. For instance Australia had extremely bad harvests in 1994, 2002, 2006 and 2007 (due to droughts), leading to a less than half the crop yield compared to previous years. This had important implications on the world market, as Australia is a major exporter of wheat (see further).

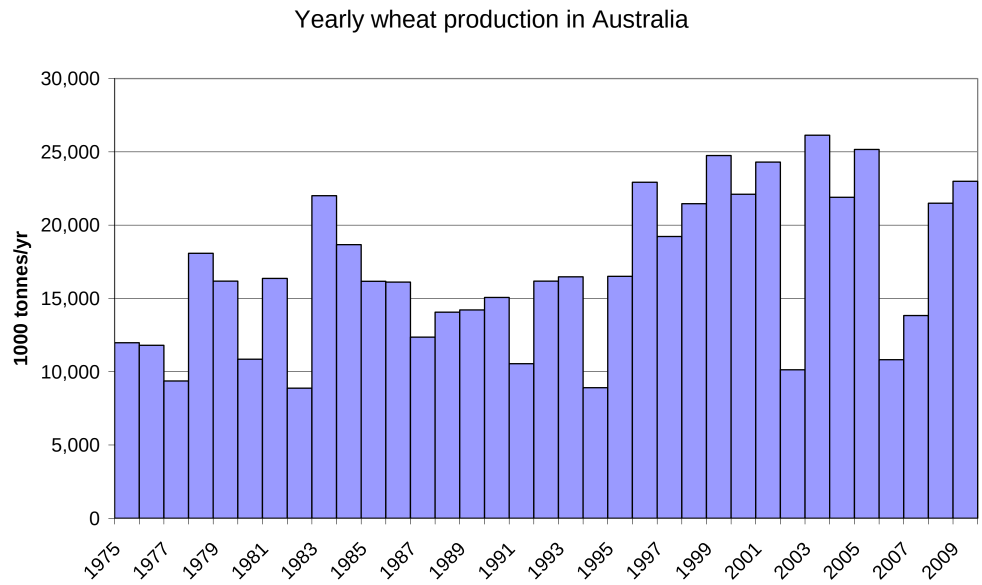

Figure 21: Yearly wheat production in Australia
Data derived from [USDA-FAS, 2009]

The picture for wheat export looks very different from the production figures. Some countries export the main part of their production, while others use the wheat for internal purposes.
The United States is the world's leading wheat exporter (40-50% of their production), followed by Canada, the EU, Australia and Argentina. Together they account for about 80% of world wheat exports (see Figure 22). Canada and Australia export up to 70% of their own production, while the EU export is limited to10-15% of its production.

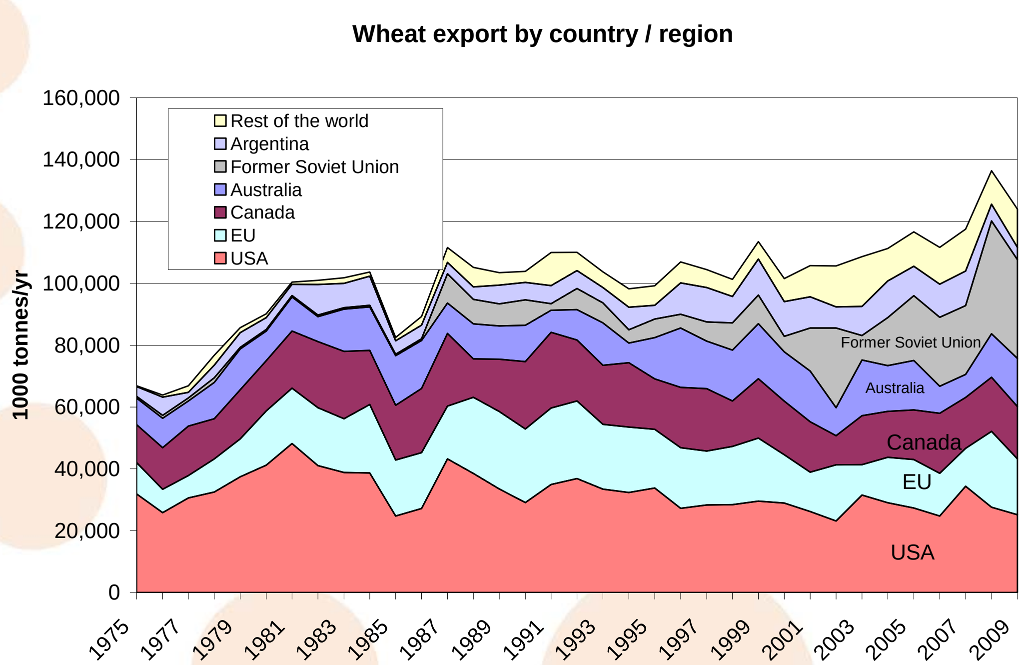

Figure 22: Wheat export by country / region
Data derived from [USDA-FAS, 2009]

3.2.4 Grains versus ethanol: China

As developed countries, especially the United States, are expanding biofuels production, developing countries are expanding their biofuels industry as well, to power their growing economies. China is the fourth-largest producer and consumer of ethanol, behind the United States and Brazil, and just behind the EU. Unlike Brazil, the United States, and some other developing countries, though, China has the largest population in the world and thus food security is an issue.

The figure below (Figure 23), shows the evolution of China's fuel ethanol production; Since 2002, the amount of ethanol produced in China has been rising steadily, with a stabilisation from 2007.

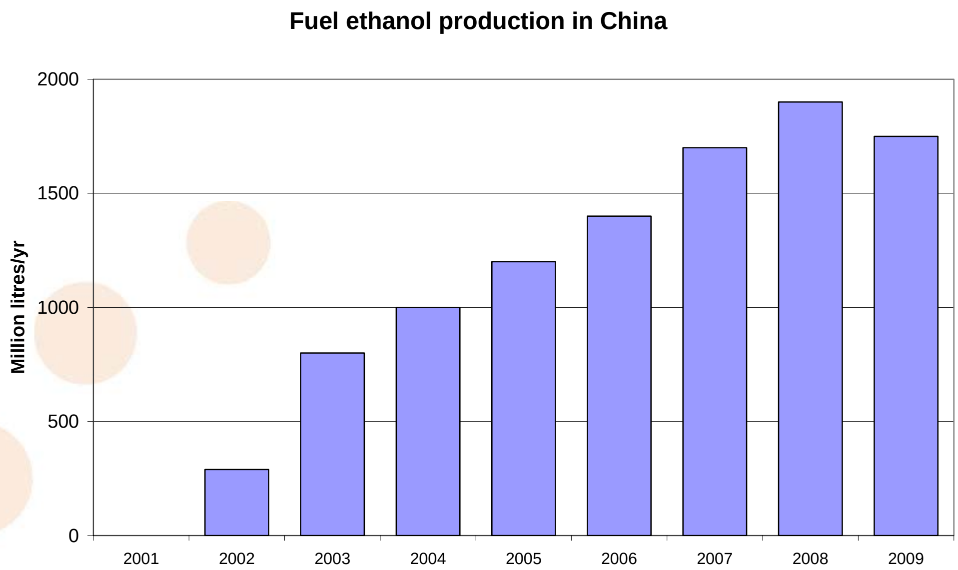

Figure 23: China fuel ethanol production
Data derived from [F.O.Licht's, 2009]

Concerned about excess old stocks in the grain reserve system, rural poverty, and the issues of rising dependency on oil imports and increasing greenhouse emissions, China's government began developing its plan for biofuels development, especially the fuel ethanol industry. China outlined a Five-Year Plan, which set the goal of using biofuels for 15% of the country's transport fuels by 2020. Four ethanol plants have been authorized by the government to produce fuel ethanol from grains (mainly from corn and wheat). All of them are located in the main corn and wheat producing areas. [Iowa State University 2007]

Corn is the main feedstock for fuel ethanol manufacturing in China, followed by smaller volumes of wheat. The following two figures (Figure 24 and Figure 25) show the evolution of corn and wheat use in China respectively. When we take a closer look at China's corn and wheat use, we see that corn is primarily used as an animal feed, while wheat is primarily used for food, seed and for industrial applications. China's wheat and corn produced is almost completely used for domestic consumption. Over the past 10 years, only 9% of the produced corn was exported to other countries. For wheat this was only 1%.

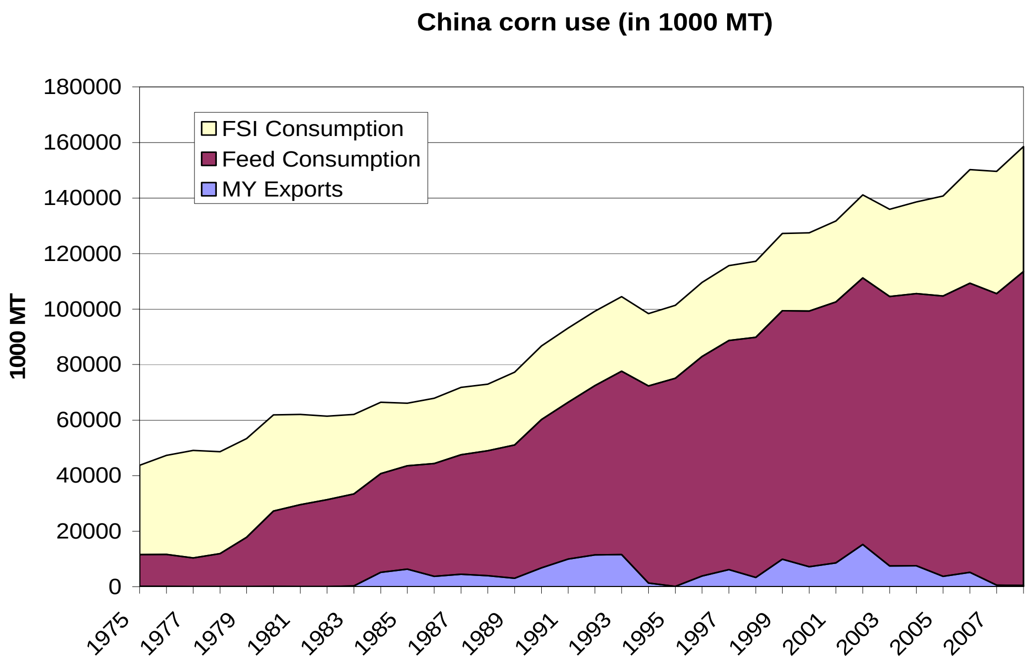

Figure 24: Evolution of China corn use (Note: FSI = food, seed and industrial use)
Data derived from [USDA-FAS, 2009]

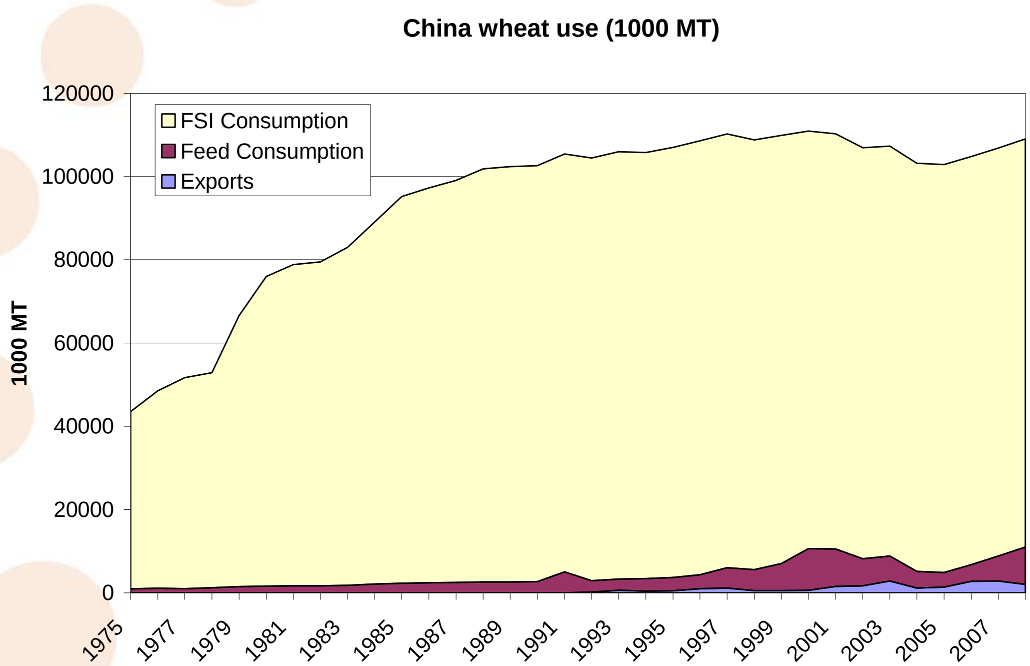

Figure 25: Evolution of China wheat use (Note: FSI = food, seed and industrial use)
Data derived from [USDA-FAS, 2009]

In 2007 4.1 million tonnes of grain (mainly corn and wheat) were used for ethanol, representing 1.5% of Chinese grain production. While this number is also marginal, in response to high food prices, the government suspended new ethanol projects based on edible grains.

As demand for corn increased significantly, the price of corn was pushed higher on worldwide markets (see Figure 18). In the nine months preceding June 2007 in the Dalian Commodities Exchange, domestic corn prices increased 30%. Because corn is the main feedstock for hogs, the price of pork has gone up by 43% as of mid-May 2007 compared with the same period in 2006 (although a disease that killed hundreds of thousands of hogs has also been blamed) [Iowa State University 2007]. The jump in pork prices caused quite a stir in Chinese society. The crop price increase can raise rural incomes, which is one of the initial goals of China's biofuels development. As food prices increase, however, those poor and net food-purchasing urban and rural households are the most adversely affected.

Due to growing concern of a conflict between food and fuel uses of agricultural resources, China revised its output targets for biofuels. In 2006, China reversed its decision to invest in facilities to produce more ethanol from grains. The government declared in 2007 that all ethanol production projects in the pipeline would be suspended; projects under construction or proposed would be rectified and the four authorized fuel ethanol plants could not increase producing capacity without the approval of the government. These actions indicate that China is stepping away from food for fuel because for the Chinese government food security is politically more important.

Given its food policies, China is now focusing on using cassava, sweet sorghum and sweet potatoes as feedstock for future increases in ethanol production. Under its current five-year plan, China aims to producing 2 million tonnes of non-grain-based fuel ethanol by 2010.

Besides China, also the EU, Canada and other regions are using wheat as an input for ethanol, albeit to a marginal extend. Wheat prices rose from 157 US$ /tonne in the beginning of 2005 to 480US$/tonne by mid 2008 (see Figure 26). Since then prices have dropped again below 250US$/tonne.

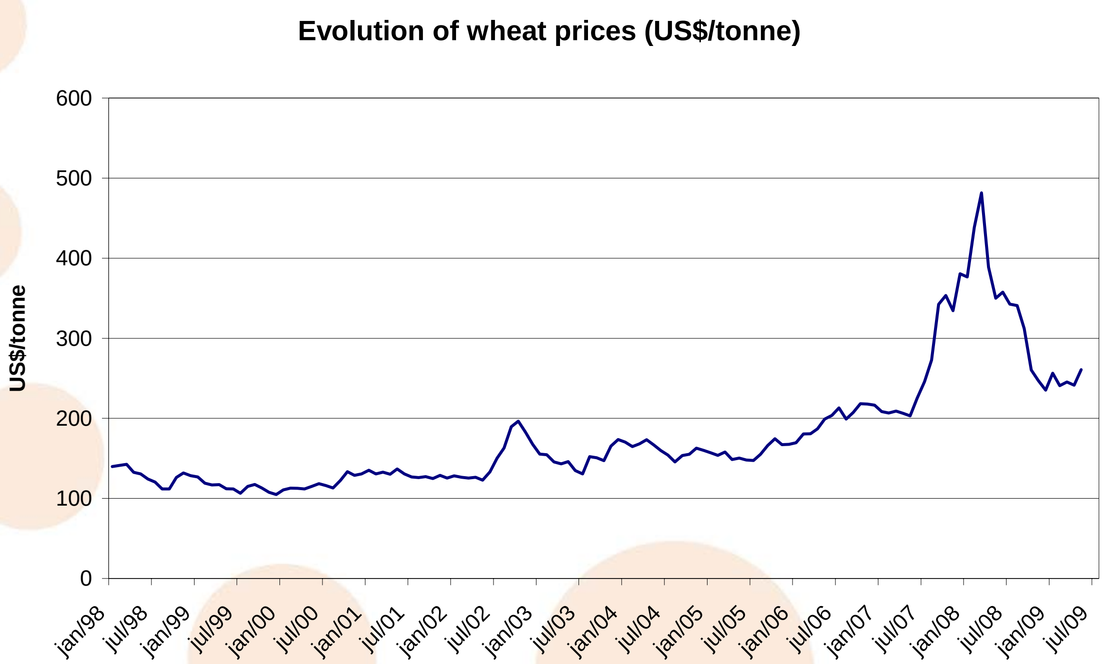

Figure 26: Evolution of wheat prices
Data derived from [FAOSTAT, 2009]

3.3 Oilseeds versus biodiesel

3.3.1 Vegetable oil market

World vegetable oil production has increased continuously in the past decades, mainly related to growth in the feed and food market.

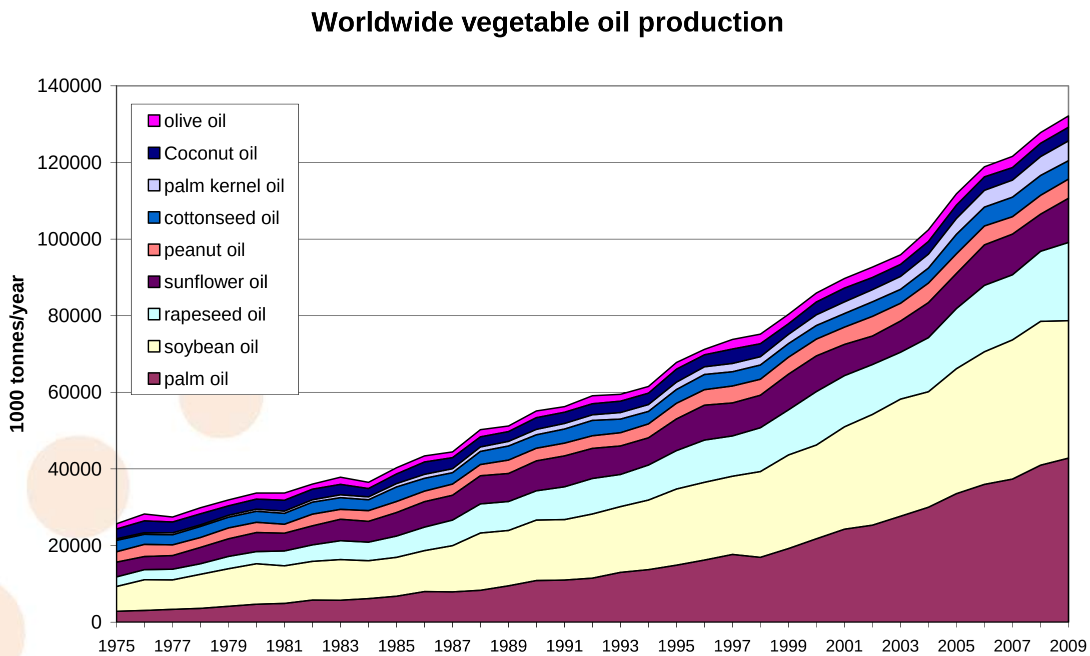

Figure 27: Worldwide vegetable oil production
Data derived from [USDA-FAS, 2009]

The main types are palm oil (30% of vegetable oil production), soybean oil (28%), rapeseed oil (15%) and sunflower oil (9%). The other oils account together for less than 20% (see Figure 27).

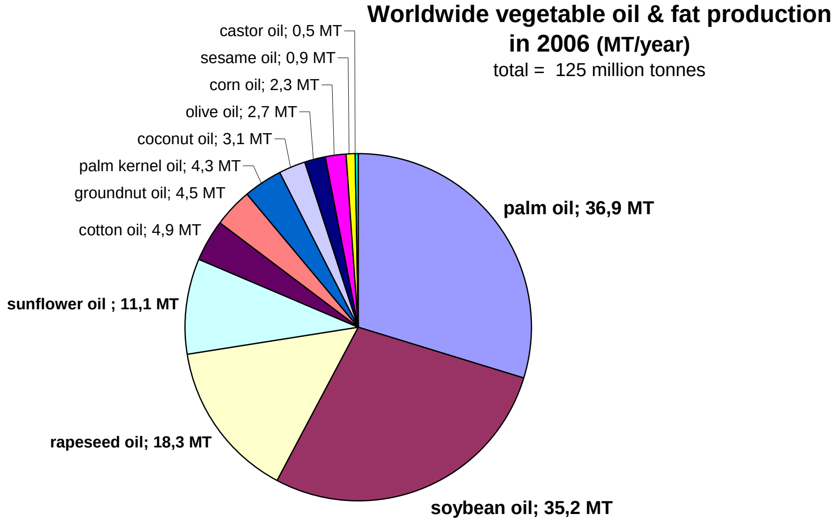

Figure 28: Worldwide vegetable oil & fat production
Data derived from [USDA-FAS, 2009]

While production of the lower share oils is fairly stable, rapeseed oil, soybean oil and especially palm oil production are increasing exponentially.

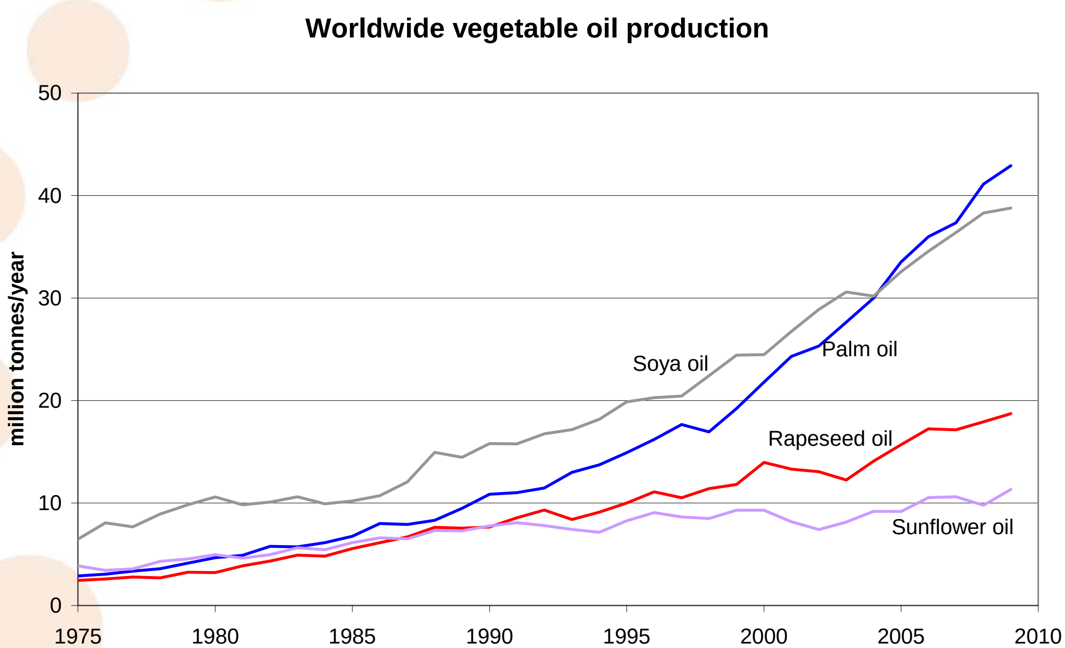

Figure 29: Worldwide vegetable oil production
Data derived from [USDA-FAS, 2009]

The following table shows the average yearly production growth of the main vegetable oils in the last 20 years.

Table 5: average production growth between 1987-2007

	Million tonnes / year	% / year
All vegetable oils	*3.86*	*5.2%*
palm oil	1.47	8,1%
soybean oil	1.22	5,7%
rapeseed oil	0.52	4,8%
sunflower oil	0.20	2,5%
palm kernel oil	0.17	7,6%
cottonseed oil	0.10	2,5%
olive oil	0.07	3,2%
peanut oil	0.08	2,1%
coconut oil	0.02	0,8%

Data derived from [USDA-FAS, 2009]

3.3.2 Vegetable oil versus biodiesel

The global use of vegetable oils can be divided into food applications and industrial use. Part of the industrial use is applied for biofuel production. The following figure (Figure 30) shows the evolution of vegetable oil use, and the role of industrial applications, including biofuels. It shows that there is an enormous growth in food use of vegetable oils. There is a growing role for industrial and biofuel use, however food still accounts for 60% of the annual growth of vegetable oil use in the past 5 years.

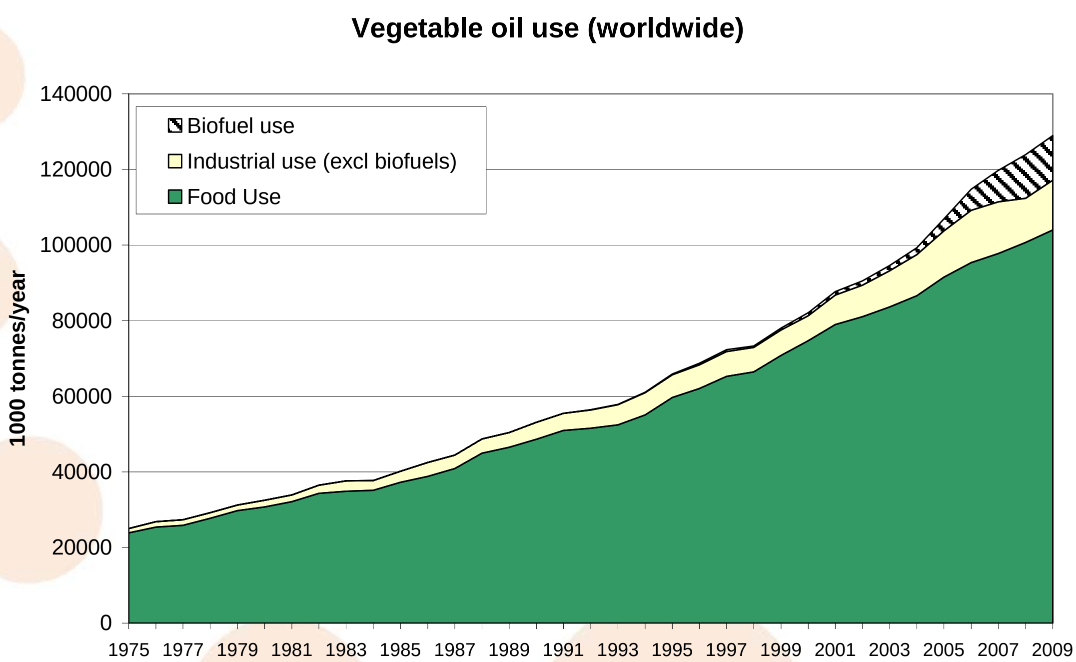

Figure 30: Vegetable oil use
Data derived from [USDA-FAS, 2009 & F.O.Licht's, 2009]

Biodiesel experiments started in Europe end 1980s - begin 1990s, mostly to offer alternative outlets for agriculture, which was facing overproduction at that time. France (focusing on low blending up to 5%) and Germany (focusing on the use of pure biodiesel) were the main players. Only in recent years (mainly from 2005) other regions in the world started to introduce biodiesel in their diesel markets (see Figure 31). With the discussion on sustainability of biofuels, and increasing prices of biodiesel feedstocks, the biodiesel market in Europe is somewhat stagnating.

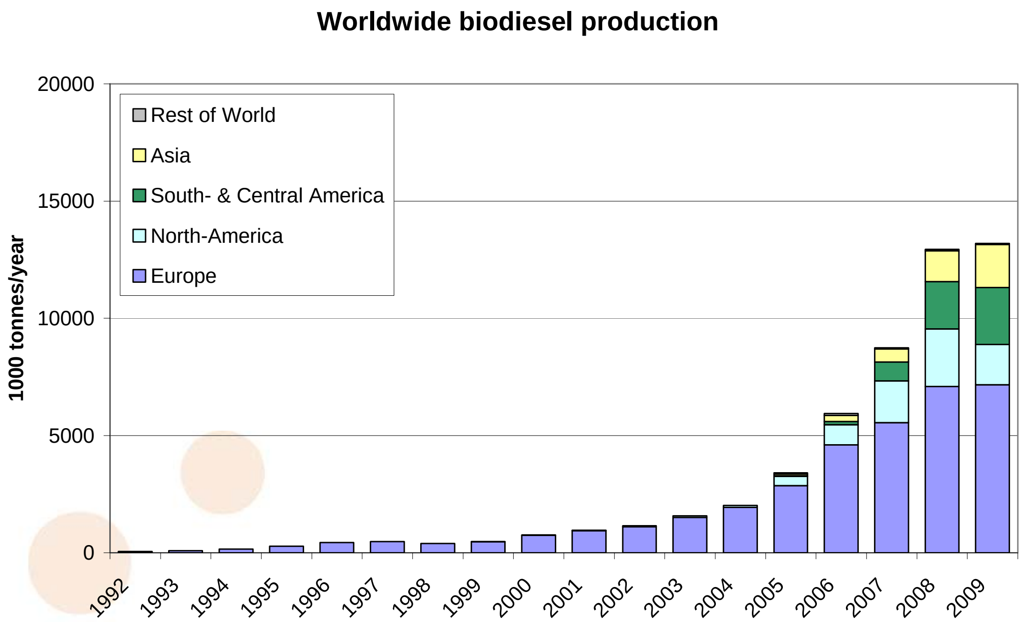

Figure 31: Worldwide biodiesel production
Data derived from [F.O.Licht's, 2009]

Vegetable oil prices have been rather stable until end 2006. From March 2007 to February 2008, vegetable oil prices have more than doubled for all types of oil (expressed in US$/tonne). This raises questions about the link between increased biodiesel production and raising vegetable oil prices (especially for rapeseed oil), although there are also other causes playing a role (see before). The similarity with the evolution of crude oil prices is very striking.

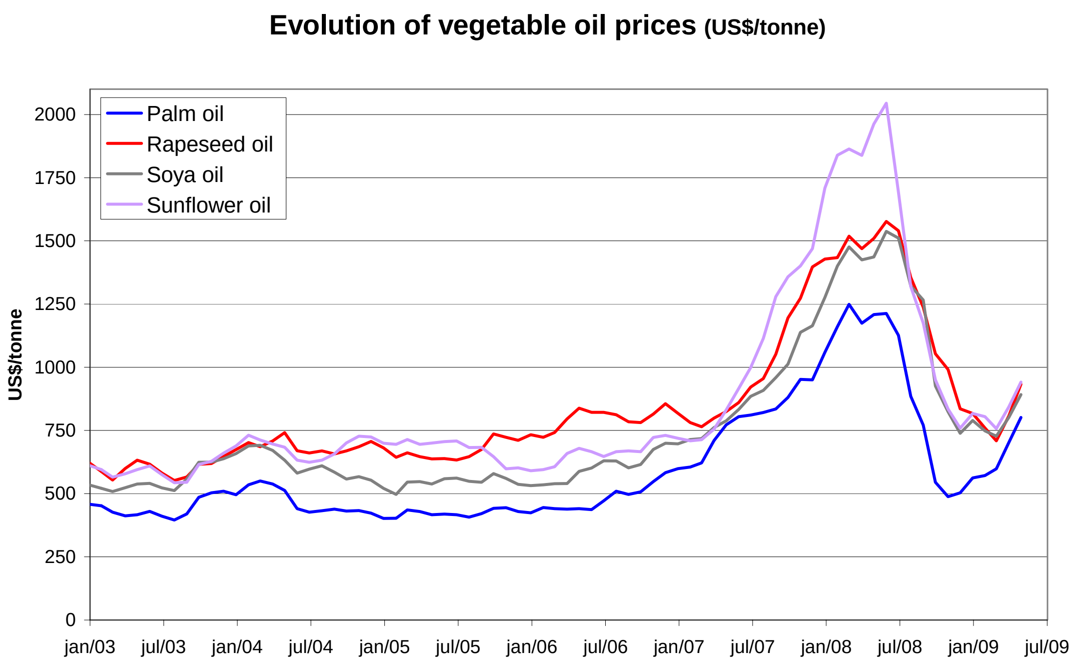

Figure 32: Evolution of vegetable oil prices
Data derived from [FAOSTAT, 2009]

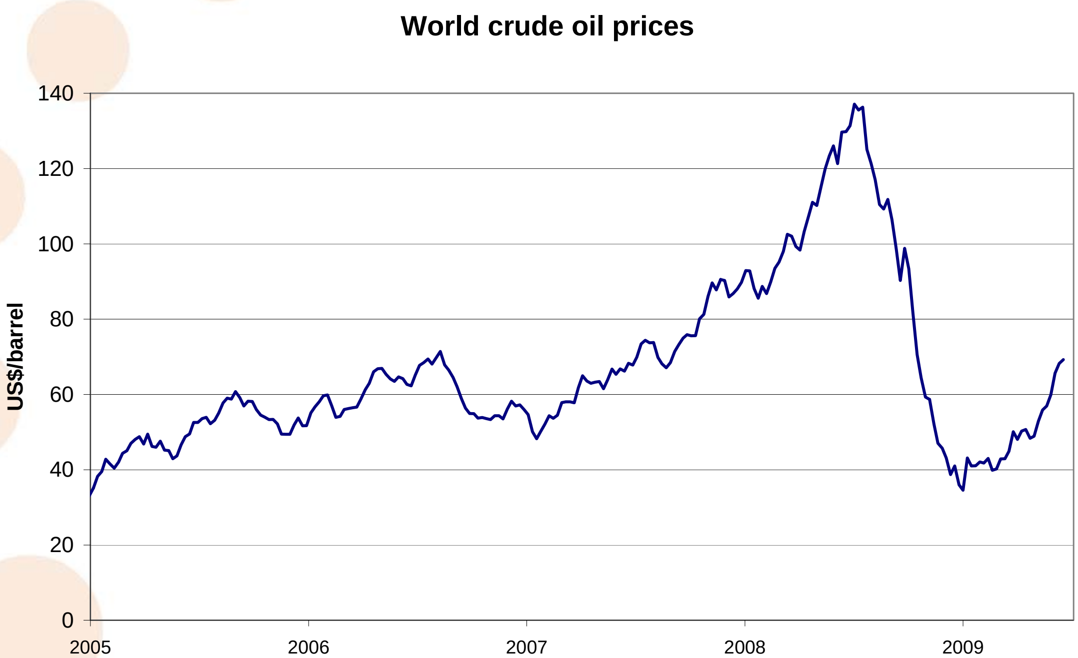

Figure 33: World crude oil prices
Data derived from [EIA, 2009]

3.3.3 Palm oil market

Global palm oil production and trade have risen sharply and continuously from the 1970s onward (see Figure 34 and Figure 35) Around 80-85% of worldwide palm oil is produced in Indonesia and Malaysia. Smaller fractions are produced in Sub-Saharan Africa and South-America.

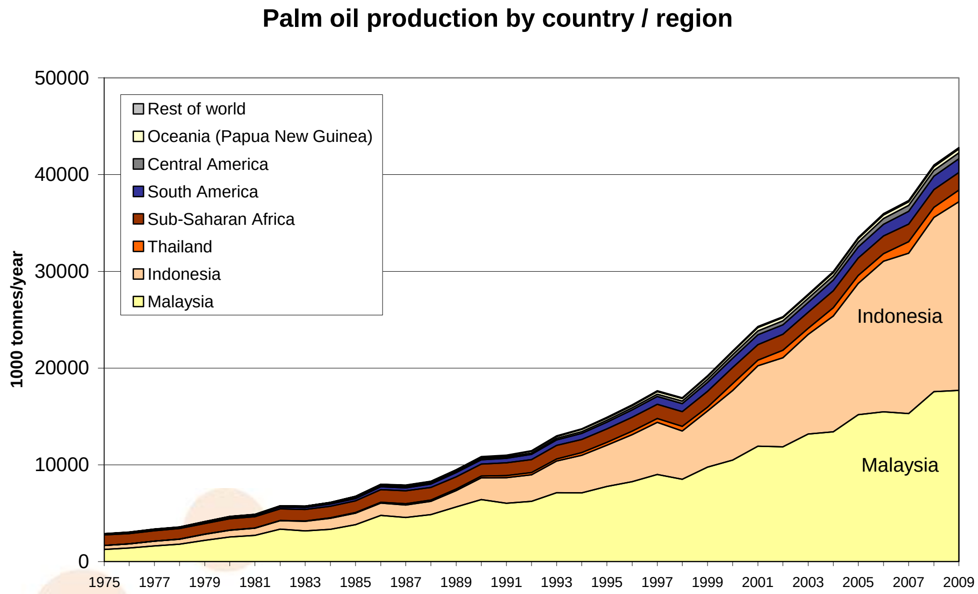

Figure 34: Palm oil production by country / region
Data derived from [USDA-FAS, 2009]

When looking at the export figures, it is striking that about 70% of palm oil production is exported to the rest of the world. Main volumes are again coming from Malaysia and Indonesia. Malaysia is exporting 80-90% of its palm oil; Indonesia exported around 50% of its palm oil production in the 1990s, this figure has risen up to 70% by 2007.

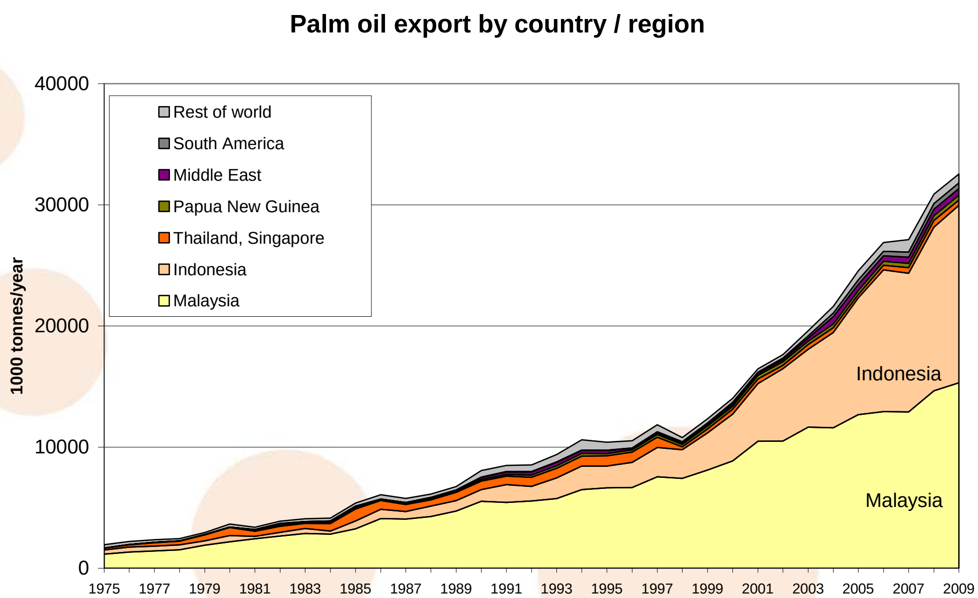

Figure 35: Palm oil export by country / region

Data derived from [USDA-FAS, 2009]

Palm oil is exported to all parts of the world. The main importing regions are China, India, EU, Middle East and Pakistan.

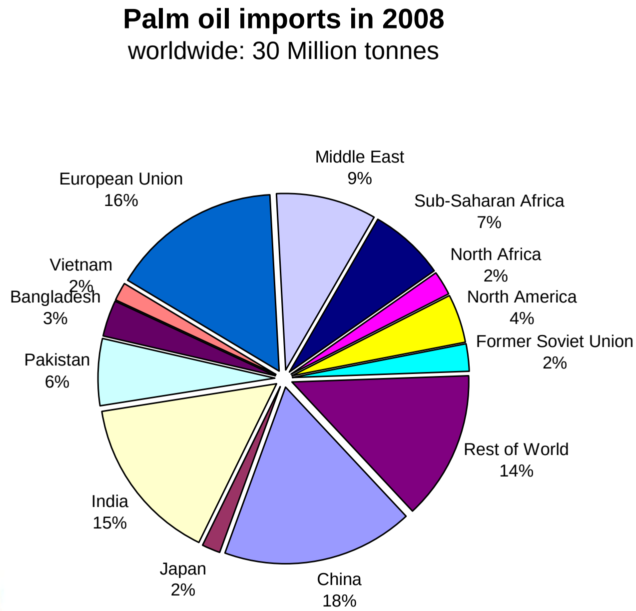

Figure 36: Palm oil imports (million tonnes / yr) in 2008
Data derived from [USDA-FAS, 2009]

When looking at the evolution over time, the palm oil import is rising in most countries, with China having a spectacular rise since 2000. The demand in Europe has also increased continuously. Only in 2009 a first decline is expected.

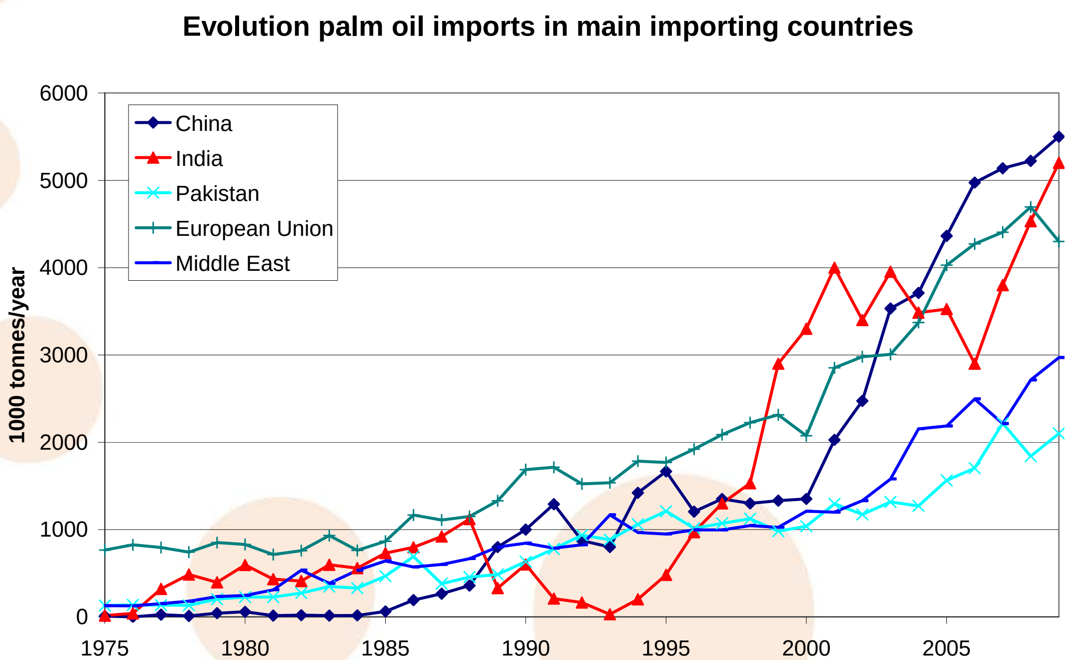

Figure 37: Evolution palm oil imports in main importing countries

Data derived from [USDA-FAS, 2009]

3.3.4 Palm oil versus biodiesel: South-East Asia

Since Malaysia and Indonesia account for 85% of global palm oil supply, any discussions involving biofuels in South-East Asia will always involve palm oil. Figure 38 shows the evolution of global palm oil use. The global use of palm oil for food has actually doubled in the past 8 years. Since 2003 industrial applications are also growing, this may be partly related to biodiesel production, partly to other oleochemical applications (possibly replacing other vegetable oils for these applications).

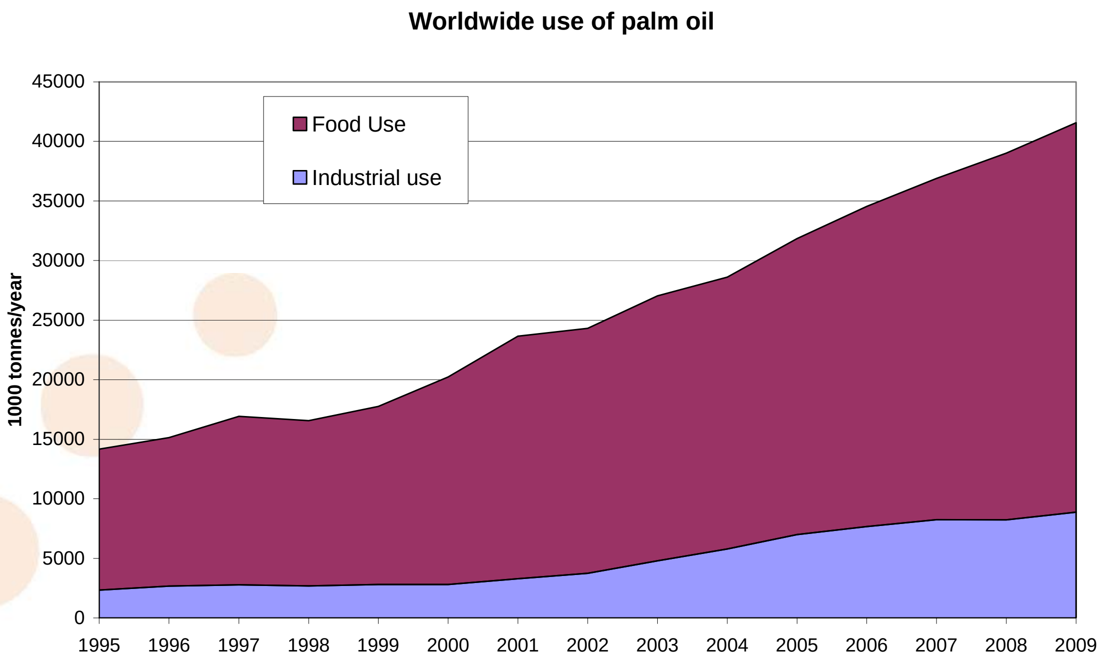

Figure 38: Worldwide use of palm oil
Data derived from [USDA-FAS, 2009]

Commercial production of biodiesel from palm oil in South East Asia has started with Malaysia taking the region's lead role. In conjunction with Indonesia, both governments have approved the allocation of up to 6 million tonnes (up to 40% of total national output) of palm oil production towards biodiesel production. However, the increase in palm oil prices has lowered the biodiesel production to less than 0.5 million tonnes in 2007 in South-East Asia. Currently, virtually the entire biodiesel 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).

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. However, the use of palm oil as biodiesel feedstock to date has been rather modest.

Nevertheless, the prospect of palm oil for biofuel remains optimistic in the longer term. Palm oil could be the beneficiary from the expected biodiesel shortfalls in EU as demand for rapeseed oil exceeds supply (see further). Ultimately, the relative prices of crude and vegetable oil, along with subsidy and trade policies in the United States and the European Union, possibly in combination with sustainability requirements, will determine the size of Indonesia's and Malaysia's export markets and, in turn, the investments in oil palm plantations.

A closer look at the evolution of world palm oil prices, shows that prices have risen considerably within the last years (since 2006) (see Figure 32). Worldwide increase in demand (mainly for food), but also speculation over biodiesel production in Indonesia and other countries helped drive palm oil prices up more than double between mid 2006 and mid 2008 up to a maximum of 1200 US$/tonne. By the end of 2008 world palm oil prices have dropped to 500US$. Meanwhile prices have increased somewhat again up to 750US$ /tonne (see Figure 32).
[KLEFFMANN 2007 / FAO 2006 b / ENVIRONMENT 2007]

3.3.5 Soybean oil market

Here we make the distinction between production of the soybeans themselves, and production of soybean oil. Some countries do produce a substantial amount of soybean oil from imported soybean.

The biggest producers of soybean are the USA, Brazil, Argentina and China.

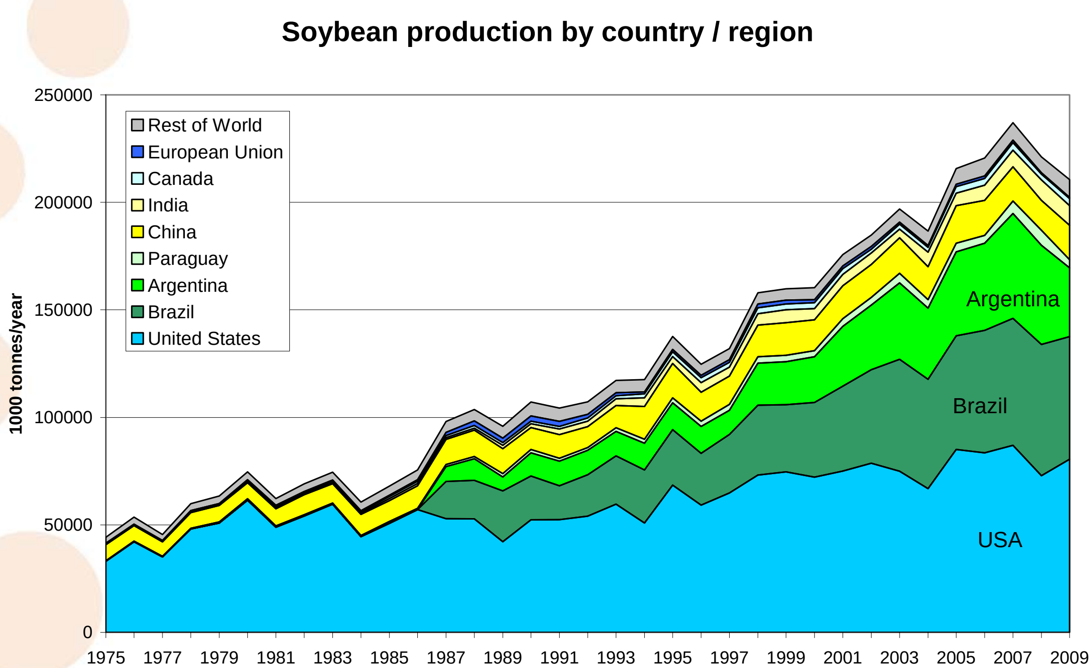

Figure 39: Soybean production by country / region
Data derived from [USDA-FAS, 2009]

About 30% of soybean production is exported to other parts of the world. The USA exports 30-40% of its soybean production, Brazil 20-40% and Argentina 15-25%. Other countries like China use most of their production for own consumption, and even import extra (see further).

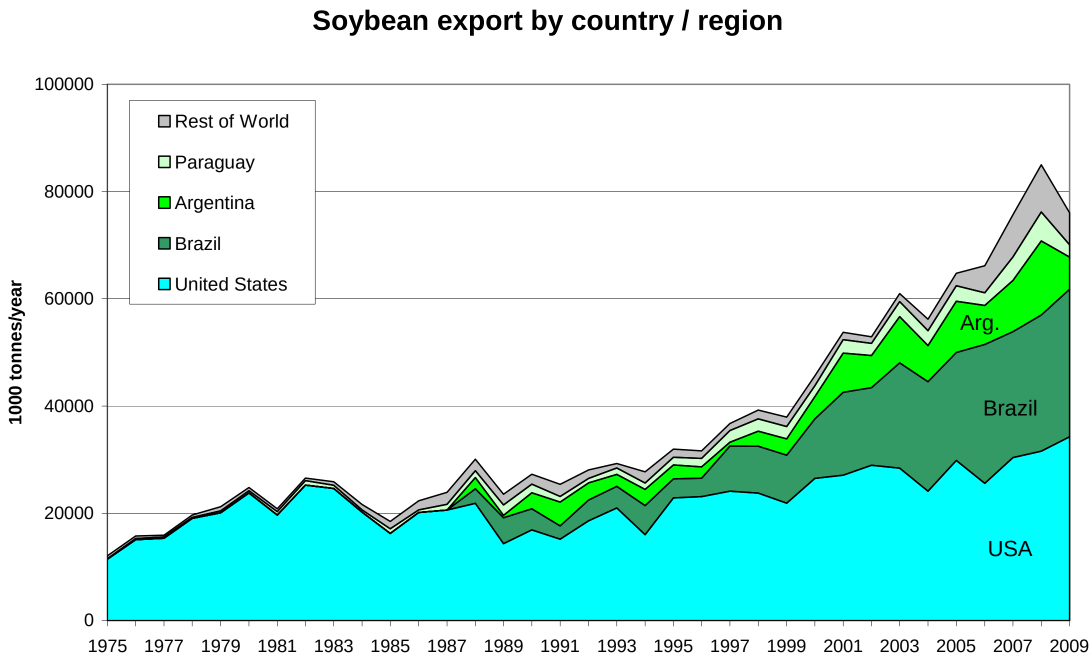

Figure 40: Soybean export by country / region
Data derived from [USDA-FAS, 2009]

The main soybean importers are China, EU, Japan, Mexico and the Middle East. About 60% is exported to Asia, of which China takes the biggest part.

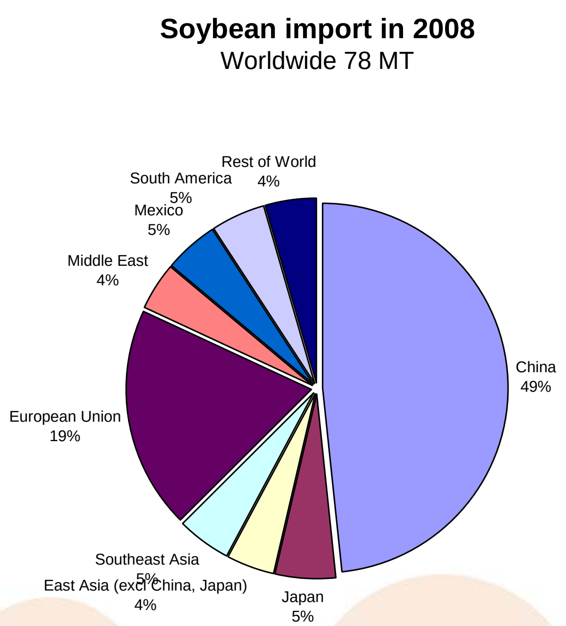

Figure 41: Soybean import in 2008
Data derived from [USDA-FAS, 2009]

When looking at the historical evolution of soybean imports, we see that until 2003, the European Union was the major soybean importer, but China has had an enormous increase since, which is mainly related to their growing feed use to produce meat.

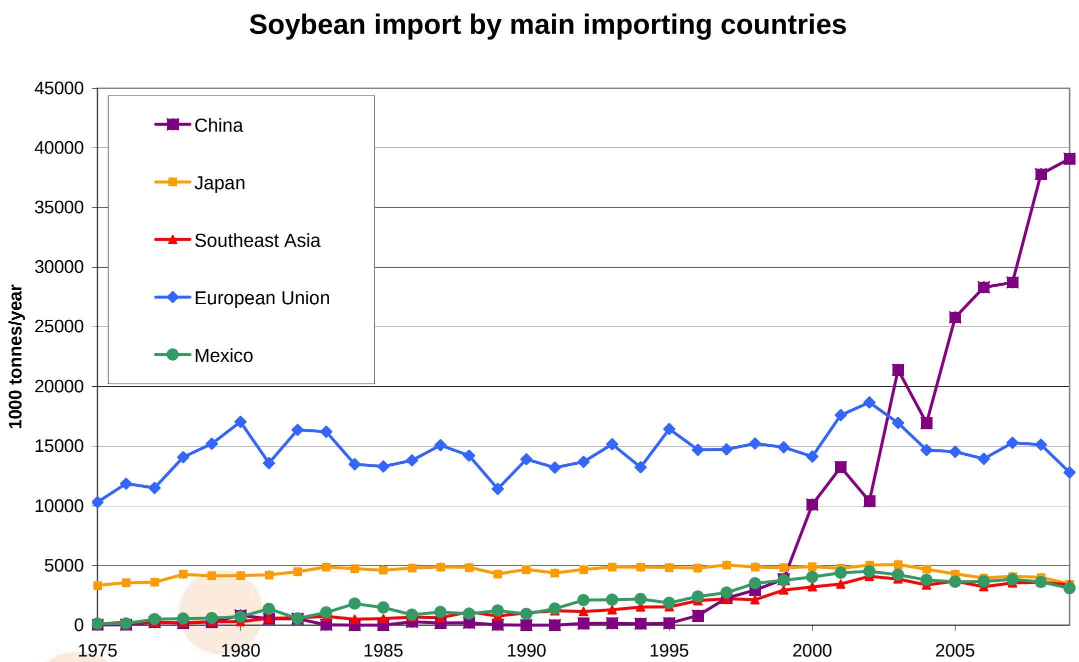

Figure 42: Historical evolution of soybean import by country / region
Data derived from [USDA-FAS, 2009]

The distribution of soybean oil production is comparable, although the role of especially China has increased (based on imported soybeans).

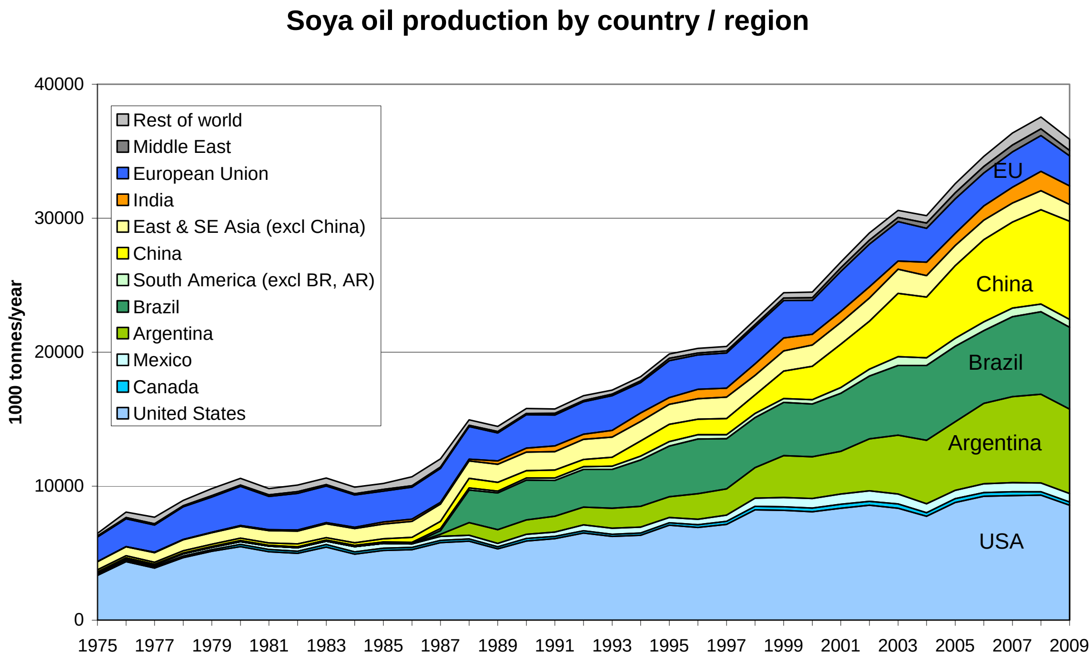

Figure 43: Soybean oil production by country / region
Data derived from [USDA-FAS, 2009]

About 30% of soybean oil is exported, however there are enormous differences between countries. Argentina exports around 90% of its soybean oil production, while this figures is 30-40% in Brazil and only 10% in the USA. Until 1990 the EU exported 50% of its soybean oil production, this figures has dropped to 10% recently.

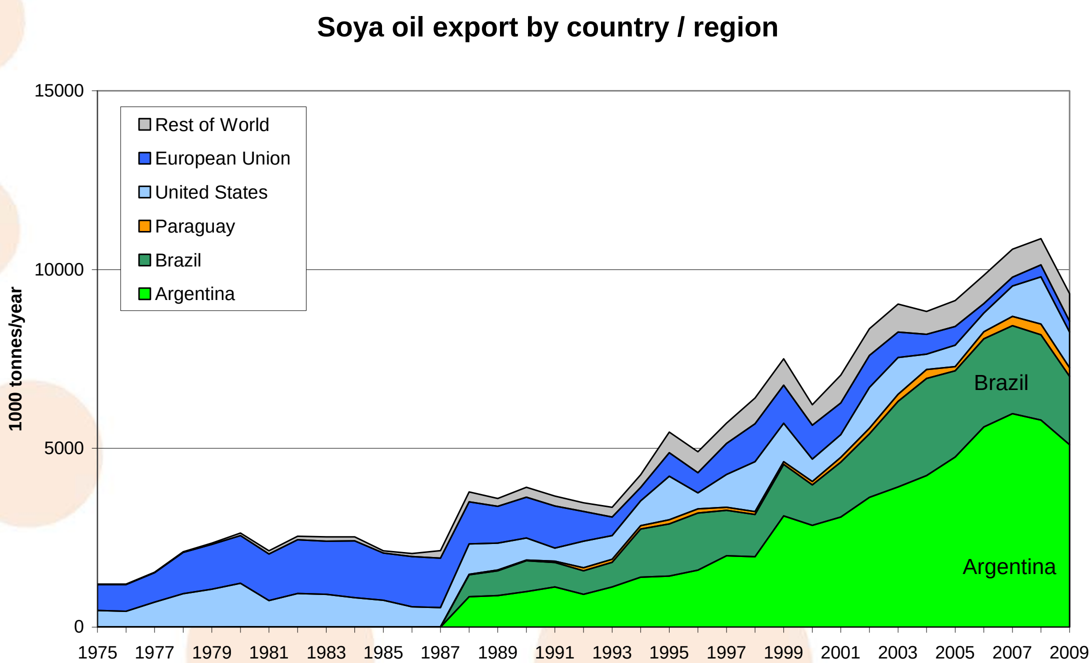

Figure 44: Soybean oil export by country / region
Data derived from [USDA-FAS, 2009]

The main importing countries of soybean oil are situated in Asia (about 50% of the total), with China, India being most important. The other exports are spread over the world.

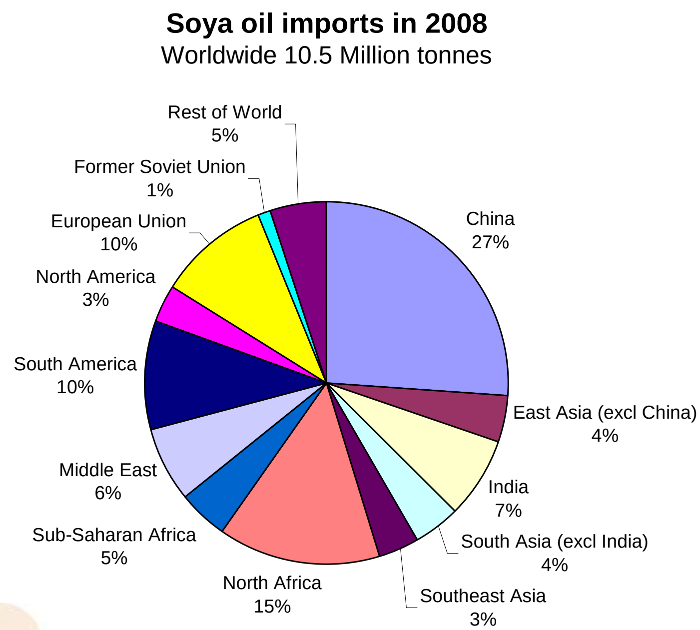

Figure 45: Soybean oil importing countries in 2008
Data derived from [USDA-FAS, 2009]

When looking at the historical evolution of imports, we see big fluctuations. The trend is clearly rising recently, mainly from Europe and China.

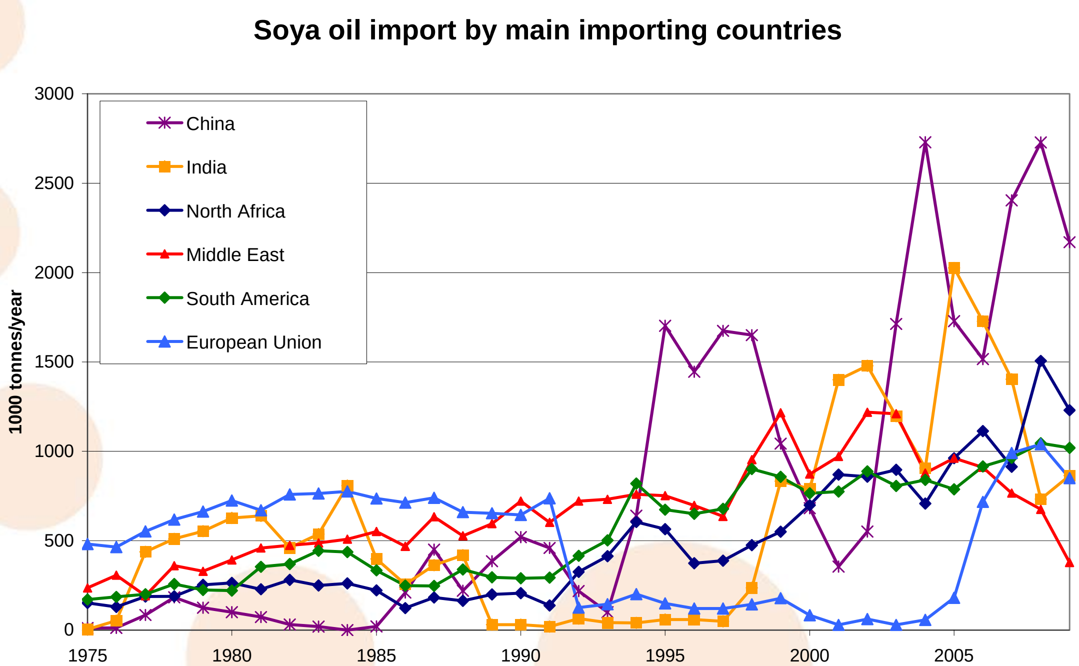

Figure 46: Historical evolution of soybean oil import by country / region
Data derived from [USDA-FAS, 2009]

3.3.6 Soybean oil versus biodiesel: United States

The use of soybean oil for food is still rising. Until 2005 industrial use of soybean oil was marginal. After 2005 its industrial use is growing, mainly for biodiesel production in the USA and South America.

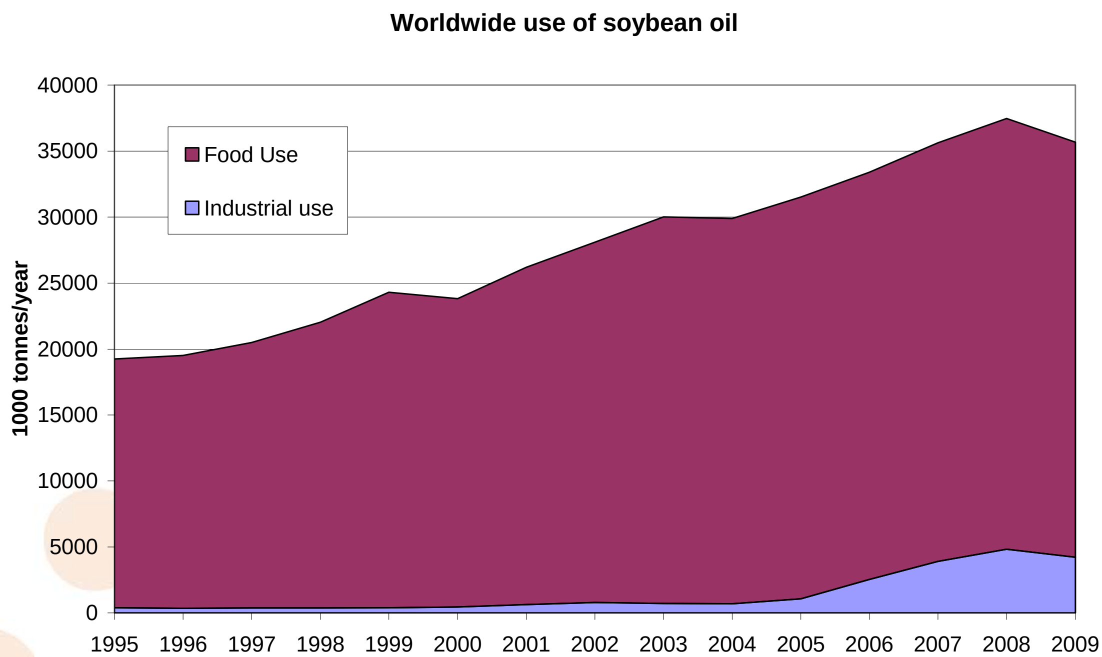

Figure 47: Worldwide use of soybean oil
Data derived from [USDA-FAS, 2009]

Although soybeans are not the most efficient crop for the production of biodiesel, their common use in the United States for food products has led to soybean biodiesel becoming the primary source for biodiesel in the US. In a few years time biodiesel production in the US increased from 83000 tonnes per year in 2004 up to 1.7 million tonnes in 2007, a level which is still 3 times lower than biodiesel production in the EU.

Prices of soybean and soybean oil have increased very fast between mid 2007 and mid 2008. Nevertheless it should be mentioned that prices were very low between 1998 and 2006 (except in 2004).

3.3.7 Rapeseed oil market

Here we make a distinction between production of rapeseed, and production of rapeseed oil. Some countries do produce a substantial amount of rapeseed oil from imported rapeseed.

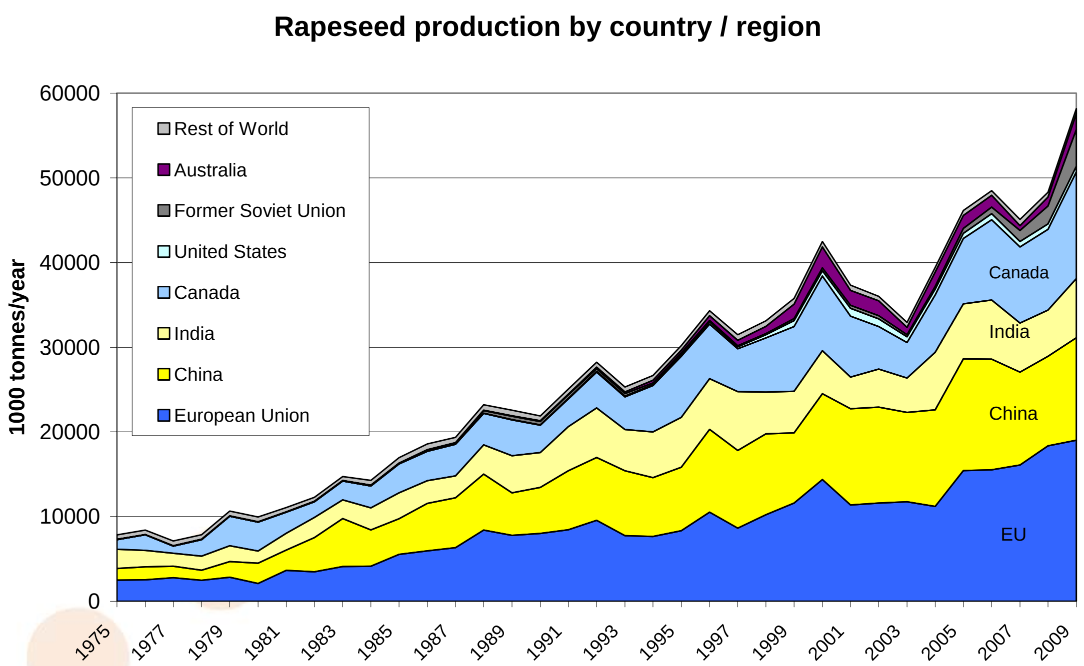

Figure 48: Rapeseed production by country / region
Data derived from [USDA-FAS, 2009]

The main rapeseed producers are the European Union, China, India and Canada. When looking at the export figures, only 15% of produced rapeseed is exported. Canada plays a prominent role in worldwide trade (50-60% of its own rapeseed production), while the other countries mostly consume their rapeseed themselves.

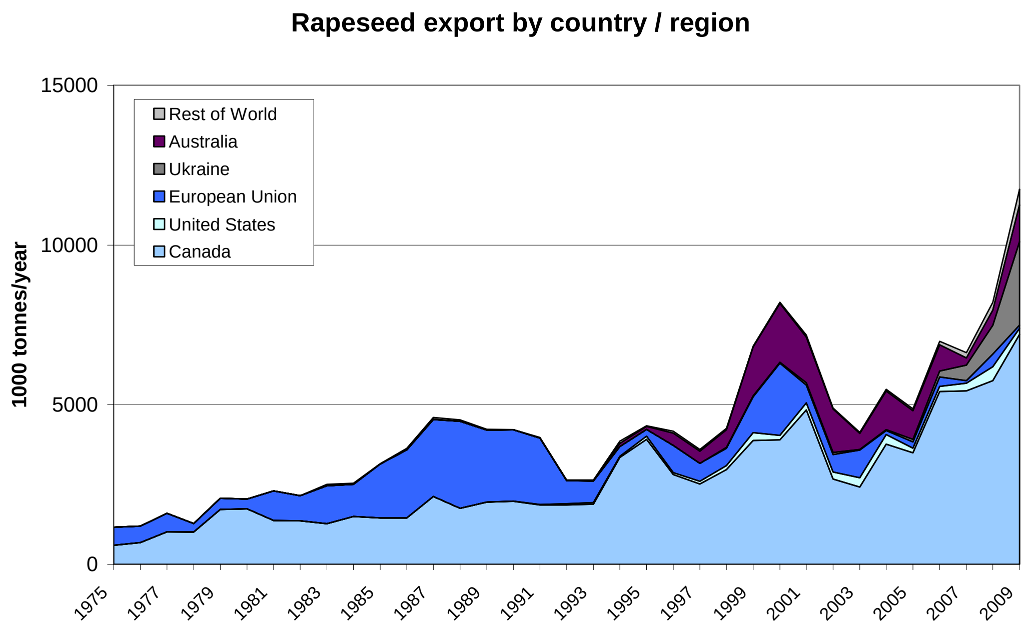

Figure 49: Rapeseed export by country / region
Data derived from [USDA-FAS, 2009]

60% of exported rapeseed goes to Asia, with Japan being the biggest importer.

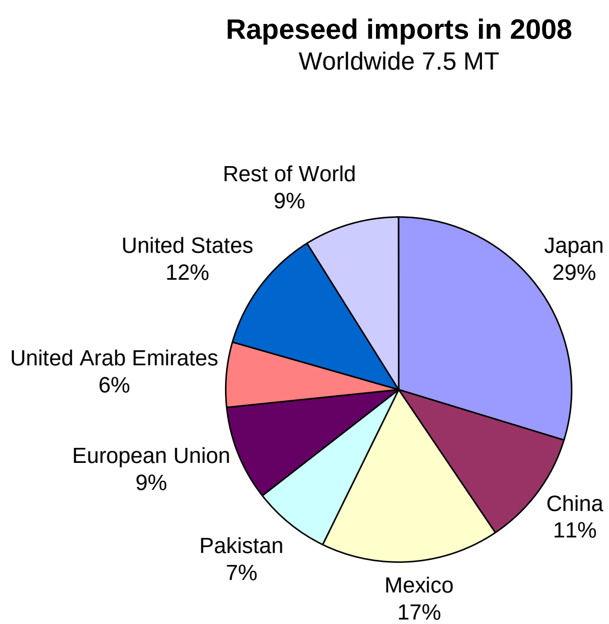

Figure 50: Rapeseed imports in 2008
Data derived from [USDA-FAS, 2009]

When looking at the historical evolution, Japan has a very stable import of rapeseed, while the role of China fluctuates a lot. Very recently Europe is increasing its rapeseed imports very much.

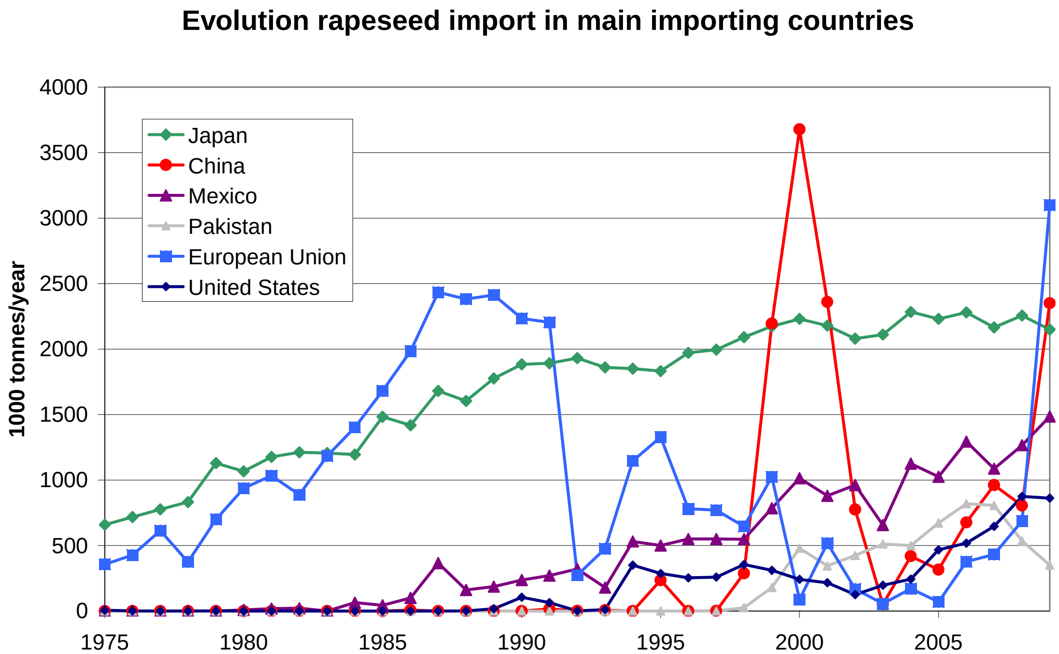

Figure 51: evolution rapeseed import in main importing countries
Data derived from [USDA-FAS, 2009]

Production figures of rapeseed oil are similar to the ones of rapeseed, with Canada playing a smaller role (as they export half of their rapeseed).

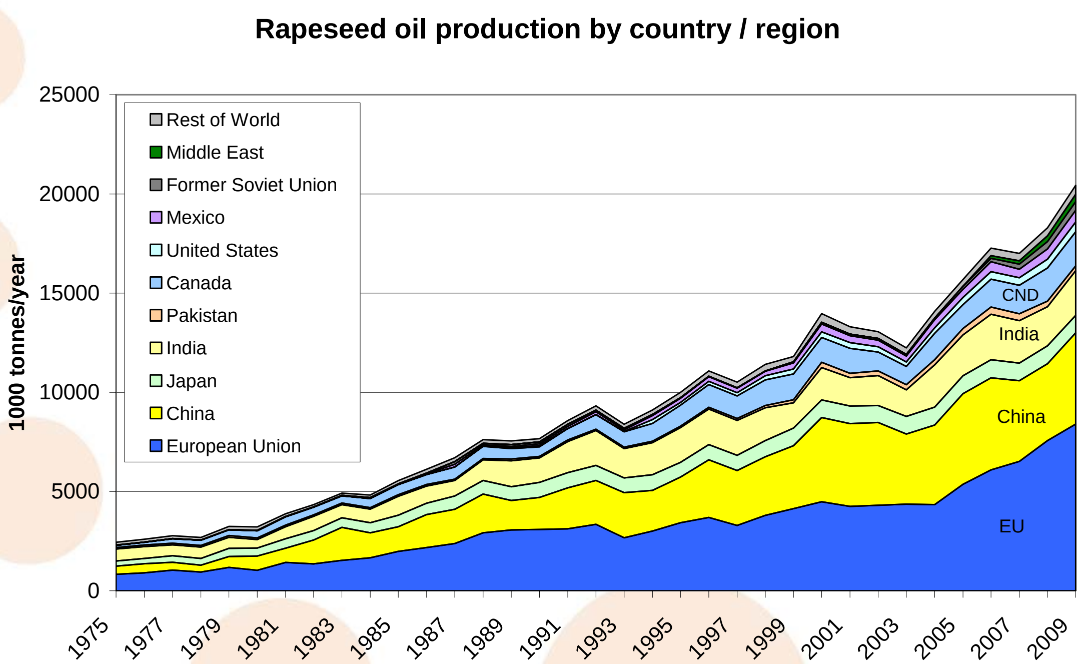

Figure 52: Rapeseed oil production by country / region
Data derived from [USDA-FAS, 2009]

Only 10% of rapeseed is exported to the global market. Europe used to be the main exporter until 1997, in the past 10 years Canada has taken over this role. Canada exports about 80% of its own rapeseed oil production.

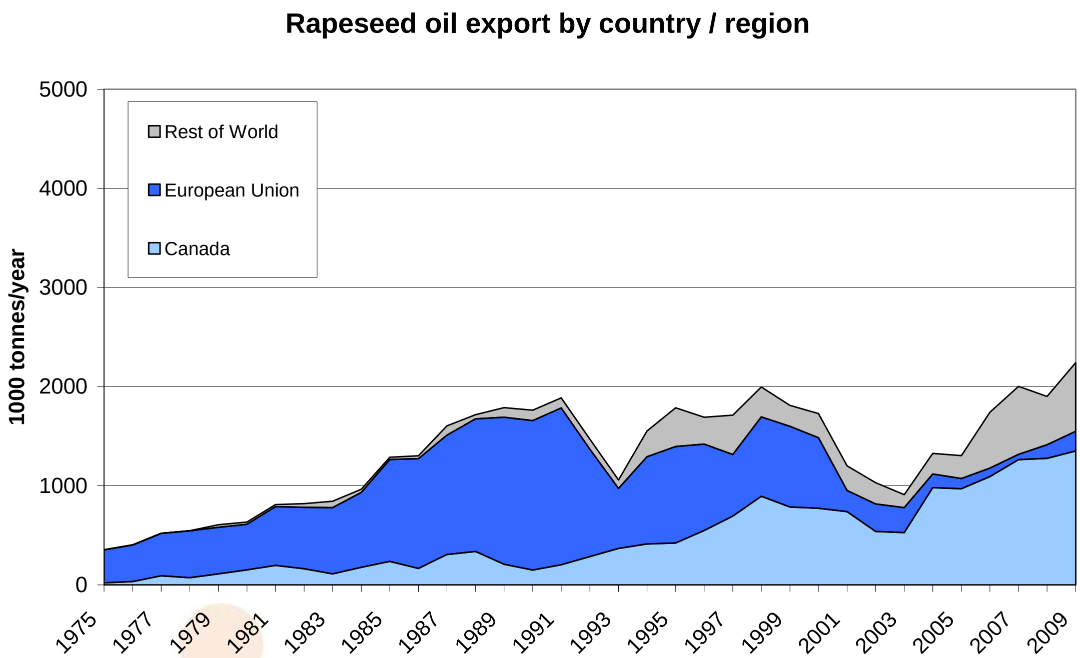

Figure 53: Rapeseed oil export by country / region
Data derived from [USDA-FAS, 2009]

Most rapeseed oil is exported to the United States, Europe and China.

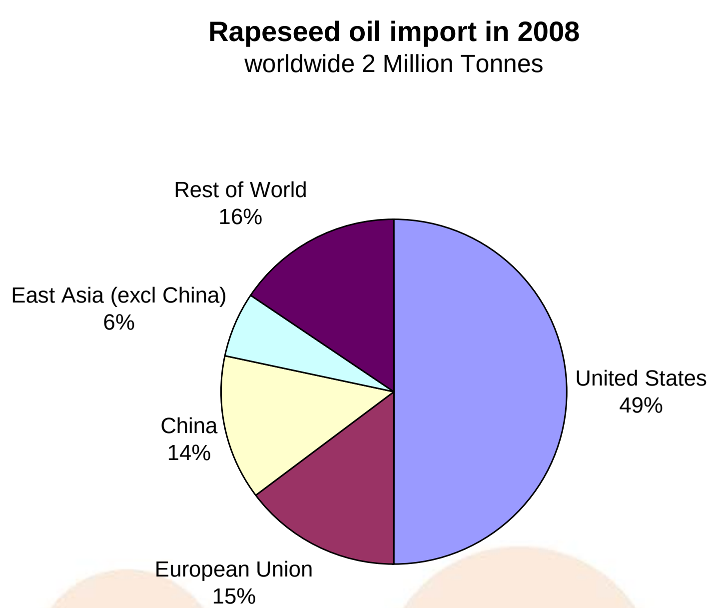

Figure 54: rapeseed oil import in 2008
Data derived from [USDA-FAS, 2009]

The export to the US is very stable, and only increasing in the past years. Europe's rapeseed oil import has clearly been growing since 2005, although there is a fall-back in 2008. The exports to China fluctuate a lot.

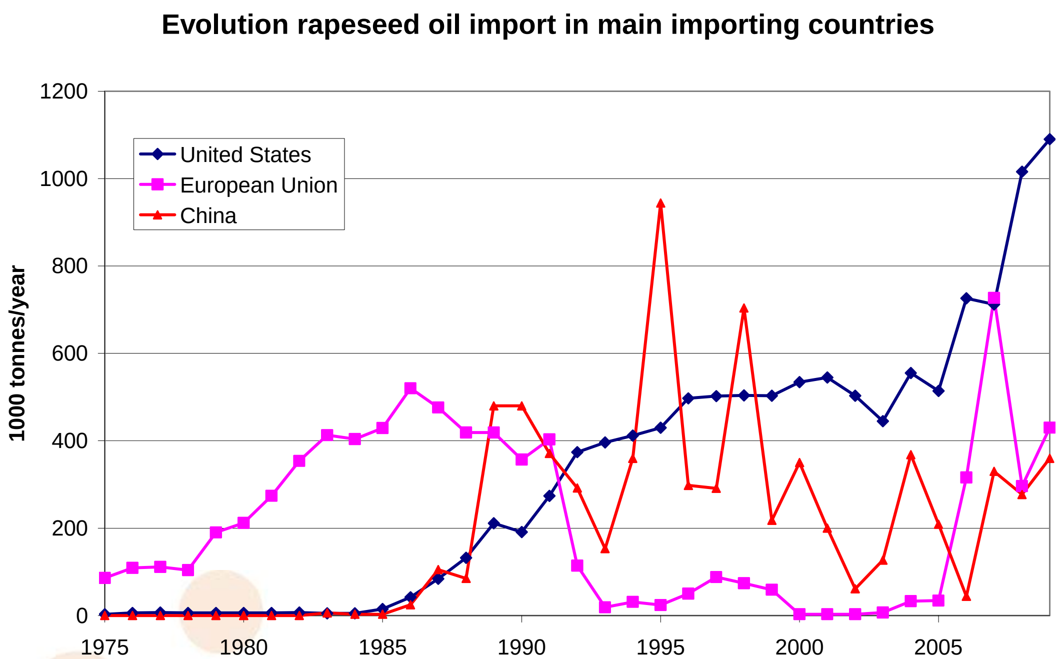

Figure 55: Evolution rapeseed oil import in main importing countries
Data derived from [USDA-FAS, 2009]

3.3.8 Rapeseed oil versus biodiesel: EU

The EU - the world's main biodiesel producing region - has witnessed strong growth rates in biofuel production in the last ten years (see Figure 31). The bulk of biofuel demand is met by biodiesel produced from domestically grown rapeseed The reason for the dominant role of rapeseed oil - a relatively high priced feedstock – is to be found in the tradition of producing rapeseed, and the high level of public support provided in EU countries.

If we look at the worldwide use of rapeseed oil (see Figure 56), we can see that the use for food applications is rather stable although strong global growth in average income combined with rising population has increased the demand. The main growth is in industrial applications (specifically biodiesel in Europe) since 2003. At the same time EU exports of rapeseed oil have been decreasing (see Figure 53) over the past decade and EU imports have been increasing since 2005 (Figure 55). This evolution indicates a clear influence of the biodiesel sector to rapeseed demand.

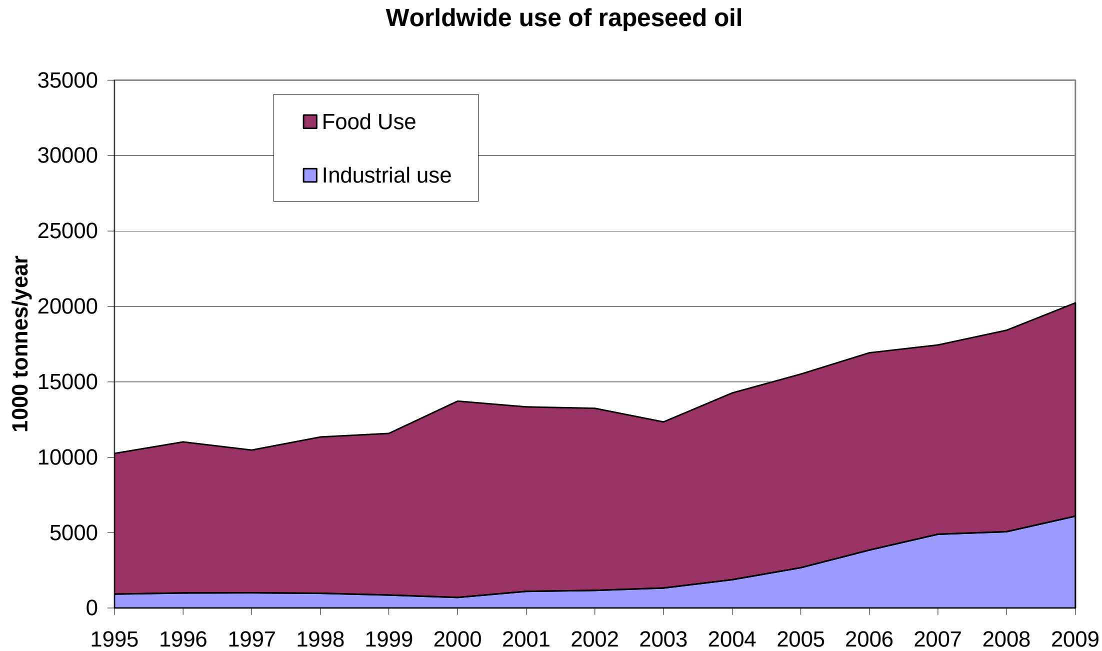

Figure 56: Worldwide use of rapeseed oil
Data derived from [USDA-FAS, 2009]

3.3.9 Overall vegetable oil situation in the EU

As previously stated, the EU is the world's main biodiesel producing region and has witnessed strong growth rates in between 1999 and 2008. The bulk of biofuels demand is met by biodiesel produced from domestically grown rapeseed. The reason for this dominant role – a relatively high priced feedstock – is to be found in the tradition of producing rapeseed, and the high level of public support provided in EU countries. The EU has recently accepted a mandate for renewable fuels (mostly biofuels) that will account for 10% of transportation fuel by 2020.
Nevertheless there seems to be a stabilisation of the production of biodiesel in Europe between 2008 and 2009. Some countries are still increasing their production and use towards the European targets (5.75% biofuels by 2010), while other countries like Germany experience various setbacks in biodiesel production. Reasons are:

(1) decrease of crude oil prices, making the case of biodiesel less profitable;
(2) competition with subsidized imported biodiesel;
(3) reduction of policy support, mainly to the pure biodiesel market (B100);
(4) sustainability discussions, reducing political backing and also reducing the support of the public. In some countries the debate was really detrimental for the image of biofuels in general.

If we look at the worldwide use of rapeseed oil, it can be seen that the use for food applications is rather stable, although strong global growth in average income, combined with rising population, has increased the demand for vegetable oils in general quite significantly. Since 2003 the main growth for rapeseed oil has been for industrial applications, and particularly biodiesel in Europe.

While soybean oil production in the EU has been decreasing since 1970, rapeseed oil production has been increasingly over the same period and particularly from 2004 onward, as illustrated in the figure below. This trend is further illustrated in Figure 58 which shows rapeseed production (minus exports) and imports in the EU from 1999 to 2008; these amounts are both processed and consumed within the EU. A significant feature is the small role of imports, although there is a noticeable increase from 2007 and 2008.

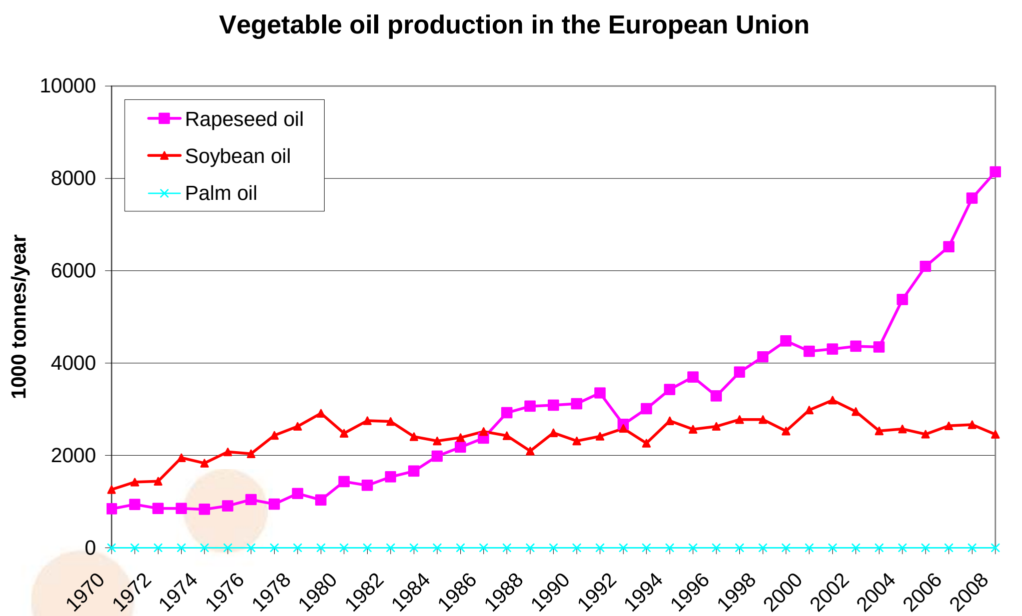

Figure 57: Production of rapeseed oil, soybean oil and palm oil in the European Union
Data derived from [USDA-FAS, 2009]

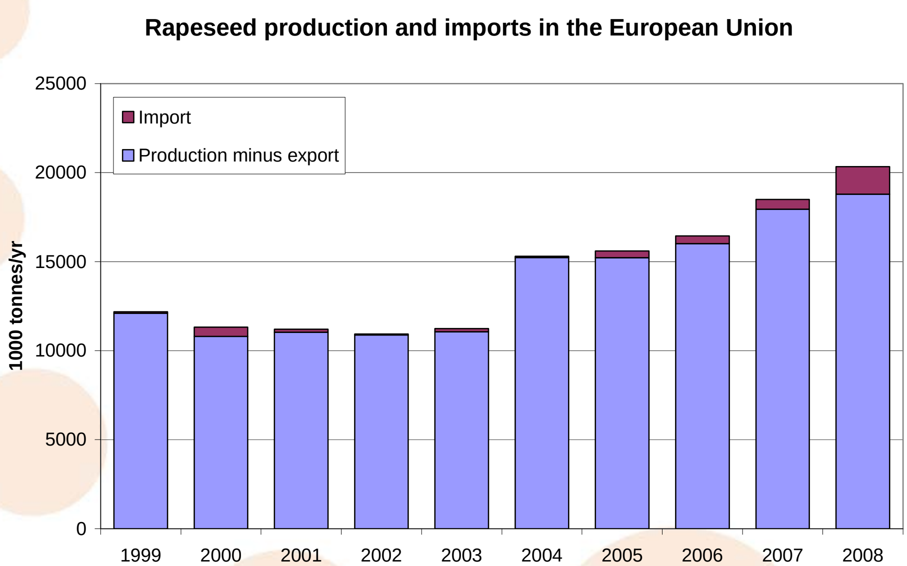

Figure 58: Rapeseed production (minus export) and imports in the European Union, 1999 – 2008
Data derived from [USDA-FAS, 2009]

Figure 59 shows vegetable oils (palm oil, soybean oil, rapeseed oil) export by the EU from 1970 throughout 2008, which, as can be seen, are very small for rapeseed and soybean, while in the case of palm oil is almost non-existent. The exports of vegetable oils have been declining for decades, particularly since mid 1990s, as most of the production is used domestically.

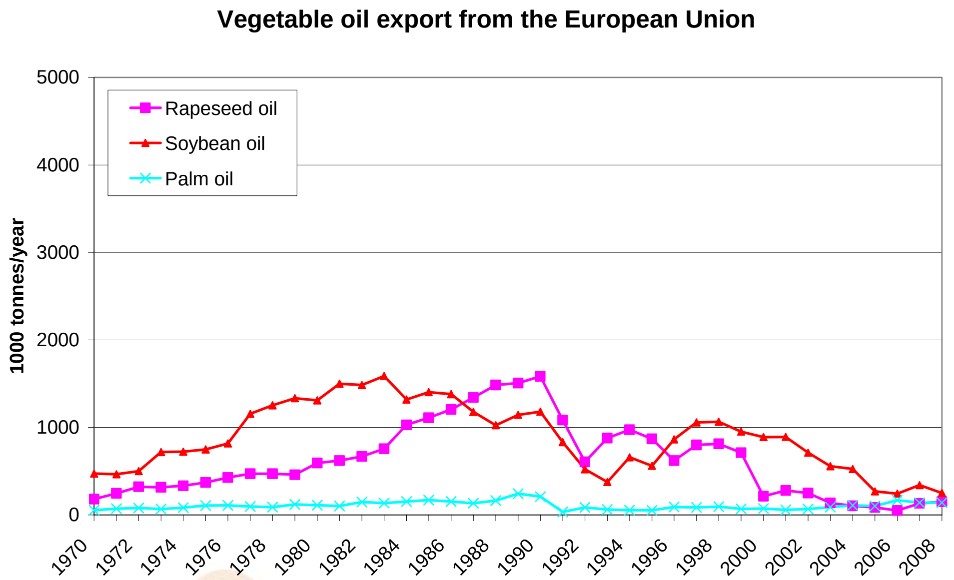

Figure 59: Export of rapeseed oil, soybean oil and palm oil from the EU, 1970-2008
Data derived from [USDA-FAS, 2009]

In contrast, the import has been increasing, especially of palm oil. However, this trend started in the 1980s, before the boom in biodiesel production, driven by the food market. Nevertheless, in recent years, the increased use of rapeseed oil for biodiesel may have contributed to a switch to palm oil for food or other industrial applications.

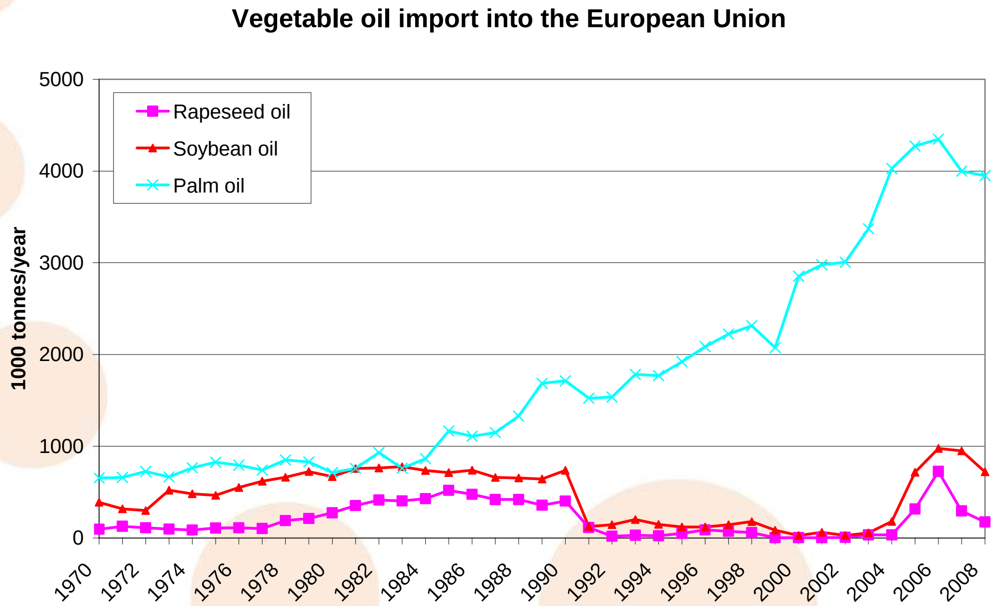

Figure 60: Import of rapeseed oil, soybean oil and palm oil into the EU, 1970-2008
Data derived from [USDA-FAS, 2009]

Conclusions for the European market

Two specific observations in European trends can be made that are of particular relevance for global trade in vegetable oil:

- Increasing consumption of domestically produced rapeseed oil for biodiesel uses may have lead to a considerable gap in EU food oil demand (which continues to increase), resulting in an increase on imports for other types of oil (mostly edible palm oil).
- Various projections indicate that in the future EU biofuel consumption would have to rely heavily on imports of feedstocks rather than on domestic sources because of their higher costs.

The case for biodiesel from vegetable oils in Europe, and certainly its growth, will be rather difficult in the future. One of the main reasons can be that greenhouse gas reduction for biodiesel from rapeseed is estimated around 40% (without indirect effects); from 2017 there will be a minimum limit of 60% greenhouse gas reduction. Although there are still questions around second generation technology, there will probably be a strong drive to push cellulose or waste/residue based biofuels instead of current 1st generation biofuels.

4 Conclusions

Increasing biofuel production either due to pure market forces and/or policy decisions may have significant impacts on agricultural markets, including the trade in agricultural commodities. There are also other linkages between food and biofuel production, including the competition for land, but also for other production inputs. The effect of an increasing supply of by-products of biofuel production also affects other markets, but in a more positive way.

Biofuel policies were often blamed in the past two years as the primary reason for the commodity price increases in the period 2007-2008. Nevertheless things should be put into perspective and it is clear that a combination of factors has contributed to the rise of commodity prices.
When looking at the amount of feedstock currently used for biofuel production, we can state that biofuels use significant commodity shares of sugar cane in Brazil, corn in the USA, rapeseed in the EU and the use soy oil for biodiesel in South- and North America is also getting significant proportions. While the sugar market currently seems less linked to energy prices, worldwide markets of corn and vegetable oils were noticibly influenced by the recent growth of biofuels. For the other commodities the effect should be marginal or indirect, although larger impacts may be seen in the future when biofuel shares go up to levels in the order of 10%.

For the possible conflict between food and fuel, land use is also mentioned as an important parameter. Nevertheless this should also be put into perspective: total worldwide land used for biofuel feedstocks is around 20 million hectares (most in USA, Brazil and EU). This compares to a total use of agricultural land of 1500 million hectares worldwide. Growth of land use for biofuels or bio-energy should not necessarily lead to reduced availability of agricultural land - increased prices could even trigger more efficient use of agricultural land.

So there are clearly threats and opportunities to the development of biofuels, and there is a high responsibility in policy choices to avoid the clear risks and disturbances of other markets, while on the other hand positive effects are maximised. The future work in the ELOBIO project will focus stakeholder-supported development of low-disturbing biofuels policies, using model-supported assessment of these policies' impacts on food & feed markets, as well as model-supported analysis of the relations between the biofuels policies and ligno-cellulosic markets.

5 References

DEFRA 2008: The Impact of Biofuels on Commodity Prices. UK Department for Environment, Food and Rural Affairs. April 2008

EC 2007: EC DG Agriculture and Rural development, *'The Impact of a minimum 10% obligation for biofuel use in the EU-27 in 2020 on Agricultural Markets'*, 2007

EC 2009: '*Directive 2009/28/EC of the European Parliament and the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC*'.

ECN 2008: Bole, T. et al, *'The changing dynamics between biofuels and commodity markets'*, Energy Research Centre of the Netherlands, 2008.

EIA 2009: US Department of Energy, Energy Information Administration database. Available at www.eia.doe.gov. Accessed in June 2009.

ENVIRONMENT 2007: Naylor, R. et al, *'The ripple effect: biofuels, food security and the environment'*, Environment, November 2007.

FAO 2006 a: Schmidhuber, J., *'The Long-Term Outlook for Food and Agriculture'*, FAO Expert Meeting 5 on Bioenergy Policy, Markets and Trade and Food Security, 2006.

FAO 2006 b: Thoenes, P., *'Biofuels and commodity markets – Palm Oil Focus'*, FAO, October 2006

FAO 2007 a: Müller, A. et al, *'Some insights in the effect of growing bio-energy demand on global food security and natural resources*', FAO, Paper presented at the International Conference: 'Linkages between Energy and Water Management for Agriculture in Developing Countries', Hyderabad, India, January 2007.

FAO 2007 b: Schmidhuber, J., *'Biofuels: An emerging threat to Europe's Food security?'*, FAO, May 2007.

FAO 2008 a: *The State of Food and Agriculture – Biofuels: prospects, risks and opportunities*, 2008.

FAO 2008 b: A. Flammini, '*Biofuels and the underlying causes of high food prices'*, Food and Agriculture Organization of the United Nations (FAO). October 2008

FAOSTAT 2009: Commodity prices derived from Food and Agriculture Organisation of the United Nations (FAO), http://www.fao.org/worldfoodsituation/FoodPricesIndex/en/ Accessed in September 2008, and updated in June 2009.

FAPRI 2005: FAPRI, *'Implications of Increased Ethanol Production for U.S. Agriculture'*, August 2005.

FAPRI 2006: FAPRI, *'Baseline Update for US Agricultural Markets'*, June 2006.

FERRIS 2005: Ferris, J.N. et al, *'An econometric analysis of the impact of the expansion in the US production of ethanol from corn and biodiesel from soybeans on major agricultural variables, 2005-2015'*, Agriculture as a Producer and Consumer of Energy. Cambridge, MA: CABI Publishing, 2005.

F.O. LICHTS 2008 a: *'The global ethanol market continues to expand at a rapid race'*, F.O. Licht's World Ethanol & Biofuels Report, 8 May 2008

F.O. LICHTS 2008 b: *'The impact of biofuels on global grain and oilseed markets'*, F.O. Licht's World Ethanol & Biofuels Report, 8 April 2008

F.O. LICHTS 2009 a: *'Biodiesel output in 2009 may grow slower'*, F.O. Licht's World Ethanol & Biofuels Report, 26 March 2009

F.O. LICHTS 2009 b: *'Biofuels and feedstock markets in 2009'*, F.O. Licht's World Ethanol & Biofuels Report, 14 April 2009

F.O. LICHTS 2009 c: *'2009 world ethanol production growth to hit five-year low'*, F.O. Licht's World Ethanol & Biofuels Report, 26 May 2009

Fritsche 2009: Fritsche U., '*Bioenergy GHG Emission Balances including Direct and Indirect Land Use Change Effects'*, presented at the IEA workshop "Sustainability Certification of Biofuels and Bioenergy", 29 January 2009, Brussels.

IEA Bioenergy 2009: F. Rosillo-Calle, L. Pelkmans, A. Walter (2009). '*A global overview of vegetable oils, with reference to biodiesel*'. Study performed within the frame of IEA Bioenergy Task 40. June 2009. Available on http://www.bioenergytrade.org.

IFPRI 2006: Rosegrant, W. et al, *'Biofuels and the Global Food Balance'*, IFPRI, December 2006

IFPRI 2007: Msangi S. et al, *'Global Scenarios for Biofuels: Impacts and Implications'*, International Food Policy Research Institute, 2007

IFPRI 2008: *'Biofuels, international food prices, and the poor'*. International Food Policy Research Institute (IFPRI). June 2008

INRA 2007: Gohin, A., *'Impacts of biofuels on the European agriculture'*, INRA Rennes, September 2007

Iowa State University 2006 a: Elobeid, A. et al, *'The Long-Run Impact of Corn- Based Ethanol on the Grain, Oilseed, and Livestock Sectors: A Preliminary Assessment'*, Center for Agricultural and Rural Development, Iowa State University, Briefing Paper 06-BP 49, 2006

Iowa State University 2006 b: Elobeid, A. et al, *'Removal of U.S. Ethanol Domestic and Trade Distortions: Impact on U.S. and Brazilian Ethanol Markets'*, Iowa State University, October 2006 (Revised)

Iowa State University 2007: Dong, F., *'Food security and Biofuels Development: The case of China'*, Iowa state University, October 2007.

Iowa State University 2008: Babcock, B., *'Breaking the link between Food and Biofuels'*, Iowa state University, July 2008.

JRC 2008: De Santi, (G.) et.al, Biofuels in the European context: facts and uncertainties, JRC, 2008.

KLEFFMANN 2007: *'Impact of biofuels on AG-commodities markets'*, Prepared for ASA International marketing, KLEFFMANN, September 2007.

OECD 2006: OECD, *'Agricultural Markets Impacts of Future Growth in the Production of Biofuels'*, 2006

Purdue University 2007 a: Banse, M. et al, *'Impact of EU Biofuel Policies on World Agricultural and Food Markets'*, Paper Submitted for the GTAP Conference, Purdue University, 2007

Purdue University 2007 b: Birur, D. et al, *'The biofuels boom: implications for world food markets'*, Purdue University, October 2007.

USDA 2007 a: Coyle, W. , *'The Future of Biofuels: A Global Perspective'*, USDA, November 2007.

USDA 2007 b: Valde, C., *'Ethanol Demand Driving the Expansion of Brazil's Sugar Industry', USDA, June 2007.*

USDA 2007 c: Westcott, P., *'Ethanol expansion in the United States, How will the agricultural sector adjust?'*, USDA, May 2007

USDA 2007 d: USDA, *'USDA Agricultural Projections to 2016'*, February 2007.

USDA 2008 a: Trostle, R., *'Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices'*, USDA, May 2008.

USDA 2008 b: '*ERS USDA Briefing Room - Corn*', www.ers.usda.gov/Briefing/Corn/

USDA 2009: *'USDA Long-term Agricultural Projections to 2018'*, February 2009

USDA-FAS 2009: Commodity statistics derived from United States Department of Agriculture, Foreign Agricultural Service http://www.fas.usda.gov/psdonline/psdQuery.aspx. Accessed in September 2008, and updated in July 2009. Figures for 2009 are projections.

WAB 2008: Dornburg et al., '*Assessment of global biomass potentials and their links to food, water, biodiversity, energy demand and economy*'. Performed by various authors in the framework of the Netherlands Research Programme on Scientific Assessment and Policy Analysis for Climate Change (WAB), January 2008.

Walter 2009: A. Walter (2009): *'Initiatives toward sustainability of biofuels production in Brazil'*. UNICAMP. Presentation at IEA workshop 'Sustainability certification of biofuels and bioenergy', Brussels, 29 January 2009

Wiesenthal 2007: T. Wiesenthal, G., P. Christidis, L. Pelkmans, P. Georgopoulos, *Assessment of biofuel policies in Europe – lessons learnt and future policy options*, PREMIA report, IPTS, Spain, May 2007.

World Bank 2008: *'A Note on Rising Food Prices'*. Policy Research Working Paper 4682. July 2008

WUR 2008: Banse, M. et al, *'Why are current world food prices so high?'*, LEI Wageningen UR, May 2008.

Contact Elobio

Energy research Centre of the Netherlands (ECN)
P.O. Box 1
1755 ZG Petten
The Netherlands
info@elobio.eu
http://www.elobio.eu

elobio
Biofuel policies for dynamic markets