UNION ZUR FÖRDERUNG VON OEL- UND PROTEINPFLANZEN E.V.

Supply report 2016/2017

European and world demand for biomass for the purpose of biofuel production in relation to supply in the food and feedstuff markets

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Why a "UFOP supply report"?

The issue of climate protection is both a challenge and an opportunity for agriculture. According to the Paris climate agreement (COP21), more or less complete decarbonisation should take place by 2050; fossil fuel should be replaced by sustainable, renewable carbon. At the same time, adequate supply of affordable and sustainably produced food to the population will be ensured, as a cornerstone of social peace and well-being. The government's regard of democratic basic principles is also of great significance. This is shown by the current example of Venezuela, which is impoverished and on the brink of collapse despite its enormous oil reserves. Along with poor governmental leadership and corruption, there are additional causes for hunger, for example natural disasters and periods of drought, as most recently in Africa.

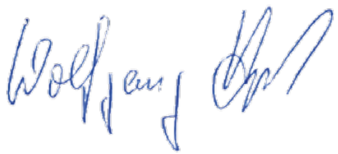
The question might arise as to whether comprehensive food provision to the population is possible or what production potential is to be expected when existing resources are used more efficiently based on a sustainable intensification of agriculture and new sources are developed (e.g. algal biomasses). Just reducing losses in cultivation and harvesting, as well as in transport, storage and processing, offers enormous potential.

The aforementioned aspects are often the subject of a critical discussion on the primary use of arable land, fields and pastures. Biofuels represent the conflicting demands in relation to "availability" and "ethical use". Of course "Food first" applies for agriculture in particular. Nevertheless it cannot be denied that the global basic supply is more than adequate thanks to technological advancement, and there is even potential for growth. But to increase this potential, it must also be possible to exploit the options of technological advancement taking into account social aspects and the safety of biodiversity.

Against this backdrop, the discussion shifts to the pros and cons of using biofuels from sustainable biomass cultivation. The European Union has created legal requirements for this, the effects of which are singular even for third parties who would like to export biofuels or biomass to the EU for production. The suggestions of the EU Commission from November 2016 for revision of the Renewable Energy Directive now threaten to end this "level playing field".

With this report, UFOP aims to objectify the discussion. Select data and statistics demonstrate that the food quantities produced globally are more than adequate for serving plant and animal markets, but also existing and growing markets for material and energy usage. Sustainably produced biofuel materials from cultivated biomass can already contribute greatly to greenhouse gas reduction compared to fossil resources, but also to protein feed supply. The area of material usage and its added value potential will be an important demand driver in the long-term.

And this demand is important: Globally, the producer prices for grains and oilseeds are not sufficient for sustainable intensification. It is often overlooked that agriculture must also earn money itself in order to invest in technological advancement. If the framework conditions for agricultural operations in the EU deteriorate with reference to the global competition, the threat will arise of cultivation of raw materials migrating to other regions. This shifting effect would be unjustifiably measured by cultivation potential for biomass in the EU. In addition, a "one generation contract" would be concluded with COP 21. There are only 33 years left to implement this.



» **Wolfgang Vogel**
Chairman of the UFOP Executive Board

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Editorial department, charts and descriptions:
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1 Feedstock supply

1.1 How much grain is produced on a global scale?

» 1.1.1 Global grain production

As a result of progress in plant breeding, expansions in overall area and improvement of agricultural production practices (fertiliser applications, pest and disease control, reduced losses at harvest and in storage), world grain production has continuously increased over the past decades.

Since 1960/61, harvests of barley, oat, millet, maize, rice, rye and wheat have tripled. Bumper crops in many production regions have led to oversupply on the markets. The number one grain is maize, reflecting its globally increasing importance in the feed sector.

Like barley, maize is mainly used as livestock feed. By contrast, rice and wheat are predominantly used in human diets.

World grain production increases to 2.6 billion tonnes

Production of grains, total and by major crops, worldwide, 2016/17, estimated, in million tonnes

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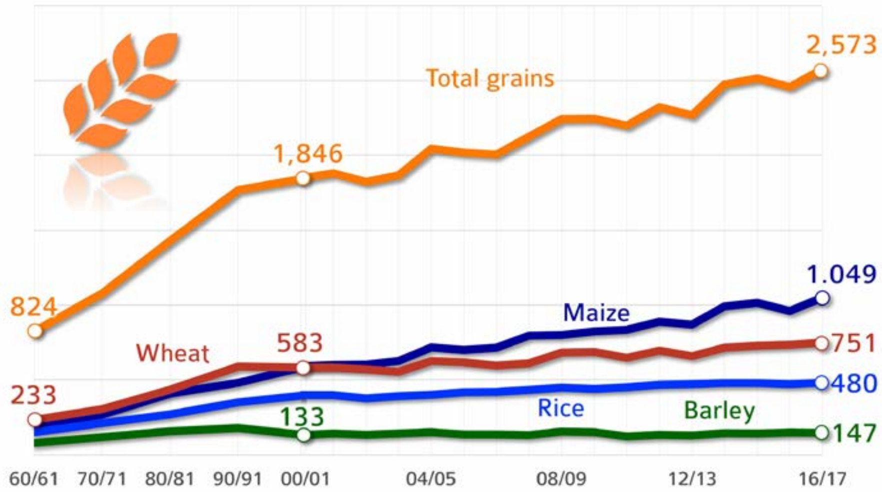


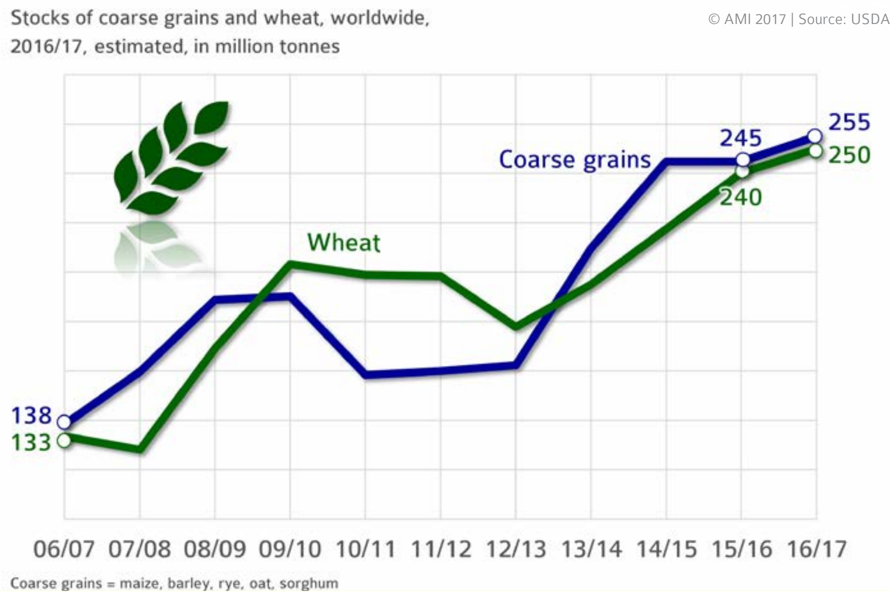
Total grains = maize, wheat, barley, rice, rye, oat, sorghum

» 1.1.2 Global stocks of grains

Due to significant productivity increases in grain cultivation, world grain stocks have grown considerably. In most areas in several consecutive years, production of wheat, maize and coarse grains consistently exceeded consumption. Stocks that are left at the end of a marketing year are the ending stocks that, as beginning stocks, ensure supply at the beginning of the following marketing year.

Over the past ten years, stocks of the different kinds of grain have virtually doubled. Current wheat stocks are sufficient to supply the world with wheat for another 123 days. Coarse grain stocks would cover global demand for 59 days.

Global grain stocks increase to 505 million tonnes



1.1 How much grain is produced on a global scale?

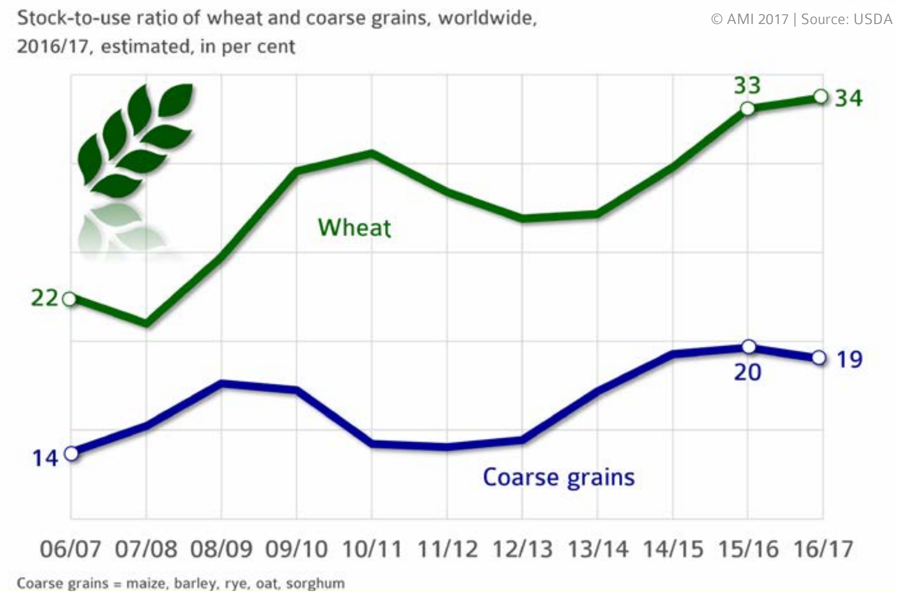
» 1.1.3 Global grain supply

The ratio of supplies to consumption (also called the stock-to-use ratio) is a key figure in estimating supply and, consequently, potential price trends. Large stocks indicate security of supply on the one hand, but they also put pressure on prices.

In other words, the absolute level of global stocks of feed grains shows that, for example, stocks at 255 million tonnes in 2016/17 were up 9 million tonnes from a year earlier. However, a different picture emerges if we look at stocks in relation to increasing use: the value dropped by 0.6 percentage points to 19 per cent.

However, compared to the previous years, the level remains very high, underlining the excellent supply situation for grains (excluding rice) in the markets.

Supply and demand estimate based on the stock-to-use ratio



1.2 How much oilseed and vegetable oil is produced on a global scale?

» 1.2.1 Global oilseed production

World oilseed production reached a new high at more than 558 million tonnes in 2016/17.

Global rise in demand for high-quality feed protein is a key driver of North and South American soybean production and the main reason for the expansion in cultivation area. On a global scale, soybean is the number one oilseed crop, accounting for 60 per cent of world production.

Oilseed crops differ in oil and protein content as well as fatty acid composition and protein quality, along with their climate and soil requirements.

Soybeans are the world's no. 1 oilseed crop

Production of oilseed crops, total and by oilseed crop, worldwide, 2016/17, estimated, in million tonnes

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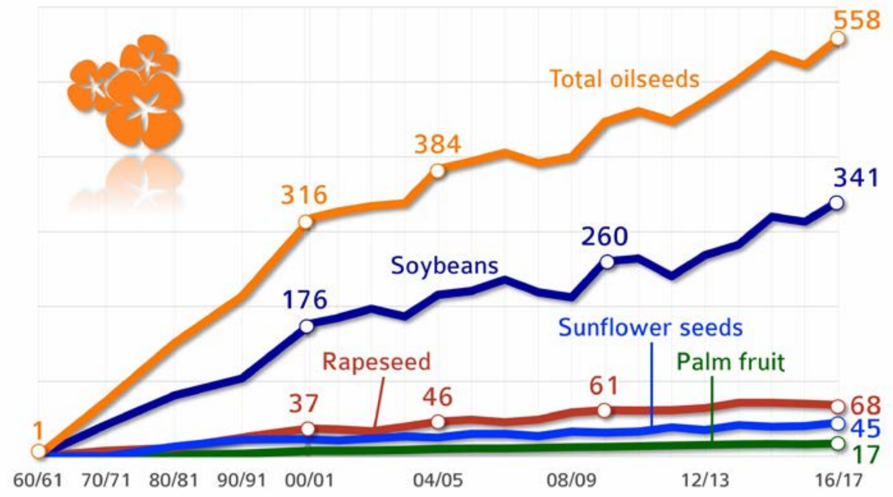

Total oilseeds = soybeans, rapeseed/canola, sunflower seeds, palm fruit, peanuts, coconut, cotton

1.2 How much oilseed and vegetable oil is produced on a global scale?

» 1.2.1 Global oilseed production

↳ 1.2.1.1 Composition of oilseed crops

Sunflowers have the highest oil content

Proportion of pure protein and oil in different oilseed crops, in per cent

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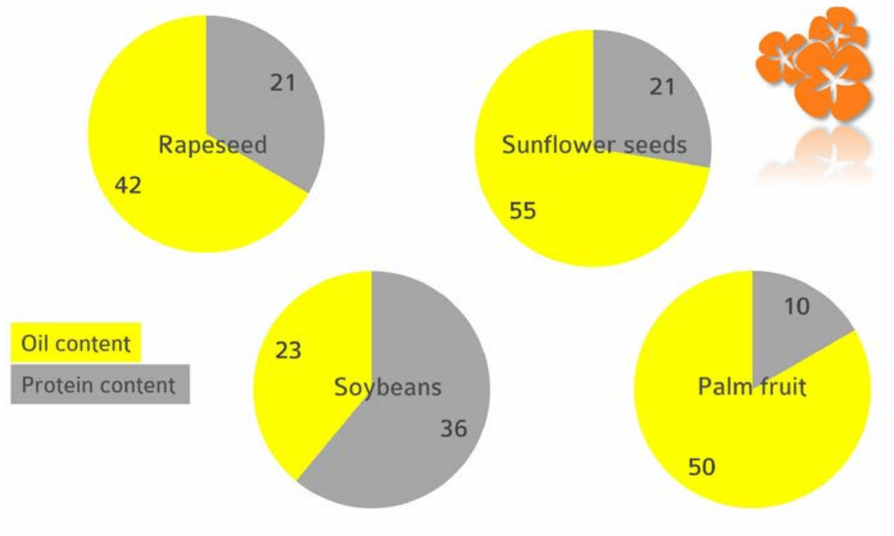

1.2 How much oilseed and vegetable oil is produced on a global scale?

» 1.2.2 Global vegetable oil production

Vegetable oil production has seen a rocket rise over the past decades. Production of vegetable oil from the eight key oilseed crops amounted to approximately 184 million tonnes in the 2016/17 marketing year.

This was more than twice the amount at the turn of the millennium. Palm and soybean oil together accounted for more than 64 per cent of world production alone. Rapeseed oil occupied third place, accounting for almost 15 per cent, followed by sunflower oil, which accounted for 9 per cent of world output.

Vegetable oils are not only used in human diets, but also as a feedstock for transport fuels and other industrial purposes.

Palm oil strengthens its top position

Production of vegetable oils, total and by oilseed crop, worldwide, 2016/17, estimated, in million tonnes

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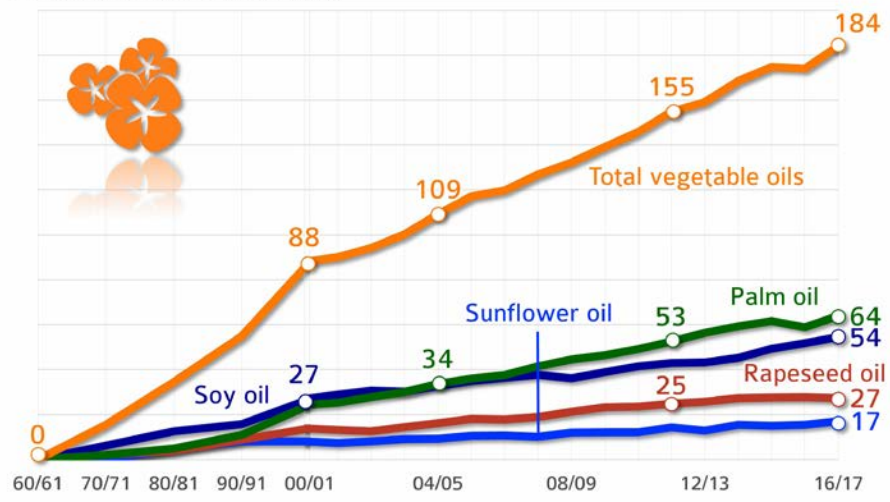


Total vegetable oils = soy oil, rapeseed oil, sunflower oil, palm oil, palm kernel oil, peanut oil, coconut oil, cotton oil

1.2 How much oilseed and vegetable oil is produced on a global scale?

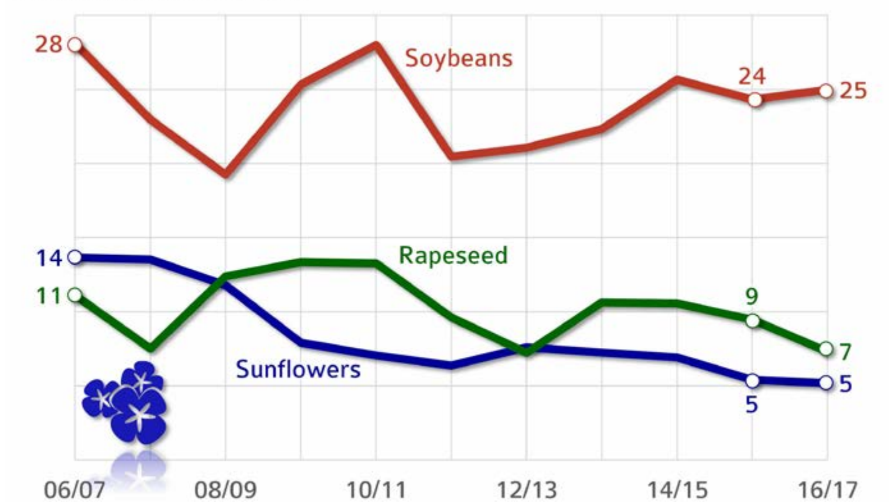
» 1.2.3 Global oilseed supply

Contrary to grain, the stock-to-use ratio of the key oilseed crops has been on the decline for years now. Although production of oilseeds, especially soybeans, has grown continuously, the supply and demand balance is relatively tight, because demand is also rising sharply. The reason is the steady increase in demand for soybeans for use in animal feed, especially in China. As the economy of this highly populated country grows, spending power increases and, with that, demand for meat. As meat production grows, so does demand for oilseed meal for use in feeds. Although this development is at the cost of oilseed stocks, price dynamics are more intense than they are in the case of wheat, which has benefits for German and EU-28 rapeseed production. On the other hand, the fact that – unlike rapeseed – large amounts of soybeans are harvested in both the northern and the southern hemisphere has a stabilising effect on prices. Consequently, the prevailing conditions at the time of sowing and harvest prospects are the main determinants of the volume of contracts concluded in the commodities futures markets and what these agree. This is why these markets are also frequently called weather markets.

Tight supply of rapeseed and sunflower seed

Stock-to-use ratio of soybeans, rapeseed and sunflowers, worldwide, 2016/17, estimated, in per cent

© AMI 2017 | Source: USDA

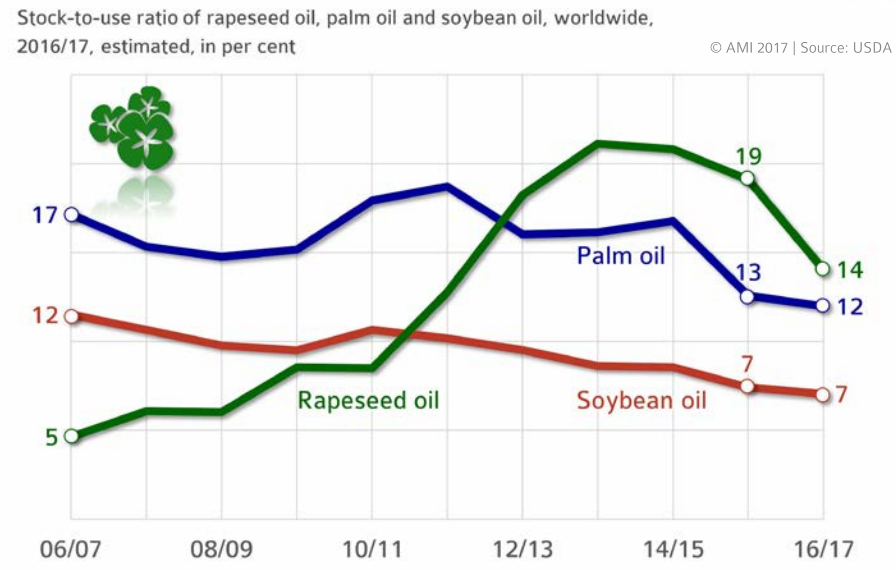


1.2 How much oilseed and vegetable oil is produced on a global scale?

» 1.2.3 Global oilseed supply

↳ 1.2.3.1 Global vegetable oil supply

Markets are comparatively well supplied with rapeseed oil



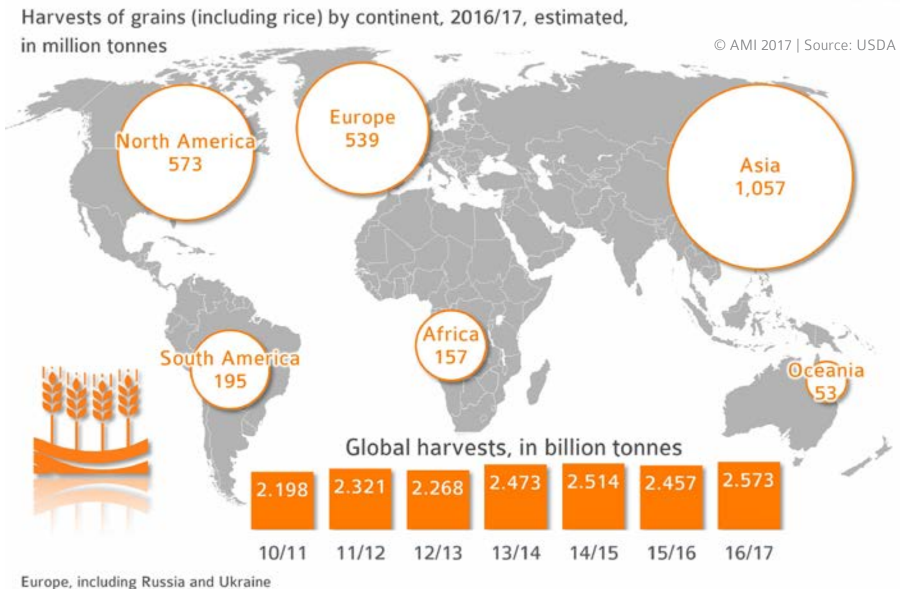
1.3 How much oilseed and grain (including rice) does each continent produce?

» 1.3.1 Production of grain

In 2016/17, world production of grain (including rice) was at the highest level ever, reaching more than 2.6 billion tonnes, according to USDA estimates. The majority, around 41 per cent, was produced in Asia. The main reason is that Asia is the home of rice production.

China was the main country of origin for grain and rice. North America held second position, headed by the US with more than 453 million tonnes. Whereas marketing grain globally is vital for the economy of countries like the US or Canada, China hardly offers any of its grain on the world market, as the country produces most of its agricultural feedstock to cover domestic demand.

World grain production hits record



1.3 How much oilseed and grain (including rice) does each continent produce?

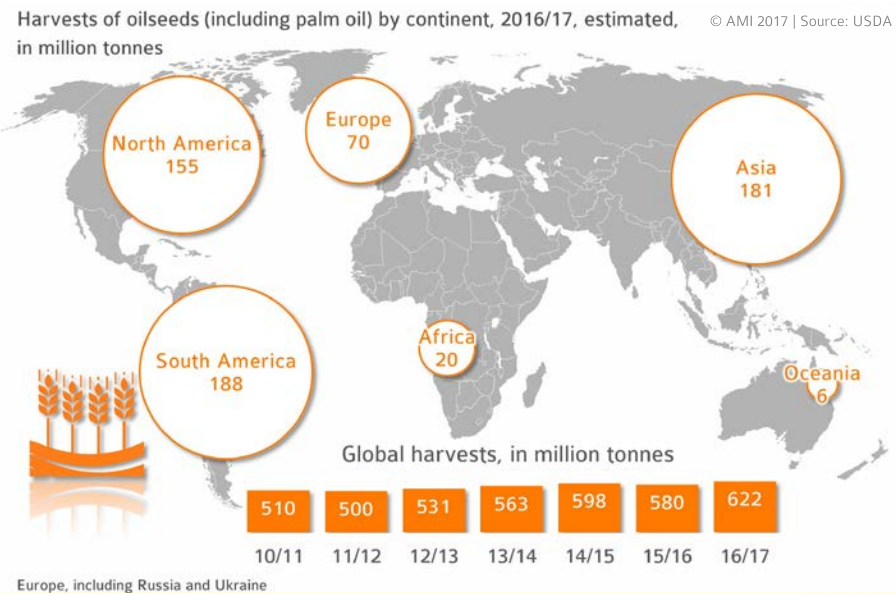
» 1.3.2 Production of oilseeds

Globally, the most important areas growing oilseeds and palm oil are more evenly distributed. The difference is not so much in output, but in crops grown. Whereas soybean is the most important oilseed crop in South America and the US, rapeseed prevails in Canada and the EU-28.

At the same time, soybean output in the US, Brazil and Argentina virtually doubled over the past 13 years.

Asian countries such as China and India produce large amounts of both rapeseed and soybeans. On the other hand, oil palm is the primary oilseed crop in countries such as Malaysia and Indonesia.

Oilseed harvests growing steadily

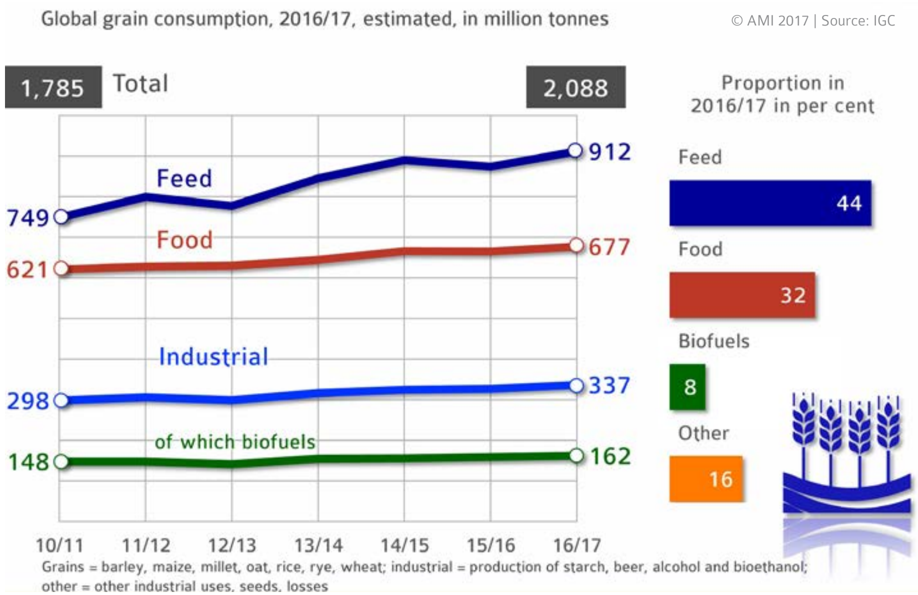


1.4 What products are made from grain?

» 1.4.1 Global use of grains

Global production of grains in the 2016/17 marketing year amounted to an estimated 2.1 billion tonnes. The produce is intended for human consumption, but also used as a livestock feed and feedstock in bioethanol production. At 44 per cent, the largest part of the grain harvests went into feeding troughs, trending upward. By contrast, demand for grain for use in transport fuel production increased only slightly, remaining at around 8 per cent for several years, the International Grains Council (IGC) reports. This means that there is enough grain to meet the growing demand for food, feedstuff and industrial uses. In the US, bioethanol is mostly made from maize. The process generates Dried Distillers Grains with Solubles (DDGS), which is used as a protein feed. One tonne of wheat that is processed into bioethanol produces on average 295 kg of DDGS having a moisture content of 10 per cent. One tonne of maize yields 309 kg of DDGS. When grain prices are high, processing is the first activity to go down, before farmers begin to save on feed. The high added-value potential on the food markets ensures that grain mostly goes into the production of food when grain prices are high. The biofuels market serves as a "buffer" so that grain is available for human consumption and feed uses to ensure "security of supply".

Grain is mainly used for feed production

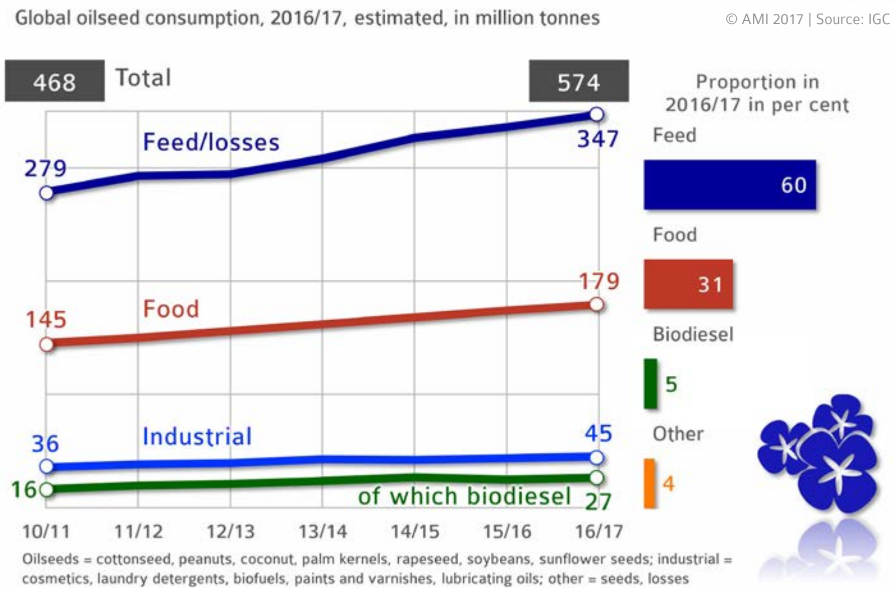


» 1.5.1 Global use of oilseeds

Oilseeds grown worldwide are pressed to make vegetable oils, generating extraction meal and oilseed cake as joint products of pressing. Vegetable oil can be gained by various chemical and physical methods. Before being pressed, the feedstock is heated to increase oil yield. The meal that remains after pressing is used as a protein feed, because it has a high protein content.

In 2016/17, soybean meal was the number one feed in terms of quantity, reaching 224 million tonnes worldwide and having a global protein content of more than 100 million tonnes. It was followed by rapeseed meal at 34 million tonnes. The share of rapeseed meal in global protein supply was around 11 million tonnes. Farmers in the EU-28 only produce GM-free rapeseed. Consequently, rapeseed is by far the most important GM-free source of protein for animal feeding. The amount of sunflower meal is ten times smaller than that of soybean meal. Production of sunflower oil is much more important. Any meal that accumulates also goes into the feed trough.

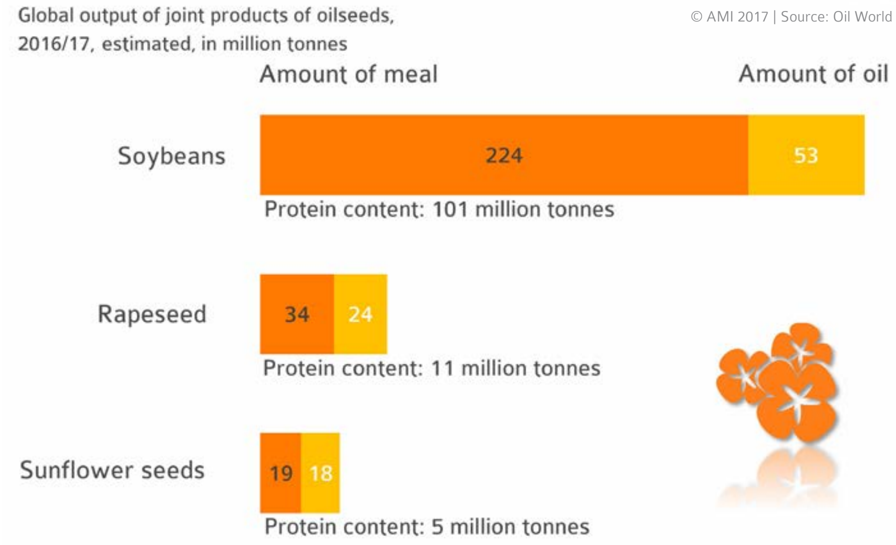
Most oilseeds also destined for animal feed



» 1.5.1 Global use of oilseeds

↳ 1.5.1.1 Global production of oils and meals

Practical dual use of oilseeds



2 Production of biofuels

2.1 Which countries promote biofuels?

» 2.1.1 Global output of bioethanol

More than 98 million m^3 of bioethanol were produced globally in 2015. The US is the by far most important producer of bioethanol. The reason for the large volume of US production is, among others, the Renewable Fuel Standard (RFS). In force since 2005 and enhanced and extended in 2007, the standard requires transport fuels that are sold in the US to contain a specific, annually increasing percentage of renewable transport fuels. Its aim is to save fossil energy sources and cut down on greenhouse gas emission. By far the most important feedstock source for bioethanol production is maize. The US produced around 56 million m^3 of bioethanol in 2015. About 98 per cent was based on maize and 2 per cent on other kinds of biomass. The second largest bioethanol-producing country was Brazil with an output of 28 million m^3. South America and also Australia process sugar cane to make bioethanol. Brazil adopted its National Alcohol Programme in response to the oil crisis in the seventies with the intention of reducing the country's dependence on fossil-energy imports. In the EU, the Directive on the Promotion of the Use of Biofuels or other Renewable Fuels for Transport (2003/30/EG) and the Energy Tax Directive (2003/96/EG) created the framework conditions for European biodiesel and bioethanol production in 2003. In 2015, the EU-28 produced more than 5 million m^3 of bioethanol from grain and sugar beet.

Most bioethanol produced in America

Bioethanol production in key countries, in 2015, in 1,000 cubic metres

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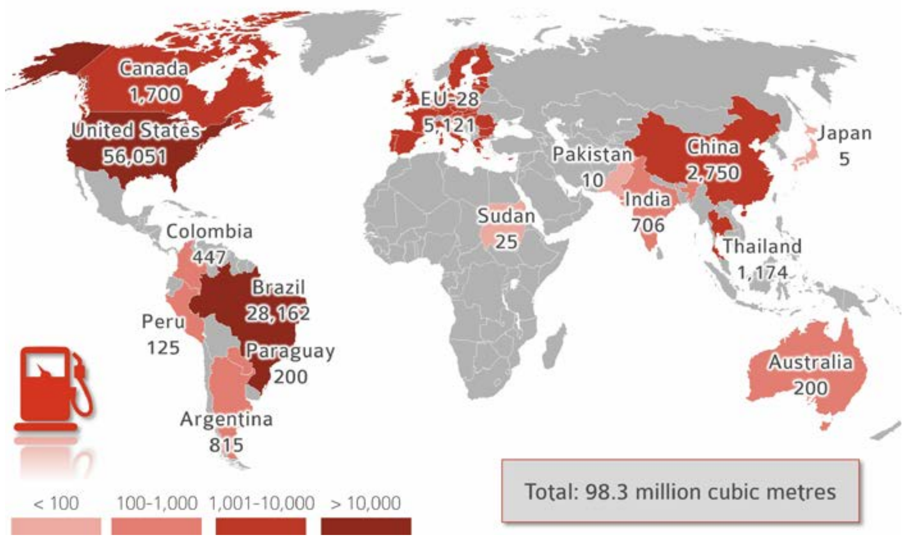
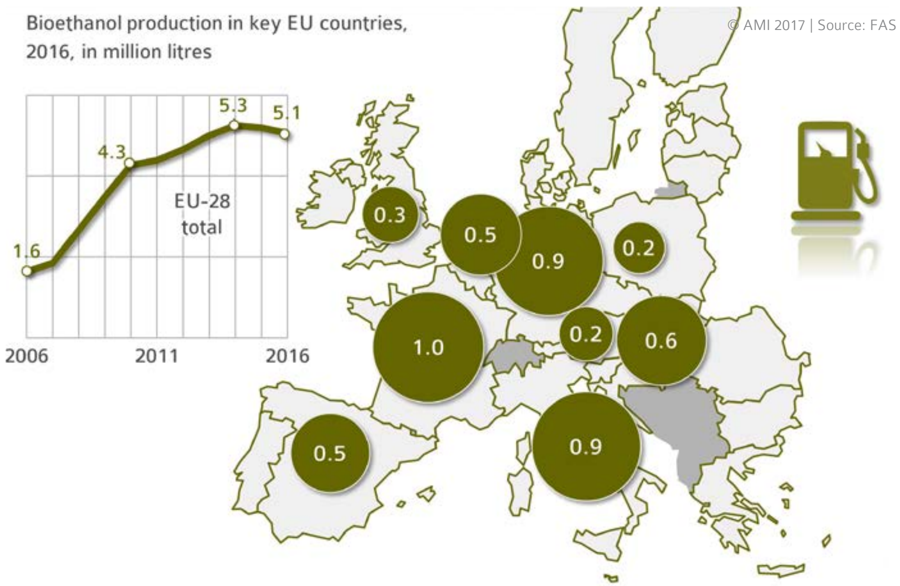


2.1 Which countries promote biofuels?

» 2.1.1 Global output of bioethanol

↳ 2.1.1.1 Key EU-28 bioethanol producers

France and Germany are the leading bioethanol producers in the EU-28



2.1 Which countries promote biofuels?

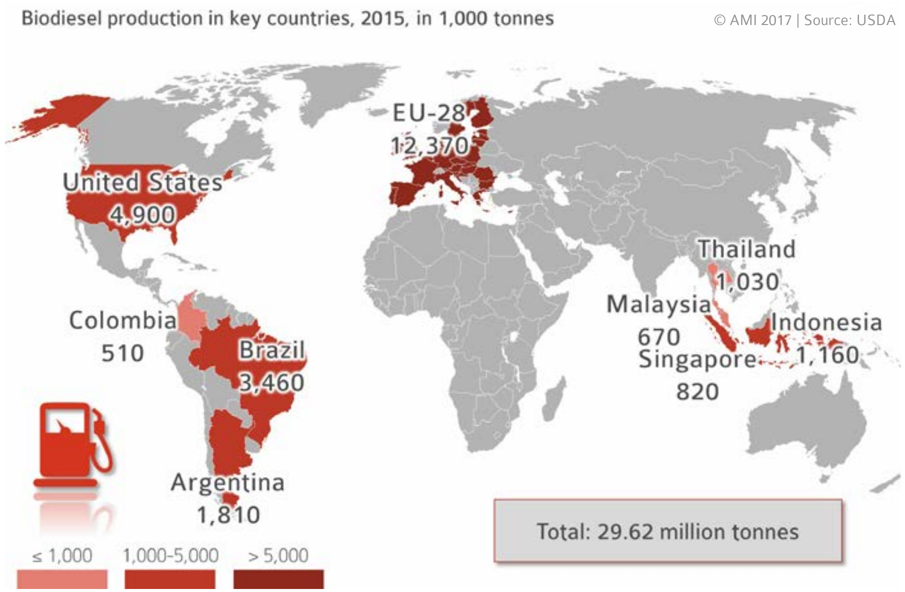
» 2.1.2 Global output of biodiesel

The term "biodiesel" is used in the statistics to refer to biodiesel, hydrogenated vegetable oil (HVO) and biofuels made from vegetable oils in petroleum refineries (co-processing). In 2015, world biodiesel production amounted to just less than 30 million tonnes.

By far the most important biodiesel producer is the European Union, which accounts for almost 42 per cent of global output. The EU's key feedstock is rapeseed. On the American continent, biodiesel production is based on soybeans.

The most important American biodiesel producers are the US, Brazil and Argentina. Southeast Asia is gaining more and more importance in the biodiesel market. In the key palm oil producing countries, Indonesia and Malaysia, biodiesel production is on a steady increase, driven by structural glut and pressure on prices in the vegetable oil markets.

EU-28 is top of the list of biodiesel producers

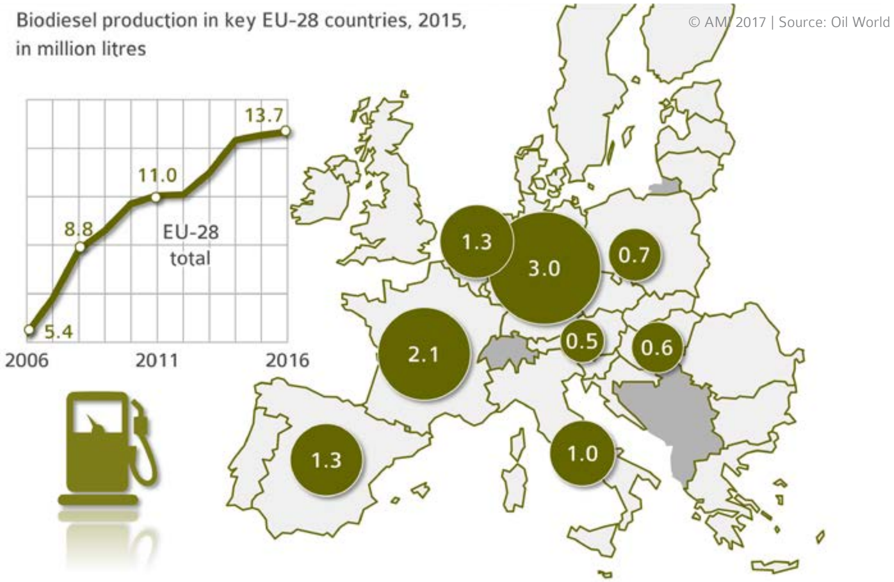


2.1 Which countries promote biofuels?

» 2.1.2 Global output of biodiesel

↳ 2.1.2.1 Key EU-28 biodiesel producers

Germany leads the way in biodiesel production



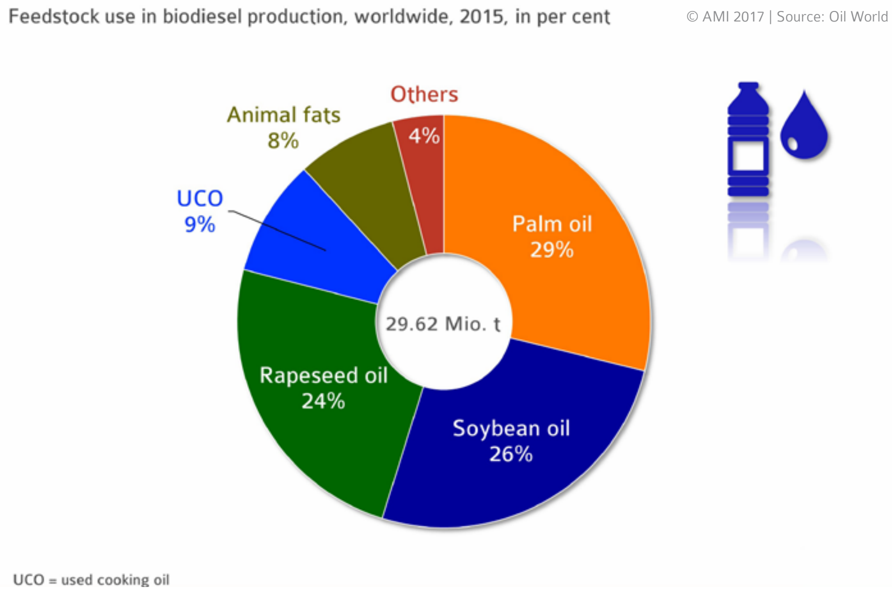
2.2 What feedstocks are used in world biofuels production?

» 2.2.1 Global resource bases for biodiesel

Vegetable oils are the key feedstock in biodiesel production. The use of waste vegetable oils (VWO) or waste animal fats plays an increasingly important role, but it is still of secondary significance on a global scale.

By far the most important feedstocks in biodiesel production are palm oil (29 per cent), soybean oil (26 per cent) and rapeseed oil (24 per cent). The most important vegetable oils used to make biodiesel are palm oil in East Asia, soybean oil in North and South America and rapeseed oil in Europe.

Biodiesel is mainly made from vegetable oils



2.3 What feedstocks are used in European biodiesel fuel production?

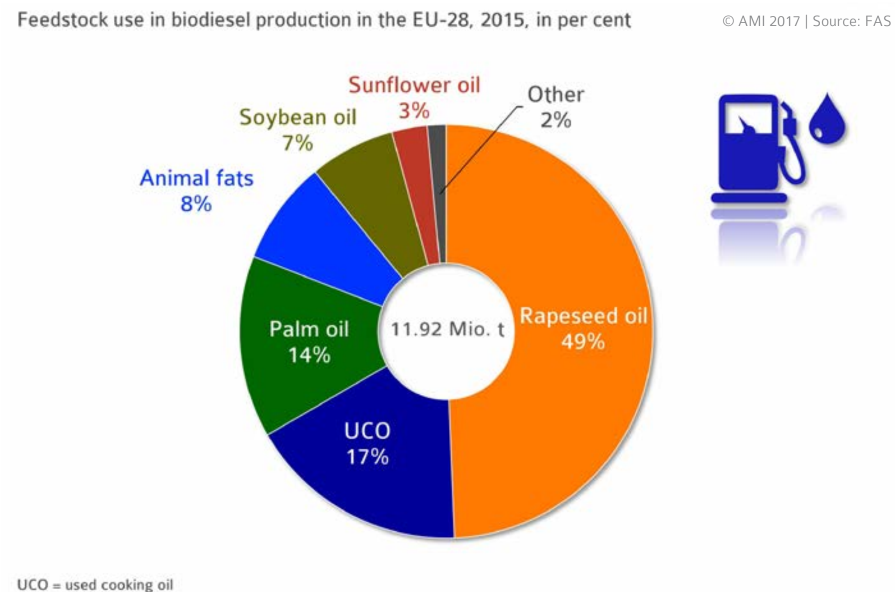
» 2.3.1 Resource bases for biodiesel in the EU-28

Biodiesel can be made from any vegetable oil or animal oil or fat. However, the key aspects are availability and price.

Accounting for 49 per cent, rapeseed is the single most important feedstock source in EU-28 biodiesel production. This fact underlines the importance the biodiesel market has for the continuation of rapeseed cultivation in the Community. However, imports from overseas are also used, depending on price. More specifically, palm oil from Southeast Asia has a 14 per cent share in EU biodiesel production. Used cooking oil has seen a significant rise, accounting for 17 per cent of total raw material used.

The reason is EU-28 promotion policies. In the EU, with the exception of Germany, biofuels from waste and residues count double towards national quota obligations (in terms of energy) in order to increase the binding percentage of renewable energy used in the transport sector to 10 per cent by 2020.

Rapeseed oil is Europe's no. 1 biodiesel feedstock



2.4 What feedstocks are used in the production of biodiesel used in Germany?

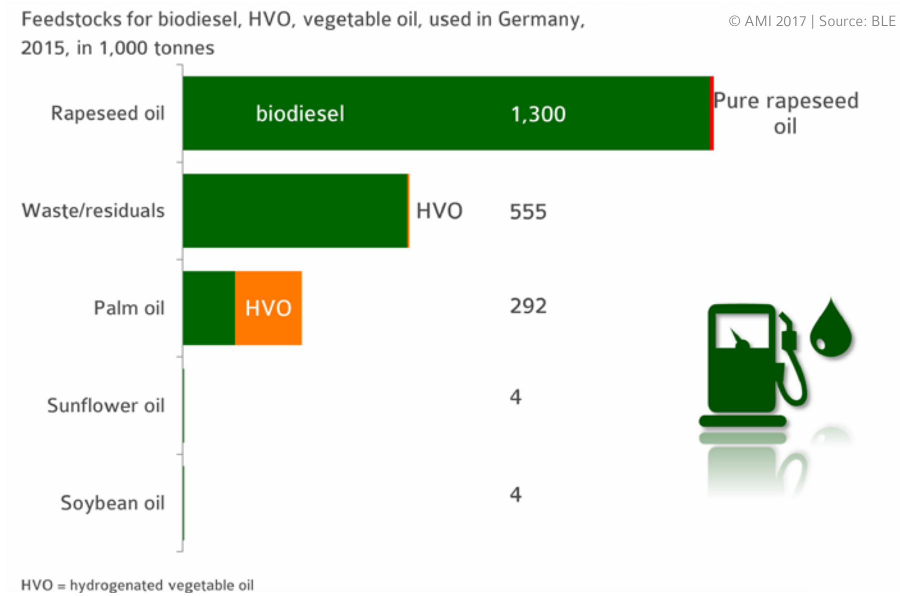
» 2.4.1 Feedstocks of biofuels, consumed in Germany

In 2015, Germany consumed around 2.1 million tonnes of biodiesel in transport fuel blends and 9,000 tonnes of pure vegetable oil. However, the mix does not start in the tank. Even at the feedstock level, there are numerous origins, both domestic and abroad.

Nevertheless, the primary feedstock is rapeseed from domestic sources. It is used to make rapeseed oil, which accounts for most (two thirds) of the feedstock used in biodiesel production, followed by used cooking fats/oils. Most used cooking oils come from Germany and neighbouring EU countries.

By contrast, palm oil and biodiesel from palm oil are imported. Their shares have declined continuously in recent years. Palm oil is the key basis of hydrogenated vegetable oil (HVO). Although HVO is not produced in Germany, it is used in Germany as a transport fuel.

Share of used cooking oil in biodiesel production increases



2.5 What feedstocks are used in German oleochemistry?

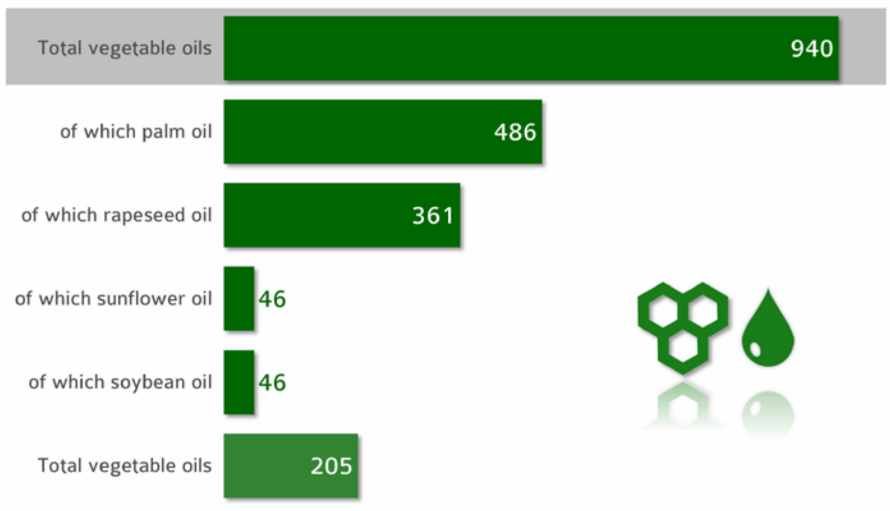
» 2.5.1 Raw material used in German oleochemistry

The chemical industry uses vegetable oils to make skin creams, soaps and biodegradable laundry detergents, and also as ingredients in cosmetics, paints, varnishes, lubricants and textile fabrics. The German chemical industry processed a total of 1.04 million tonnes of vegetable oils in 2013. This was almost one fifth of total consumption. Palm oil, at 536,000 tonnes, accounted for the largest share of vegetable oils used. Rapeseed oil, at just less than 400,000 tonnes, took second place. Sunflower and soybean oils are also used in the chemical industry. The use of animal fats for chemical and technical purposes has seen a slight decline for several years now. It should be noted that in the case of material use, statistical returns on feedstock use are comparatively inaccurate, whereas in the case of biofuels documentation is strictly regulated by law. These statutory regulations for biofuels for use in Germany or the EU also include the requirement of evidence of compliance with specific sustainability criteria. Irrespective of feedstock origin (including that of palm oil), feedstocks must be certified as sustainable. There are no analogous legal regulations for the material use of renewables.

Palm and rapeseed oil are top of the list

Processing of oilseeds in the oleochemical industry in Germany, 2015, preliminary, in 1,000 tonnes

© AMI 2017 | Source: FNR



2.6 Where do the feedstocks for German biodiesel fuel production come from?

» 2.6.1 Origins of feedstocks for biodiesel production by country

German 2015 consumption of biofuels amounted to around 2.2 million tonnes, the German Federal Office for Agriculture and Food (BLE) reports. The feedstocks were mainly sourced in Germany. Just over two thirds of the feedstock for the 1.3 million tonnes of rapeseed oil German oil mills sold to domestic biofuel producers were home-grown rapeseed.

The remaining rapeseed was bought from neighbouring EU states. Just about three quarters of residues and waste (first and foremost, used cooking fats – "used chip fat") were collected in Germany. Additional quantities were imported from Southeast Asia and North America.

Palm oil from Malaysia and Indonesia accounted for about one sixth of the feedstock mix. Other oils and fats, such as soybean oil from South America or sunflower oil from Europe, only played a secondary role.

Short distances

Use of raw materials for biodiesel / HVO production in Germany by origin, 2015, in 1,000 tonnes

© AMI 2017 | Source: BLE, Stat. Bundesamt

3 Food security

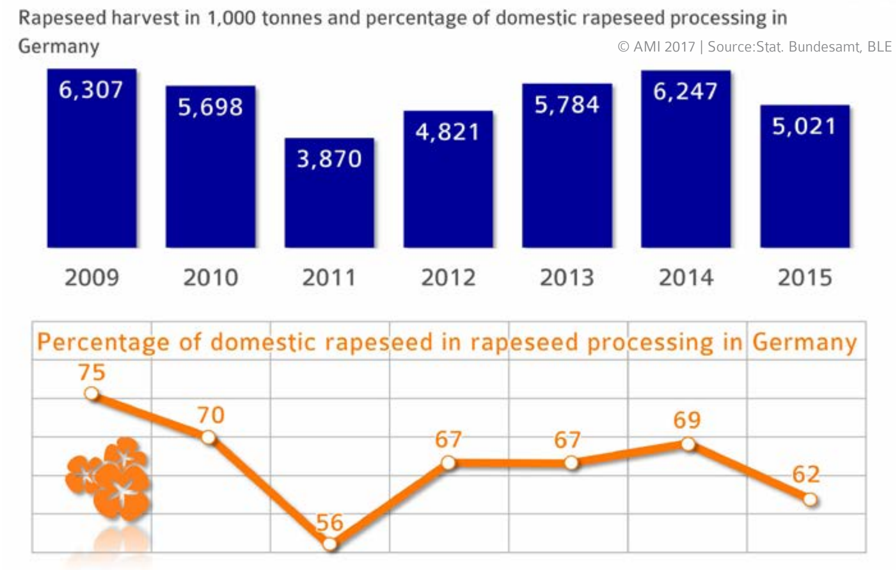
3.1 Is there sufficient rapeseed in Germany?

» 3.1.1 German rapeseed production and level of self-sufficiency

The level of rapeseed self-sufficiency primarily depends on the annual rapeseed harvest and how much the country consumes. Germany is one of the world's largest oilseed-processing countries, and needs imported oilseeds to supplement its own domestic crops. Most of these imports are rapeseed.

In 2015, German companies processed 13.1 million tonnes of oilseed, of which almost three fourth was rapeseed. About 62 per cent of this demand was covered by German rapeseed. The remainder came from other countries, mainly the EU-28. This rapeseed yielded 4.1 million tonnes of rapeseed oil, more than needed for the production of food, transport fuels or even in the oleochemical industry. About 1.1 million tonnes of rapeseed oil went to the German food industry, another 1.6 million tonnes to the engineering sector. More than 1.1 million tonnes of rapeseed oil were exported.

Never enough



3.1 Is there sufficient rapeseed in Germany?

» 3.1.1 German rapeseed production and level of self-sufficiency

↳ 3.1.1.1 German production and feeding of rapeseed meal

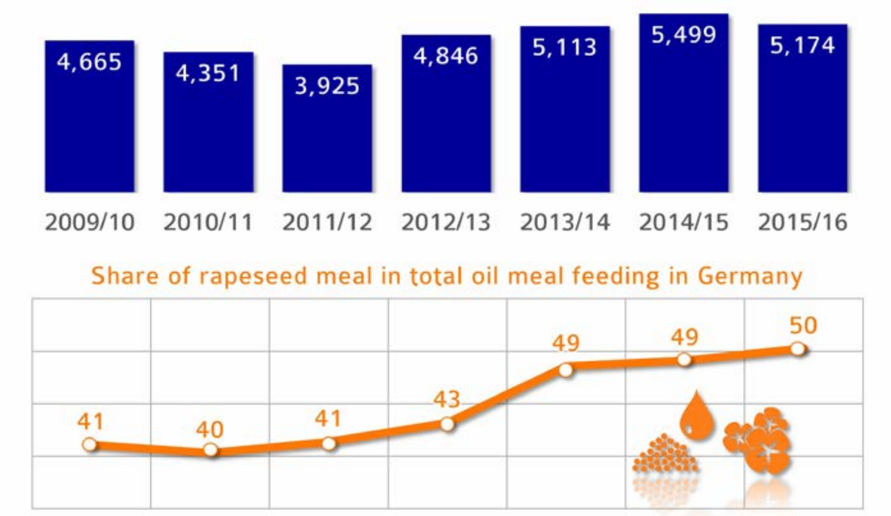
At the same time, Germany produced around 5.2 million tonnes of meal from domestic rapeseed and rapeseed from abroad in 2015/16. Rapeseed meal is used as a GMO-free protein feed. The 1.6 million tonnes of German rapeseed oil for engineering uses alone generated 2.1 million tonnes of rapeseed meal as a joint product. Theoretically, this quantity could replace around 1.6 million tonnes of soybean meal imports in the feed market. For this reason, soybean meal imports fell by 1 million tonnes over the past five years, although production of compound feeds rose.

At the same time, the share of rapeseed meal in oil meal feeding exceeded the 50 per cent mark in Germany in 2015/16, underlining the growing importance GMO-free rapeseed meal has as a source of protein – not only in Germany. Germany offers an alternative to GM (genetically manipulated) soybean meal from America to other countries as well, delivering 1.6 million tonnes to other EU countries.

Rapeseed meal is scarce without rapeseed oil for biodiesel production

Amount of rapeseed meal generated in German oil mills in 1,000 tonnes and percentage of total oil meal feeding in Germany

© AMI 2017 | Source: Stat. Bundesamt, BLE, Oil World



3.2 Why is demand for oilseeds increasing?

» 3.2.1 Global meat consumption

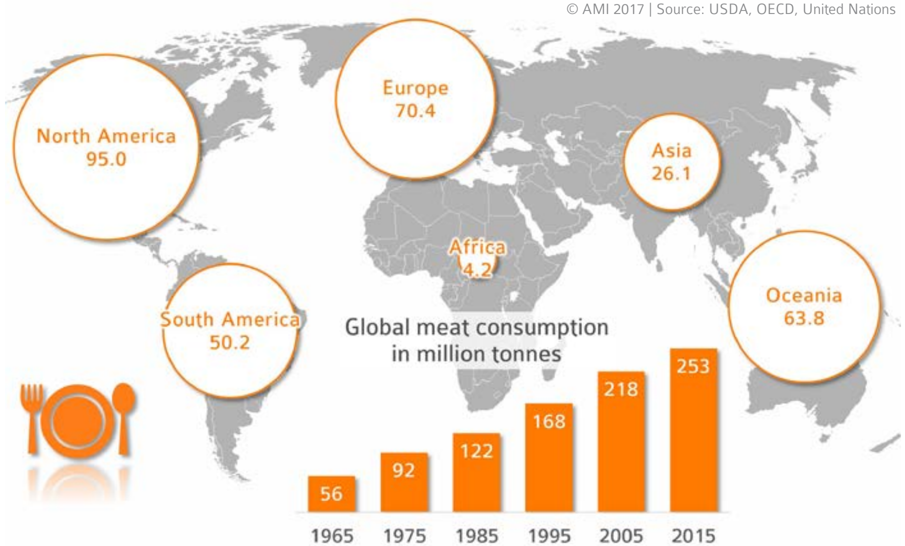
World meat consumption tripled to more than 253 million tonnes over the past 50 years. On the one hand, the world's population has grown. On the other hand, consumers' preferences have changed. Especially consumers in emerging markets such as China and Brazil eat significantly more meat than they did ten years ago. Whereas meat consumption in developed countries has stagnated, eating animal protein is seen as a sign of economic progress in developing and threshold countries.

In China in particular, a significant segment of the population with higher purchasing power has emerged. Lifestock feed is primarily based on oilseeds, especially soybeans and rapeseed, along with grains. Both soybeans and rapeseed are used to make feed meal. Most soybeans grown worldwide are raised from GM (genetically manipulated) seed. So is rapeseed produced in Canada. Because of the global surge in meat consumption, demand for feed protein from oilseeds is set to rise further in future.

Meat consumption increases worldwide

Per capita consumption of meat in 2015, by continents, in kilogram per capita

© AMI 2017 | Source: USDA, OECD, United Nations



3.2 Why is demand for oilseeds increasing?

» 3.2.2 Quota requirements to promote biofuels

On a global scale, the main means of promoting biofuels is statutory blending requirements. The motivation of the various countries differs greatly. Whereas US and Brazilian interests focus on security of supply, the EU-28 places great importance on climate protection and an increase in the overall proportion of renewable energy generated. Independently, the purpose in Asian countries like Malaysia, Indonesia and China, but also in Argentina and Brazil, is different again. In these countries, the main objective is to reduce structural surplus in an effort to stabilise market prices. National mandates of a volumetric or energy-related proportion in fossil diesel fuel range from two to 20 per cent.

The cap on greenhouse gas emission that was imposed in Germany in 2015 is unique in the world. Manufacturers, that is the petroleum companies, must provide evidence of compliance. Globally, in most countries having quota requirements, bioethanol plays the most important role. The reason is, again, structural oversupply in the grain and sugar markets. The biofuel funding policy's aim is not only to contribute to protecting the climate and natural resources, but also to reduce pressure on the market and, consequently, stabilise prices for farmers. Based on the Paris climate protection agreement, we can expect especially the major exporters of agricultural produce to further stabilise their previous biofuels policy in the national action plans they are required to provide by 2020 to make a contribution towards decarbonising the transport sector.

Blending quotas drive up usage of biofuels

Quotas for ethanol and biodiesel by country, 2015/2016, in per cent

© AMI 2017 | Source: DBFZ

E=ethanol, B=biodiesel
Germany: -3,5 % GHG avoidance 2017: -4 %, 2020: -6 %
EU-28: 2020: 10 %
Norway: B=3,5 %
Canada: E=5 %, B=2 %
USA: 2022: 7 %
Peru: E=7,8 %, B=2 %
Costa Rica: E=7 %, B= 20 %
Panama: E= 10 %
Colombia: E=8-10 %, B=8-10 %
Brazil: E=18-27 %, B=7 %
Paraguay: E=25 %, B=1 %
Argentina: E=10 %, B=10 %

E=ethanol, B=biodiesel
South Africa: E=2 %, B=5 %
Mosambique: E=10 %
Angola: E=10 %
Malawi: E=10 %
India: E=20 %, B=20 %
Indonesia: E=5-10 %, B=20 % 2025: E=20 %, B=30 %
China: 2020: E=10 %
Philippines: E=10 %, B=5 % 2020: E=20 %, B=10 %
Malaysia: B=10 % / 2020: B=15 %
South Korea: 2018: B=3 %
Thailand: B=7 %

3.3 What is the amount of grain/vegetable oil per person?

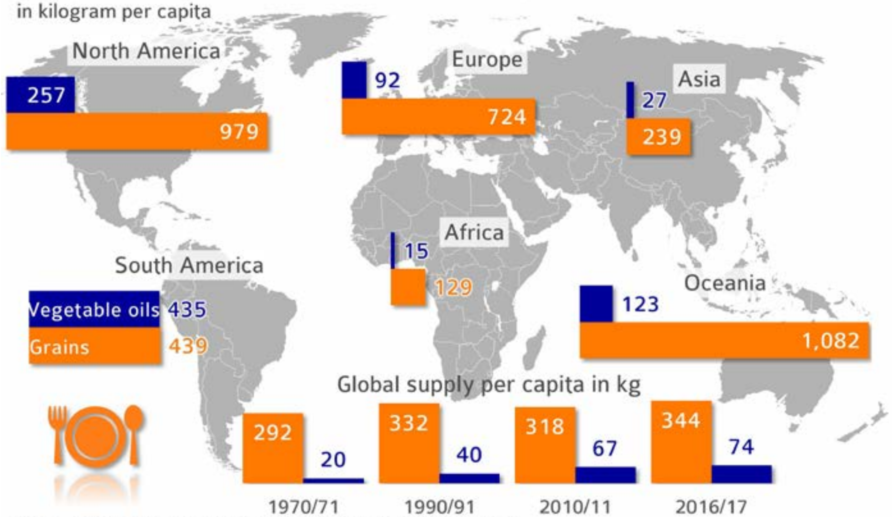
» 3.3.1 Per capita supply of grain and vegetable oil

Over the past 40 years, the per capita supply of grain and vegetable oil increased steadily to currently 344 kg of grain and 74 kg of vegetable oil despite the huge growth in world population. Adding the global 2016/17 per capita supply of grain and vegetable oil, consumption could, in theory, hit a record of 418 kg per capita. However, part of the output is used for feeds, plant-based transport fuel blends (based on statutory quotas) or other industrial uses. However, the chart highlights the considerable differences between oversupplied and undersupplied countries. The difference in availability of agricultural feedstocks is primarily a result of distribution issues rather than competing fuel and feed uses. Moreover, there are substantial differences in purchasing power in the different countries. The chart takes into account both the cost of living and inflation in the relevant countries. At the end of the day, it is possible to compare the specific shopping baskets and their respective costs and draw conclusions for per capita purchasing power. The currency to evaluate the purchasing power is the international dollar, which has the same purchasing power as the US dollar. More specifically, the International Monetary Fund put the per capita purchasing power for the US for 2016 at around 56,000 international dollars. In contrast, in Namibia the figure was only 11,200 international dollars. In countries like Burundi or the Democratic Republic of Congo, the per capita purchasing power was even less than 900 international dollars. This means that in countries where purchasing power is low the existing funds are insufficient for people to buy the amounts of food they need, although supply of agricultural products is adequate. Whereas people in industrial nations spend less than 25 per cent of their income on food, the population in the poorest countries of the world spends up to 80 per cent.

Growing population has more to eat

Supply of grain and vegetable oils, 2016/17, estimated, by continents, in kilogram per capita

© AMI 2017 | Source: USDA, FAO



Grains = barley, oat, millet, maize, mixed grain, rice, rye, sorghum, wheat
Vegetable oils = cotton, coconut, palm, palm kernel, rapeseed, soy and sunflower oil

» 3.4.1 Use of feedstocks in biofuels production

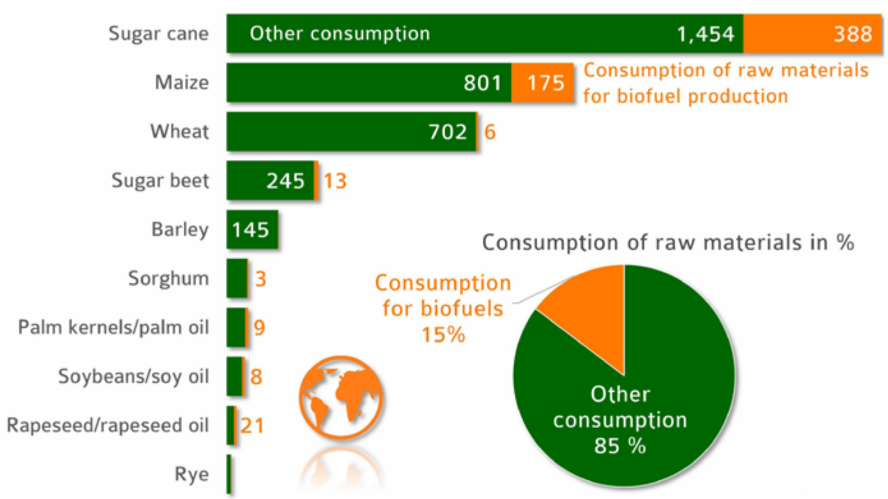
Compared with total global production, the share of agricultural feedstocks in biofuels production is small, especially because the processing of grain and maize to make bioethanol also yields considerable amounts of protein feed, such as rapeseed and soybean meal or Dried Distillers Grains with Solubles (DDGS).

On a global scale, the key challenge is to reduce the protein deficit to combat malnutrition. The share of agricultural feedstocks in biofuels production is only 15 per cent of global total use. Demand for sugar cane and maize as feedstocks for use in bioethanol production by far outstrips that for vegetable oil feedstocks for use in biodiesel production. The share of wheat and sugar beet is relatively small. Conversely, this confirms the structural surplus, especially of carbon hydrates, that exists in the countries where these crops are grown.

Vegetable oils only have a small share in global biofuel production

Shares in total consumption of raw materials for biofuel production, worldwide, 2015, in million tonnes

© AMI 2017
Source: OECD, USDA, Oil World



» 3.4.2 Food waste in Germany

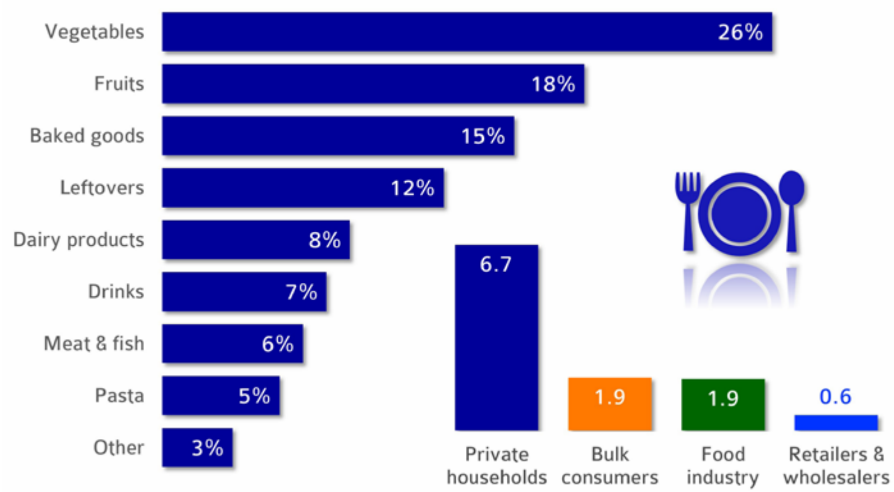
More than 6 million tonnes of foodstuff are destroyed in Germany each year. It is estimated that more than half of this waste could be avoided. Around 61 per cent of all food waste is generated in private households. This translates to an estimated 105 kg of discarded food per person per year. Above all, easily perishable goods such as vegetables and fruit end up in the waste bin. However, one must also look at the amount of land needed to make processed products such as meat, pasta and dairy products. In Germany alone, food waste amounts to approximately 2.6 million hectares or the current land planted with renewables for material and energy purposes. The amount of waste food bulk consumers, trade and industry account for, is considerably lower. A WWF study about the food losses ("Das große Wegschmeißen") has shown that overall avoidable food losses amount to around 18.4 million tonnes. If the world actually succeeded in preventing these losses, the outcome would be an almost 22 million tonne reduction in CO_2 equivalents in the CO_2 footprint, as well as saving land.

On a global scale, 1.3 billion tonnes of all foodstuffs destined for human consumption are lost or wasted. This is one third of all food. Whereas in the industrialised countries around 40 per cent of the losses occur at the trade and consumer levels, in developing countries about 40 per cent of the food is lost after harvest and during processing. In industrialised countries consumer behaviour plays a major role, which is not the case in developing countries. It makes sense in an effort to reduce food loss and waste to raise awareness in the relevant industries and among traders and consumers, and to look for productive uses of food that is currently thrown out.

Food waste in Germany

Percentage of food waste in households by product group and distribution of food waste by waste producers in Germany in million tonnes, 2012

© AMI 2017 | Source: University of Stuttgart



3.5 Why do people starve?

» 3.5.1 The issue of distribution

People in many parts of the world starve or are malnourished although in terms of figures there is adequate supply of the most important staple foods. The reasons for the shortage of foodstuff are multiple and complex: climate change, drought, unjust distribution, wars and forced migration as well as a lack of democratic structures. All these factors prevent economies from booming, farmers from farming in a cost-efficient manner and countries from establishing democratic structures without any maladministration or corruption.

It is a striking fact that in past famines, it was almost always a combination of war and economic hardship with natural disasters like dry spells that led to humanitarian emergencies. Countries having no structures for a functioning social system run a much higher risk of famine and malnutrition. Where an appropriate framework is in place, it can be used as a base on which to intensify locally adapted cultivation systems in a sustained manner and, by so doing, create the foundation for supply with food that is equally sustained.

Food and wealth, a distribution issue

Largest producers of food grains including rice und oils in 2015/16, in million tonnes, and 2015 per capita incomes, in US dollars

© AMI 2017
Source: International Monetary Fund, USDA

Country	Food production	Per capita income
United states	435	57,300
EU-28	271	29,000
Brazil	90	8,600
Russia	87	8,800
Indonesia	79	3,600
Ukraine	57	2,000
Argentina	54	12,400
Canada	49	42,300
Pakistan	38	1,500
World Ø	31	10,300
Australia	29	51,600

Country	Food production	Per capita income
Guyana	0.7	4,500
Dom. Rep.	0.6	4,500
Papua New G	0.6	2,500
Norway	0.6	8,800
Costa Rica	0.5	2,500
Saudi Arab.	0.4	20,000
UA Emirates	0.27	38,000
Surinam	0.2	5,000
Jordan	< 0.1	5,000
Namibia	< 0.1	4,400
Singapore	< 0.1	53,000

4 Use of land

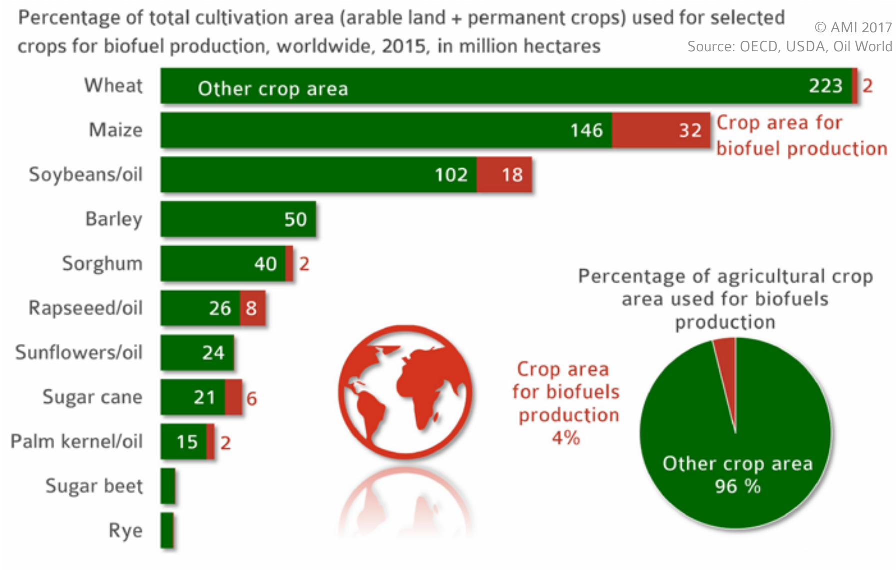
4.1 Does growing energy crops create a lack of land for food crops?

» 4.1.1 Shares of land used for global biofuels production

Crop plants are grown on more than 1.7 billion hectares worldwide. At 4 per cent, the land needed for biofuels production only accounts for a fraction of this.

Moreover, the countries that grow the crops and produce biofuels are also the biggest agricultural exporting countries for the respective agricultural feedstocks. In other words, the "driving force" in South America isn't biofuels production. Rather, the steady global rise in demand for protein feed, especially soybean meal, and consequently the changes in price determine hectarage and its expansion. The percentage of soybean oil in soybeans is only 20 per cent.

Biofuels only take up a small part of the crop area



4.2 Is there a limit to the use of palm oil?

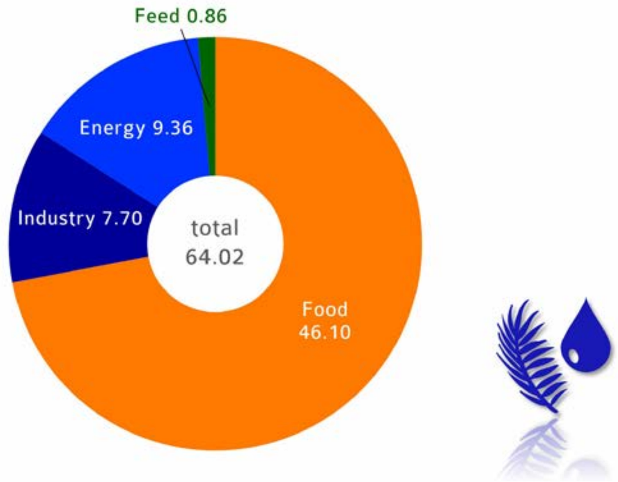
» 4.2.1 Global use of palm oil

Oil palm is the single most important oleaginous fruit crop in Southeast Asia. A significant number is also grown in Colombia and Nigeria. Palm oil is the most important vegetable oil in the world, with annual production exceeding 60 million tonnes. Like other vegetable oils, it is ideal for a wide range of uses – in the food, chemical and biofuels industries. Global 2016/17 consumption of palm oil is estimated at 64 million tonnes, most of which was edible oils used in Southeast Asia. Food uses accounted for 72 per cent, energy uses for 15 per cent (e. g. biodiesel) and oleochemical uses for 12 per cent of overall consumption. World palm oil production continues to increase due to expansion in area (by clearing primeval forest legally and illegally), replantings and the use of new varieties with a high yield potential. EU legislation requires palm oil for biodiesel fuel production to be certified as sustainable in compliance with a system accredited by the EU Commission if the oil is intended to be used for biofuels production in the European Union or for biodiesel (palm oil methyl ester) exports to the EU. Palm oil consumption is likely to continue to rise over the next few years. Food uses will presumably account for most of the rise. At the same time, the specific sectors, except the power sector, are poised to use more and more palm oil that is certified as sustainable. In the EU-28 today, the percentage of certified palm oil for energy-related uses is one hundred per cent.

Palm oil is an important foodstuff

Shares of various uses of palm oil, worldwide, 2016/17, estimated, in million tonnes

© AMI 2017 | Source: USDA, OECD



4.2 Is there a limit to the use of palm oil?

» 4.2.2 Biofuel Sustainability Ordinance

Four of the five key sustainability criteria for biofuels refer to the cultivation of the feedstock that is used in production. They aim at protecting natural habitats (Crit. 1–3) and ensuring sustained agricultural use (Crit. 4). Biofuels are only considered to be sustainable if they comply with criteria 1–4 and the minimum requirements for greenhouse gas savings (Crit. 5) valid at the time the biofuels in question are placed on the market.

The Biofuel Sustainability Ordinance set 1st January 2008 as the reference date for assessing requirements for the protection of natural habitats (Crit. 1–3). For instance, as part of the certification, evidence that the land was used as agricultural land or as a plantation before 1st January 2008 must be provided at the production level both in the EU and in third countries. The purpose of this rule is to avoid changes in land use, such as clearing primeval forest or ploughing up grassland. Because of this, one hundred per cent of the palm oil that is processed to biofuel in the EU comes from sustained production as stipulated in the Biofuel Sustainability Ordinance. This legal rule only applies if the intended use is for biofuels production. However, the debate about the sustainability requirements in the biofuels sector contributes towards ramping up initiatives to promote the sustainability certification in the food sector and for uses in the chemical industry.

Biofuel Sustainability Ordinance

Key sustainability requirements for biofuels

© AMI 2017 | Source: Biokraft-NachV, VDB

Feedstock-related requirements

1. Protection of high nature value areas
2. Protection of land with high carbon stocks
3. Protection of peat bogs
4. Sustainable farming

Product-related requirements

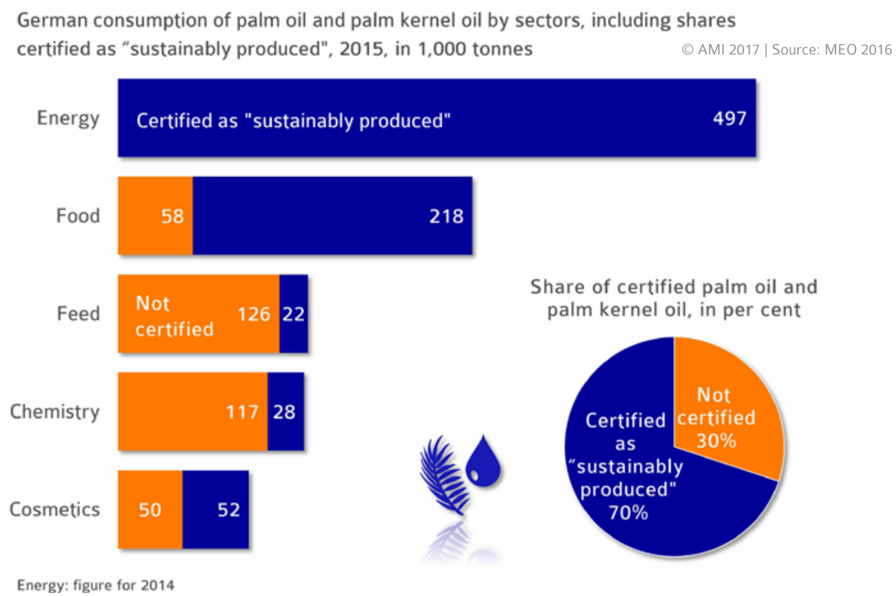
5. Greenhouse gas reduction:
   Biodiesel and bioethanol must save the following percentages of greenhouse gases from fossil fuels
   - from 1st January 2011, at least 35 per cent
   - from 1st January 2017, at least 50 per cent
   - from 1st January 2018, at least 60 per cent, if the production plant was put into operation after 31st December 2016

4.2 Is there a limit to the use of palm oil?

» 4.2.3. Certified palm and palm kernel oil in Germany

European law requires evidence of compliance with sustainability requirements as set out in the Renewable Energy Directive (2009/28/EC or its amended version 2015/1513/EC) for biofuels to count towards fulfilment of quota obligations or in the case of claiming tax benefits. These requirements have been incorporated in the criteria of the certification systems that are licensed by the EU Commission. As a result, EU law is implemented globally for biomass production in terms of sustainability. Consequently, it is only in biofuels use in the EU that one hundred per cent of feedstock production for e. g. rapeseed oil and all other cultivated biomass feedstocks are certified as sustainable. There is no other sector in agriculture – with the exception of organic farming – where this is the case. The certification systems have to be continuously developed, as re-approval is required every five years. In other applications such as the use of palm oil in the food and chemical industries, there is still a significant need for enhancement that would also contribute towards cutting illegal clearance of primeval forests and improving living conditions (social criteria).

Shares of palm oil from sustainable production in Germany



5 Development of prices

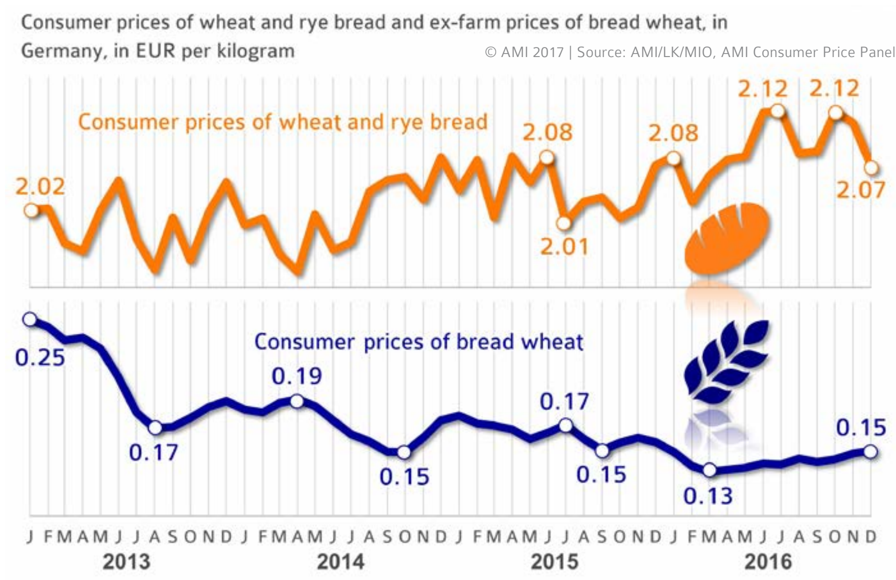
5.1 Do biofuels push food prices up?

» 5.1.1 Comparison of prices of bread and grain

Wheat is used both for food and bioethanol production, with the latter gaining more and more importance. Many people argue that this situation causes a shortage and drives up prices of feedstocks for food production. Although prices for, e. g. wheat and rye bread have indeed gone up, the increase has little to do with the expansion in biofuels production. This point is supported by the stability of prices on the production side which, from the perspective of farmers, remain too low. This factor alone shows clearly that there is no scarcity in feedstock supplies. In fact, continuing surpluses are the main factor accounting for pressure on wheat prices. The main reason for consumer price increases of soft wheat-based products, e. g. wheat and rye bread, has been rising costs for labour, rents, energy etc. One should also keep in mind that raw material only accounts for approximately 15 cents of the costs in a one-kilo loaf of wheat and rye bread.

The case that the production of biofuels reduces the availability of feedstock for food and drives prices upwards is not only made in industrial countries. The point is also made as an argument against the use of renewables in developing countries. In fact, price increases in these countries are actually primarily driven by government interventions in the markets, high freight costs, poor infrastructure and inadequate market access.

Bread price versus grain price



5.1 Do biofuels push food prices up?

» 5.1.2 Comparison of prices of bioethanol and grain

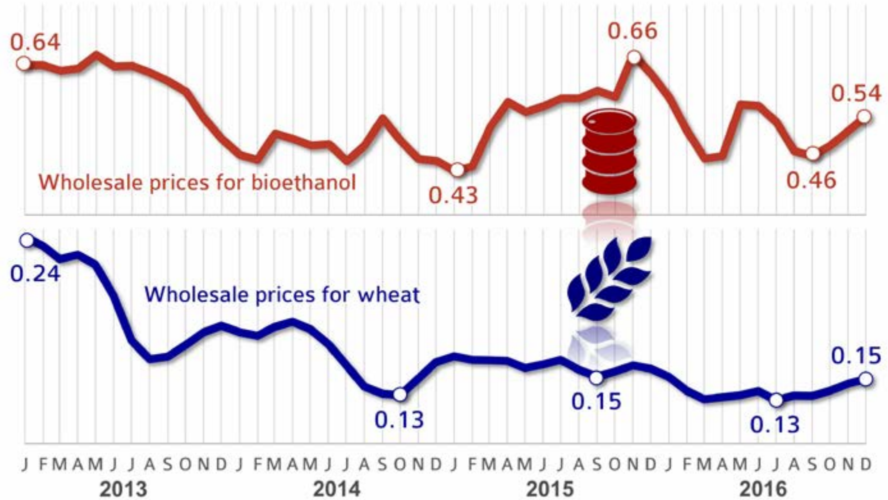
Issues surrounding global nutrition continue to be at the centre of intense discussion, especially since prices for agricultural feedstock and staple foods exploded globally in 2007 and 2008 and prices became volatile as a result. Ongoing famine, hunger and poverty situations have been closely associated with the way prices for agricultural feedstock have developed in the global market. More specifically, biofuels are often cited as the explanation for the price situation.

Suppliers have "responded": bumper crops have since led to global oversupply and increasing stocks. As the charts show, the increase in demand for agricultural feedstocks for use in biofuels production only has a minor inflationary impact on prices. In fact, the effect is quite the opposite, as demand for biofuels buffers the downward trend in feedstock prices.

Biofuel demand has little impact on prices

Wholesale prices for bioethanol (excl. taxes) in EUR per litre and ex-farm prices of wheat in EUR per kilogram, in Germany

© AMI 2017 | Source: AMI/LK/MIO

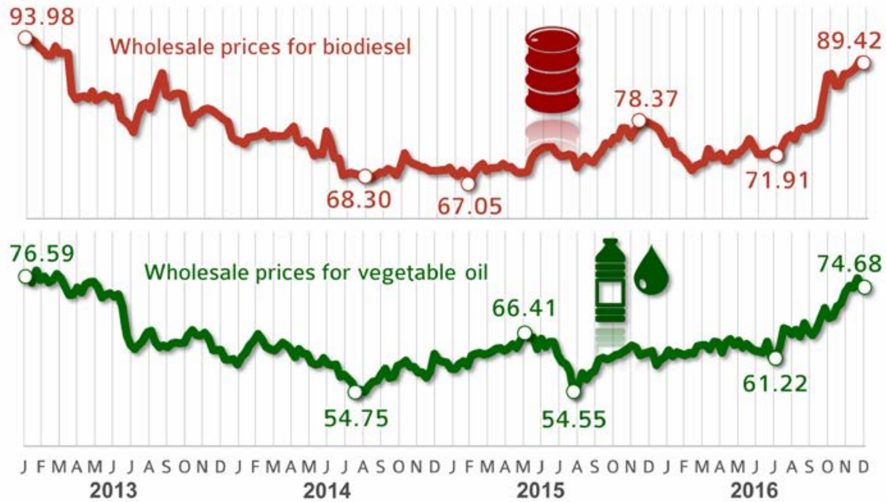


Lower-quality wheat

↳ 5.1.2.1 Comparison of prices of biodiesel and vegetable oil

Biofuel demand has little impact on prices

Wholesale prices for biodiesel and vegetable oil (as mean values of rapeseed, soybean, palm and sunflower oil prices), excl. taxes, ex works, in cent/l, in Germany © AMI 2017 | Source: AMI



Sources

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AMI/LK/MIO	AMI Producer Price Collection in cooperation with Chambers of Agriculture, Bavarian Farmer´s Association, Baden Agricultural Main Association, State Farmer´s Association in Baden-Württemberg e. V., Hessian Departement of Agriculture, Marktinformationsstelle Ost, AMI GmbH, Bonn	www.ami-informiert.de
Biokraft-NachV	Biofuel Sustainability Directive	http://www.gesetze-im-internet.de/biokraft-nachv/Biokraft-NachV.pdf
BLE	Federal Office for Agriculture and Food, Bonn	http://www.ble.de/SharedDocs/Downloads/DE/Klima-Energie/Nachhaltige-Biomasseherstellung/Evaluationsbericht_2015.html
DBFZ	German Biomass Research Centre, Leipzig	http://www.ufop.de/files/1214/7980/1268/DBFZ_Report_11_3.pdf
F.O. Licht	F.O. Licht Commodity Analysis, Ratzeburg	www.agra-net.com/agra/world-ethanol-and-biofuels-report
FAO	Food and Agriculture Organization of the United Nations, Rome	www.fao.org
FAS	USDA Foreign Agricultural Service, Washington	https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Biofuels%20Annual_The%20Hague_EU-28_6-29-2016.pdf
FNR	Agency for Renewable Resources, Gülzow-Prüzen	http://www.fnr.de/index.php?id=11150&fkz=22000411
Handbuch der Lebensmitteltechnologie – Nahrungsfette und -öle (Manual of food technology – dietary fats and oils)	By Michael Bockisch, Publishing house Eugen Ulmer, ISBN 3-8001-5817-5	Chapter. 4 Pflanzliche Fette (vegetable fats)
IGC	International Grains Council, London	http://www.igc.int/downloads/gmrsummary/gmrsumme.pdf
IWF	International Monetary Fund, Washington	http://www.imf.org
MEO	Meo Carbon Solutions GmbH, Cologne	http://www.forumpalmoel.org/imglib/downloads/20160927_Palmoel-in-Deutschland_Endbericht.pdf
OECD	Organisation for Economic Cooperation and Development, Paris	www.oecd.org
Oil World	ISTA Mielke GmbH, Hamburg	www.oilworld.biz
United Nations	United Nations Organisation, New York	www.un.org
Statistisches Bundesamt	Federal Statistical Office, Wiesbaden	www.destatis.de
University of Stuttgart	University of Stuttgart, Institute for Sanitary Engineering, Water Quality and Solid Waste Management	http://www.bmel.de/SharedDocs/Downloads/Ernaehrung/WvL/Studie_Lebensmittelabfaelle_Kurzfassung.pdf
USDA	United States Department of Agriculture, Washington	https://www.fas.usda.gov/commodities
VDB	Association of the German Biofuel Industry, Berlin	http://www.biokraftstoffverband.de/index.php/nachhaltigkeitsverordnung-biokraft-nachv.html
WWF	Study: "Das große Wegschmeißen"	www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF_Studie_Das_grosse_Wegschmeissen.pdf

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