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

UFOP Report on Global Market Supply 2018/2019

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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Global supply to the market and climate change: "resource" agriculture – "just" food or more?

It lasted until December - a drought Germany and Europe have hardly ever experienced before. In some regions, yields of grain, maize, oilseeds and also forage crops fell substantially short of the previous years' average. Whereas in a similar situation in 2008 prices for agricultural feedstock rose to record highs, farmers felt disappointed this year. Prices did not go up in the same way despite the smaller crop. In Germany, profits of exclusively arable farms nearly halved between the marketing years 2012/13 and 2017/18 to, on average, just less than EUR 35,000.

The causes are to be found in the international markets. The new issue of UFOP's Report on Global Market Supply for 2018/19 once again confirms that - in the case of vegetable oil - large harvests elsewhere, stock levels and international trade can actually overcompensate crop losses. In North and South America, yield increases are achieved by applying technical progress and forging new production areas, whereas in Asia yields are raised by using new oil palm varieties for replantings and also creating new plantations in the wake of clearing primeval forest. The market does not ask if this trend is consistent with international sustainability goals. Sustainability is not reflected in prices paid to producers.

This means that global supply with food is secured. The reasons for regional famines, such as in Yemen, have political origins. Military conflicts and widespread poor government leadership continue to be the main factors for deteriorating food supply in many parts of Africa, especially in rural areas, and for a lack of economic prospects in these regions. The results are prominent in international media coverage. Therefore, I very much welcome the fact that the European Union and German Federal Ministry for Economy Cooperation and Development (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung / BMZ) have announced their intention to focus their future activities on agriculture and food economics as key factors to create new jobs in African rural areas.

The production and yield potentials based on a sustained economic system have not yet been unlocked in many regions. New breeding methods, such as specific genome editing, offer the opportunity to exploit the yield potential of specific varieties due to the varieties' improved nutrient efficiency and enhanced resistance against harmful organisms and, above all, water deficiency.

Against the background of climate change, the role of sustained intensification of crop production under the organic economy strategy, which is an aim intensely pursued by Germany, is gaining strategic importance in the short term. Biomass from sustained production is an important feedstock source for equally sustained energy supply, particularly in the countryside, and the material use of renewables.

The current UFOP Report on Global Market Supply shows that this potential is not used fully. Low or falling prices for grain, oilseeds, sugar and vegetable oils are evidence of global oversupply. With prices at the current levels, sustainable agriculture is next to impossible, even in African rural areas. From this point of view, arable farming is highly challenged not just in Germany.

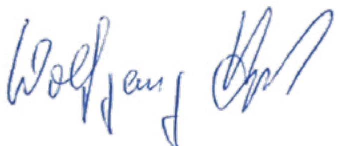
When revising the Renewable Energy Directive (Red II), the European Union failed to integrate this potential properly in its climate protection policy. In fact, production of renewables from cultivated biomass is being gradually shunted aside without developing sales perspectives in new markets.

Instead, the governments of the world's most important agricultural nations in North and South America and Asia are promoting energy-related uses of cultivated biomass in their national agricultural, energy and climate protection policies. This is reflected in rising requirements for blending biofuels in fossil fuels. I expect that these countries, as signatories of the Paris Climate Protection Agreement, not only want to see this instrument of climate protection acknowledged in their national climate and energy plans they are required to provide by 2020, but that they will also continue to pursue its further development.

This means that production of renewables will take place elsewhere in the future. As a consequence, the European Union will lose influence because it can no longer specify statutory requirements relating to sustainability criteria that would apply in non-EU countries. This situation especially affects the production of oilseeds in the European Union, because it provides the primary, and GM-free, source of protein for animal feeding. Conversely, there will be additional imports of large amounts of soybeans and therefore the corresponding "acreage". In other words, EU regulations on how to calculate greenhouse gas emissions do not take this substitution effect that supports the competitiveness of domestic feedstocks into account.

Consequently, the maxim of the liberalization of agricultural market policy the EU Agricultural Council supported again at the end of November 2018 is contrary to an environmentally safer diversification of crop rotation systems for economic reasons. Because, naturally, farmers grow the kinds of crop that promise them the highest profit. At the same time, dependence on imports of feed protein is increasing. The European protein plan will presumably do nothing to change this.

Agricultural policy is obliged to combine the requirements for cost-efficient and sustainable crop production with a proper agricultural and climate protection policy and open up sales perspectives in the fuels markets. At the same time, is must also include ambitious sustainability requirements that also apply in countries outside the EU. I am therefore interested to see what the future German agricultural strategy is going to look like in detail given these overall conditions of market policy.



» **Wolfgang Vogel**
UFOP Chairman

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Editorial department, charts and descriptions:
Agricultural Market Information Company (AMI)
Department plant production
In Charge: Wienke von Schenck
www.ami-informiert.de

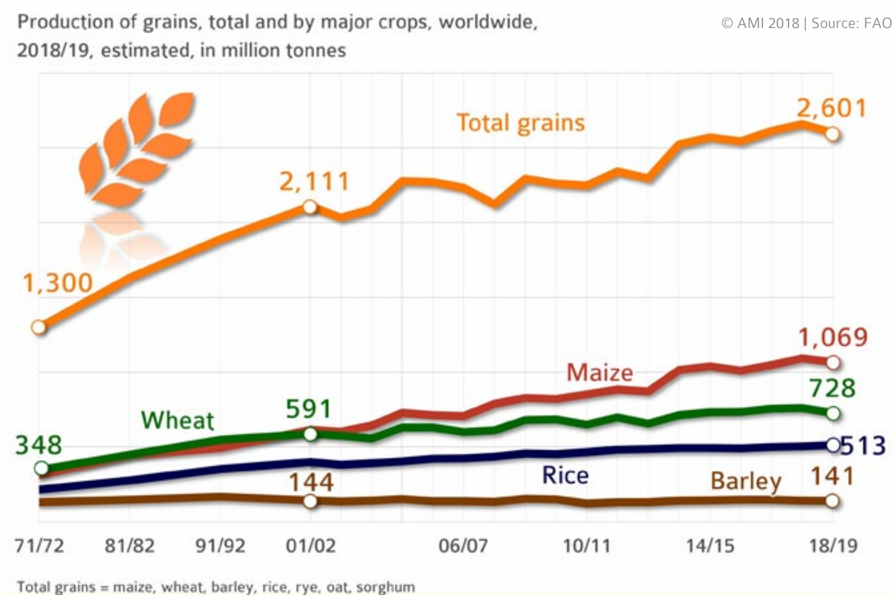
1 Feedstock supply

1.1 How much grain is produced on a global scale?

» 1.1.1 Global grain production

Poor weather conditions occurring both in the northern and southern hemisphere affected global grain production. This especially applies to wheat (-4.2 per cent) and maize (-2.2 per cent). Since these are the world's most important kinds of grain, their decline is reflected in the figures for overall grain production. Although production fell short of the previous year's by 2.1 per cent, it remained at a level of more than 2.6 billion tonnes. In general, 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 1971/72 harvest amounts have tripled (maize) or doubled (wheat and rice). Bumper crops in many production regions have led to oversupply on the markets. Maize is the number one grain, underlining its globally growing importance for supply to the feed sector and (US) bioethanol production. Like maize, barley is mainly used as livestock feed. On the other hand, rice and wheat are predominantly consumed in human diets.

Global grain production remains at more than 2.6 billions tonnes

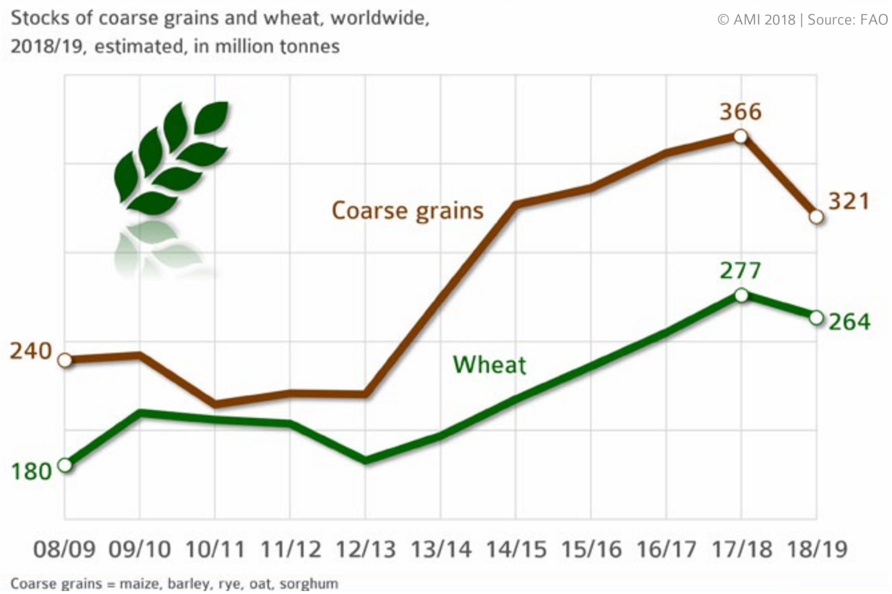


» 1.1.2 Global stocks of grains

Due to significant harvest increases in grain cultivation, world grain stocks have grown considerably. In most marketing years, production of wheat and coarse grains exceeded consumption. These 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.

Based on smaller harvests of wheat and coarse grains (maize, barley and rye) caused by poor weather and the increase in consumption on a global scale, stocks are expected to decline from their highest level of 643 million tonnes to 585 million tonnes by the end of the 2018/19 marketing year. In other words, 2018/19 output will not be sufficient to cover global demand. Although this will be at the expense of supplies and lead to a drop in stocks of wheat (-4.7 per cent) and especially coarse grains (-12.3 per cent), overall supply will remain safe with a large surplus into the next crop.

Large stocks serve as buffer for small harvest amounts



» 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. The decline in grain production in 2018/19 and the slight rise in consumption lead to a decrease in global ending stocks, with the result that the stock-to-use ratio will drop. Nevertheless, supply of wheat and coarse grains, at 35 per cent and 25 per cent respectively of the amounts harvested, is set to remain exceptionally good. This will deter a rise in producer prices right into the following marketing year. To sum up, from the perspective of farmers grain prices remain too low.

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

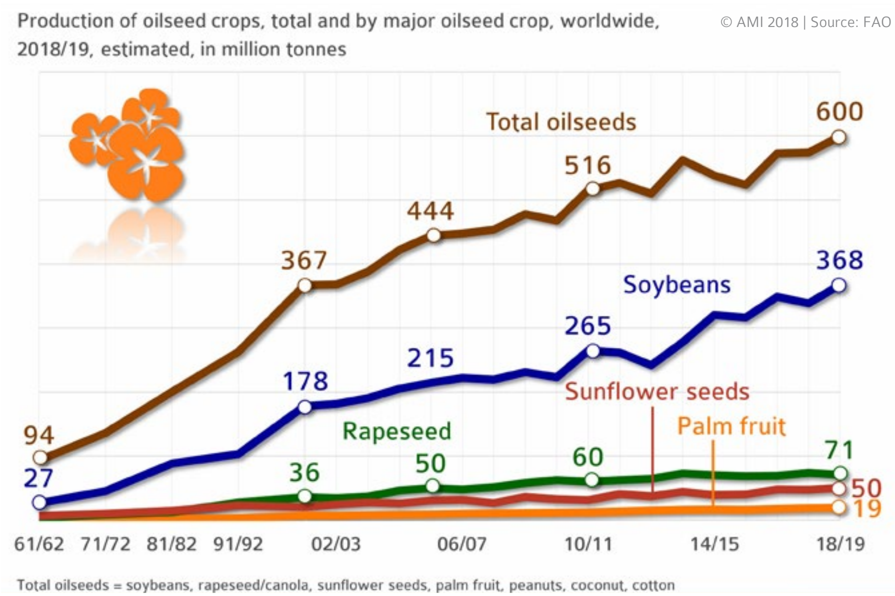
1.2 How much oilseed and vegetable oil is produced on a global scale?

» 1.2.1 Global oilseed production

In the marketing year 2018/19, production of oilseeds is likely to hit almost 600 million tonnes, the largest quantity ever. Global rise in demand for high-quality feed protein has been a key driver of North and South American soybean production for years now and is the main reason for the expansion in cultivation area. On a global scale, soybean is the number one oilseed crop, accounting for more than 60 per cent of world oilseed 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. These factors have a determining influence on the price of the oilseed crop in question. This especially applies to protein quality, because soybean is also the most valuable source of protein in terms of quality. For this reason, rapeseed breeders are working intensively on improving the protein quality of rapeseed.

Soybeans are the world's no. 1 oilseed crop

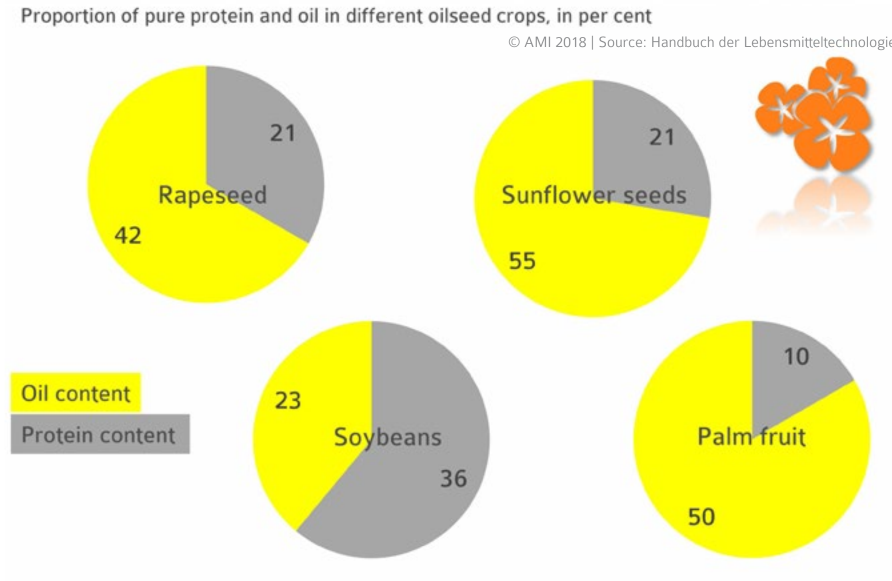


1.2 How much oilseed and vegetable oil is produced on a global scale?

» 1.2.1 Global oilseed production

↳ 1.2.1.1 Composition of oilseed crops

Sunflowers have the highest oil content



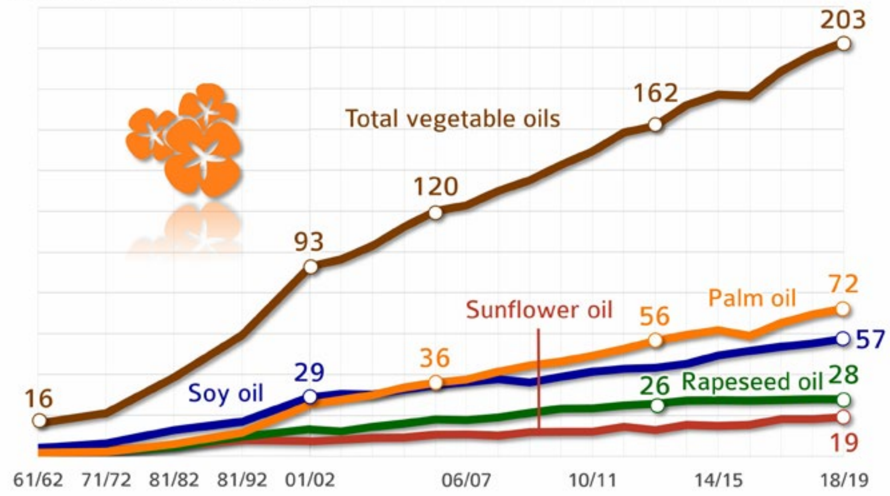
1.2 How much oilseed and vegetable oil is produced on a global scale?

» 1.2.2 Global vegetable oil production

Output of vegetable oil increased rapidly over the past decades. Production of vegetable oil from the eight key oil-yielding crops amounted to approximately 203 million tonnes in the 2018/19 marketing year. This was more than twice the amount at the turn of the millennium. Together, palm and soybean oil, the world's most important oilseed crops, account for 63.5 per cent of global production. Rapeseed oil occupies third place, accounting for almost 14 per cent, followed by sunflower oil with just over 9 per cent of world output. Vegetable oils are not only used in human diets, but also as a feedstock for transport fuel production and other industrial purposes, such as soaps, surfactants for use in detergent production, operating supplies such as lubricating and hydraulic oils, release agents for industrial uses or base substance for cosmetic products.

Palm oil strengthens its top position

Production of vegetable oils, total and by major oilseed crop, worldwide, 2018/19, estimated, in million tonnes



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

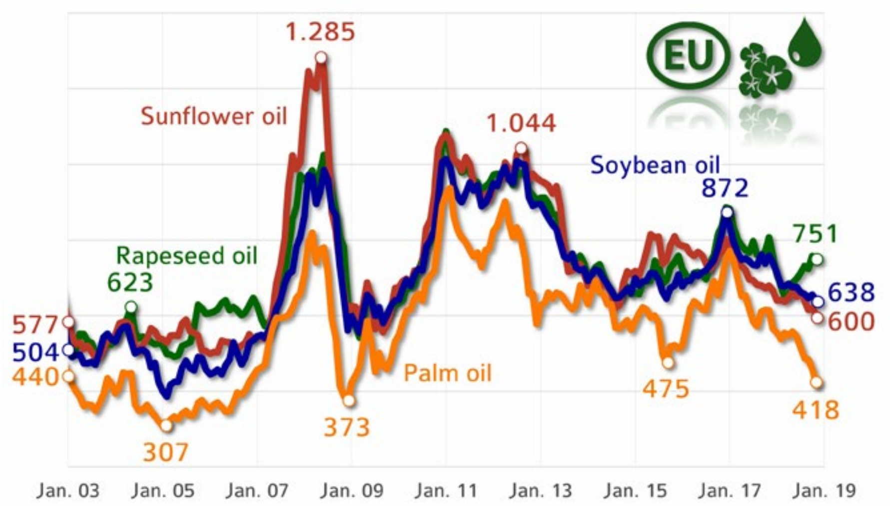
1.2 How much oilseed and vegetable oil is produced on a global scale?

» 1.2.2 Global vegetable oil production

↳ 1.2.2.1 Price developpment of vegetable oils

The price gap between oilseed rape and palm oil is the largest since 10 years

Monthly wholesale prices, fob oil mill, in EUR per tonnes

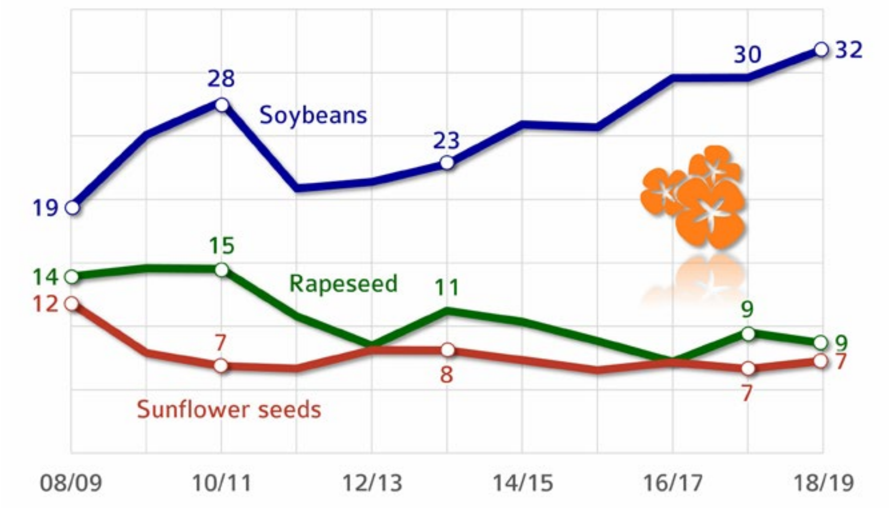


Palm oil: cif

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. The stock-to-use ratio for rapeseed and sunflowerseed has been in decline for years now. If demand for rapeseed oil for EU biodiesel production were to continue to decline, this trend would intensify, especially in the case of rapeseed. The picture is somewhat different for soybeans. Bumper crops are causing supply and stocks to rise significantly. However, there is also a steady growth in demand for soy protein for animal feed, very especially in China. Due to the positive development of the economy and income in the world's most populous country, purchasing power is increasing and so is demand for meat and, consequently, oilseed meals to feed the growing numbers of livestock. China's growth in demand for soy coincides with bumper crops in the US and Brazil in 2018/19. This correlation generates dynamic changes in price. However, the dynamics are weakened given the good supply to the market.

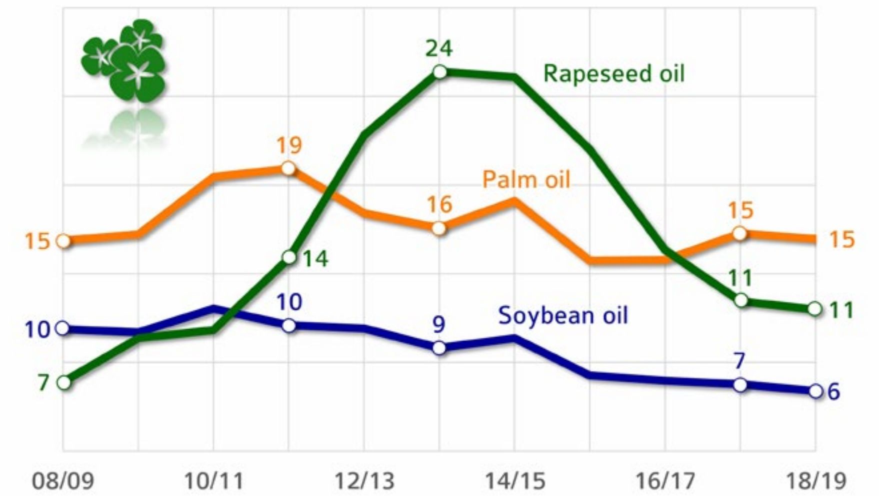
Tight supply of rapeseed and sunflower seed

Stock-to-use ratio of soybeans, rapeseed and sunflowers, worldwide, 2018/19, estimated, in per cent



Rapeseed oil in strong demand

Stock-to-use ratio of rapeseed oil, palm oil and soybean oil, worldwide, 2018/19, estimated, in per cent

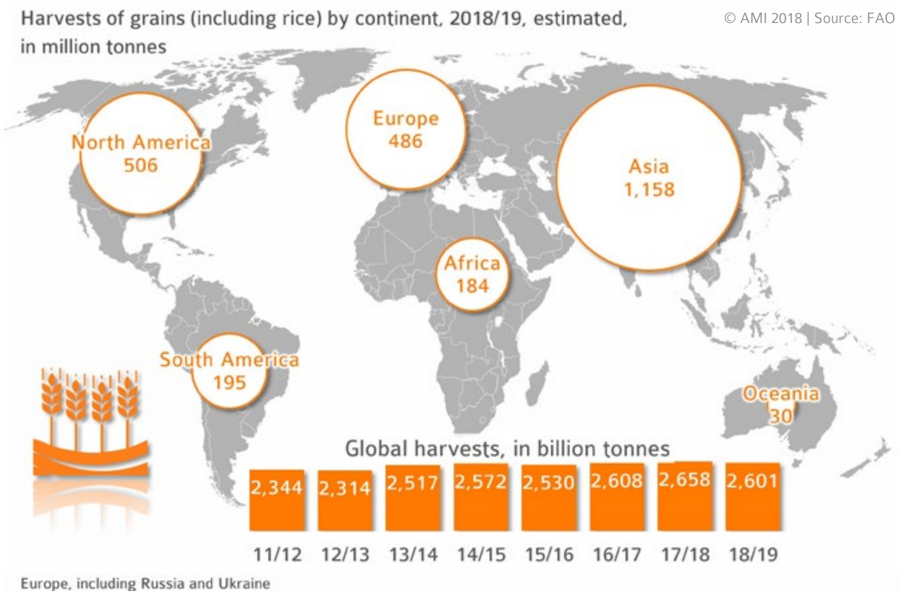


1.3 How much oilseed and grain (including rice) does each continent produce?

» 1.3.1 Production of grain

2018/19 world production of grain (including rice) is set to be slightly lower than it was in the record year of 2017/18. The larger global maize harvest cannot offset the decline in wheat and barley. The harvest was smaller especially in Europe. The Food and Agriculture Organization FAO forecast is for around 2.6 billion tonnes globally. The majority, around 45 per cent, is produced in Asia. The main reason is that Asia is the home of rice production. China is the main country of origin for grain and rice. North America holds second position, headed by the US with more than 448 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. The country produces most of its agricultural feedstock to cover domestic demand and also needs extensive imports.

Asia is the largest grain producer



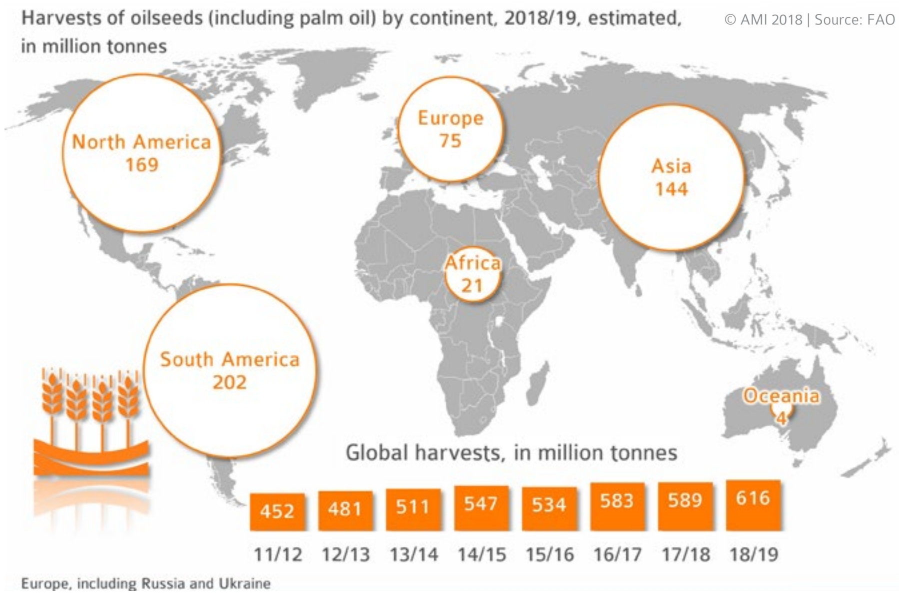
1.3 How much oilseed and grain (including rice) does each continent produce?

» 1.3.2 Production of oilseeds

The output of oilseeds is growing rapidly. The Food and Agriculture Organization FAO estimates global production in 2018/19 at 616 million tonnes. This is up 5 per cent year-on-year and just over 50 per cent from 10 years ago. The increase is primarily based on growth of output in North and South America (expansion of area planted) and Asia. The world's most important oilseed and palm oil producing regions are more evenly distributed than grain-producing areas are. The difference is not so much in output as 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 due to climatic conditions. In eastern Europe sunflowers predominate. 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 Malaysia and Indonesia.

The US was the world's biggest soybean producer in 2017/18, just ahead of Brazil. The EU-28 was top of the list of rapeseed producing countries, whereas Ukraine harvested the largest quantity of sunflowers.

Oilseed harvests growing steadily



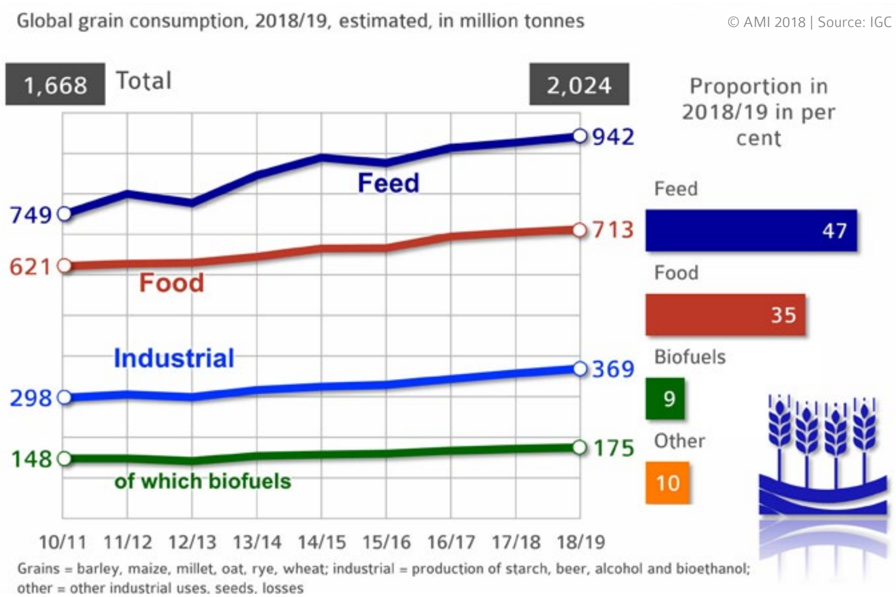
1.4 What products are made from grain?

» 1.4.1 Global use of grains

Global production of grains (excluding rice) in the 2018/19 marketing year amounted to an estimated 2 billion tonnes. The produce is intended for human consumption, but also used as a livestock feed and feedstock in bioethanol production. At 47 per cent, the largest part of the grain harvest goes into feeding troughs, trending upward (up 3 percentage points from the previous year). Although demand for grain for use in transport fuel production has increased slightly, it accounts for less than one tenth of total consumption, the International Grain Council (IGC) has reported. This means that there is enough grain to meet the growing demand for food and feed.

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 with 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 in the food markets ensures that grain mostly goes into the production of food when grain prices are high. The biofuels market serves as a "supply buffer" that ensures grain is constantly available for human consumption and feed.

Grain is mainly used for feed production

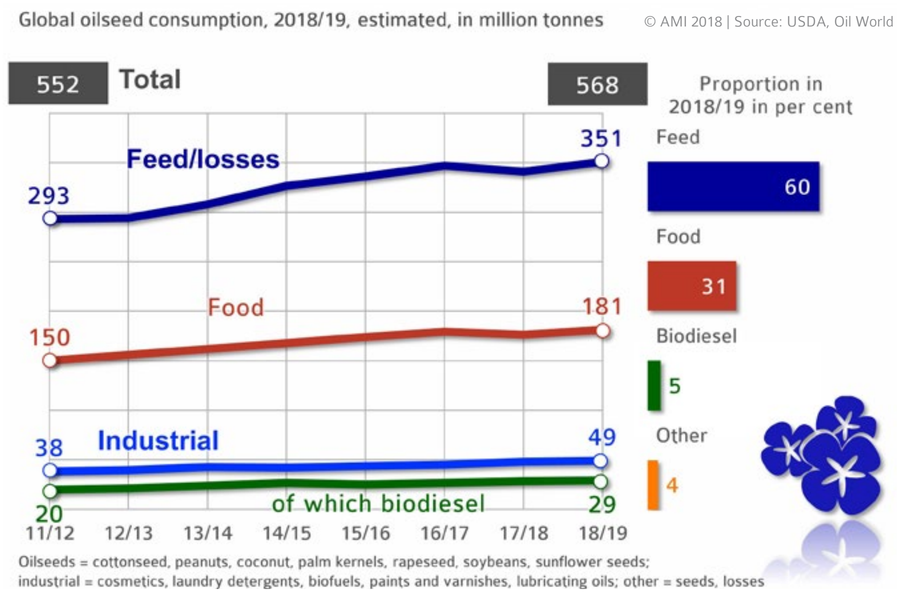


1.5 What products are made from oilseeds?

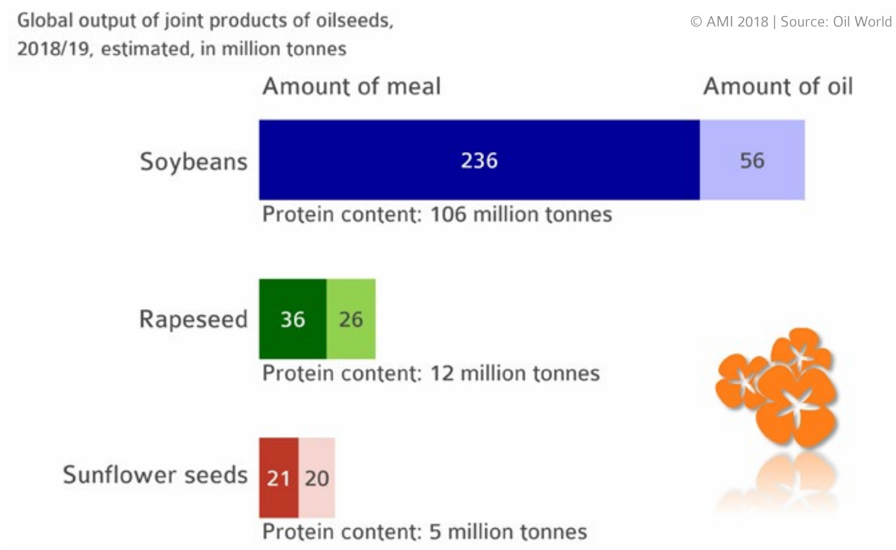
» 1.5.1 Global use of oilseeds

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 high-protein feed. Consequently, the largest part of the oilseeds – around 60 per cent – goes into feeding troughs and the smaller proportion – around 31 per cent – is used as food. Soybean meal is the number one feed in terms of quantity, with global output amounting to 236 million tonnes. It is followed by rapeseed, which has a share of around 36 million tonnes in global protein supply. 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. Therefore, EU-rapeseed meal reduces the corresponding need for soybean imports and the acreage of land that would otherwise be required for soy cultivation. On that note, the EU Commission explicitly acknowledges the importance of EU-rapeseed production as the primary domestic source of protein. Output of sunflower meal, at 21 million tonnes, is ten times lower than that of soybean meal. Production of oil is much more important with this crop. Any meal produced is also used as animal feed.

Most oilseeds also destined for animal feed



Practical dual use of oilseeds



2 Production of biofuels

2.1 Which countries promote biofuels?

» 2.1.1 Global output of bioethanol

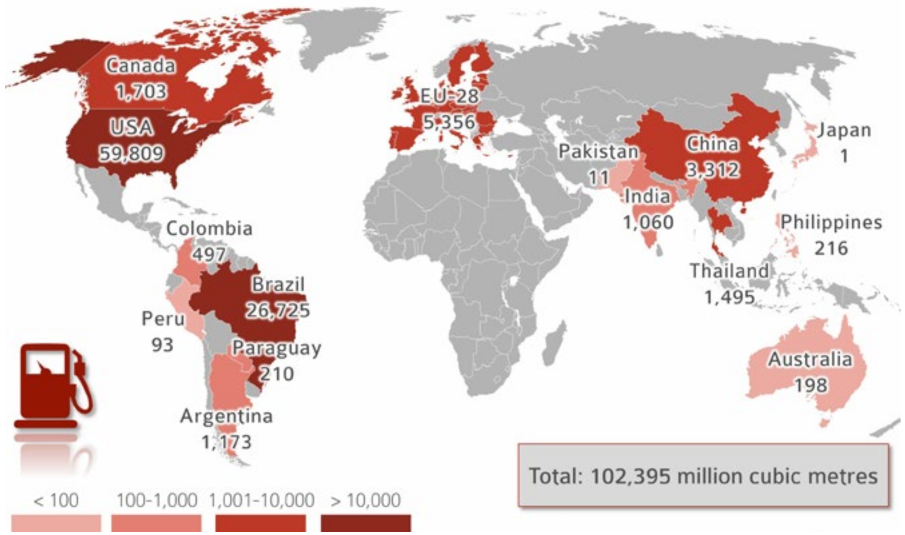
Over recent years, more and more bioethanol plants have been built to save fossil-energy sources and cut down on greenhouse gas emissions. Politics is a key factor in this by defining blending quota requirements, which exercises a direct influence on the amount of bioethanol produced. For example, in the US the blending rate was raised from 10 per cent to 15 per cent after the rate of 10 per cent was actually reached. By contrast, in China official steps taken to boost grain processing as a means of curbing local surpluses contributed to an increase in bioethanol production. The use of grain and sugar in global bioethanol production continues to grow, but at a significantly slower pace now. In the case of sugar (Brazil), production of 28.436 million m³ was lower than 2016.

Just less than 102.4 (2016: 119.3) million m3 of bioethanol were produced globally in 2017. The US is by far the most important producer of bioethanol with an output of 59.8 million m3 in 2017, of which 98 per cent was based on maize and 2 per cent on other kinds of biomass. The second largest bioethanol-producing country is Brazil with 26.7 million m3 based on sugar from sugar cane. In the EU-28, just less than 5.4 million m3 of bioethanol were produced from grain and sugar beet in 2017. This is likely to change in the foreseeable future, because in November 2018 the European Parliament and EU Council agreed on the controversial revision of the European Renewable Energy Directive (RED II).

Growth in bioethanol production slows

Bioethanol production in key countries, in 2017, in 1,000 cubic metres

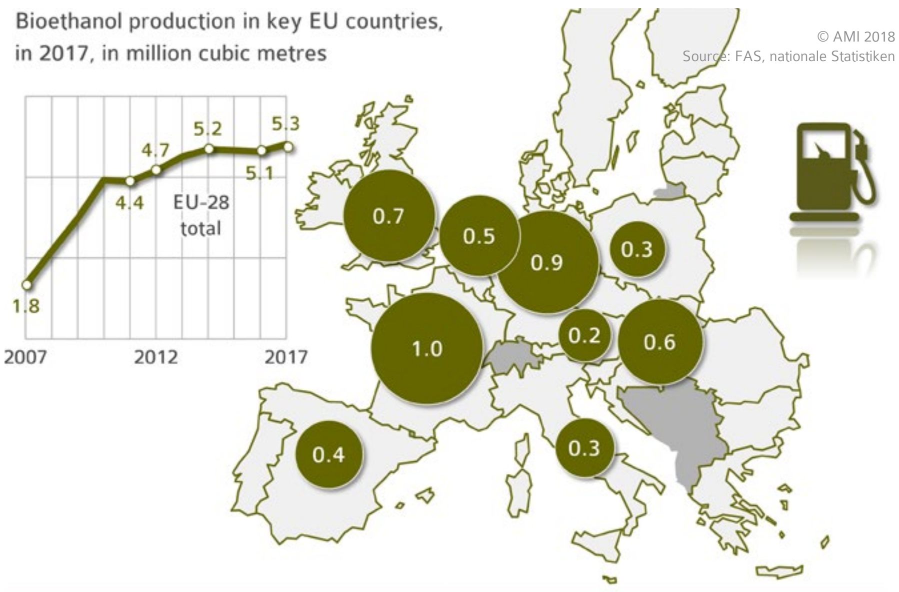
© AMI 2018
Source: Nationale Statistiken, OECD, FAS



» 2.1.1 Global output of bioethanol

↳ 2.1.1.1 Key EU-28 bioethanol producers

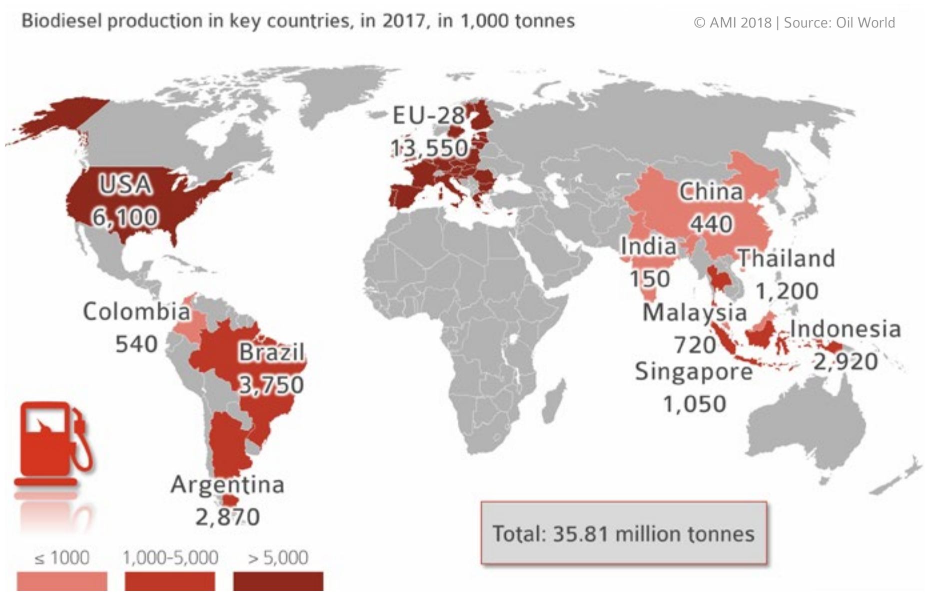
France, Germany and Great Britain account for half of EU bioethanol output



» 2.1.2 Global output of biodiesel

The single most important biodiesel producer is the European Union, which accounted for virtually 38 per cent of global output of nearly 36 million tonnes in 2017. The term "biodiesel" is used in the statistics to refer to biodiesel (FAME = fatty acid methyl ester), hydrogenated vegetable oil (HVO) and biofuels made from vegetable oils in petroleum refineries. Whereas in Europe biodiesel is mainly based on rapeseed oil, soybean oil is the primary source on the American continent. Soybean oil is a by-product of soybean meal production. It is used in biodiesel production in the wake of the steady expansion of soybean area and soy processing to cover demand for soybean meal for animal feeding. The most important biodiesel producers on the American continent are the US, Brazil and Argentina. The Southeast Asian region has gained 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 increasing glut and the associated pressure on prices in the vegetable oil markets. Contrary to the EU, these countries are raising their domestic blending quota requirements to stabilise producer prices. For the first time, global output of vegetable oils exceeds the level of 200 million tonnes in the 2018/2019 marketing year.

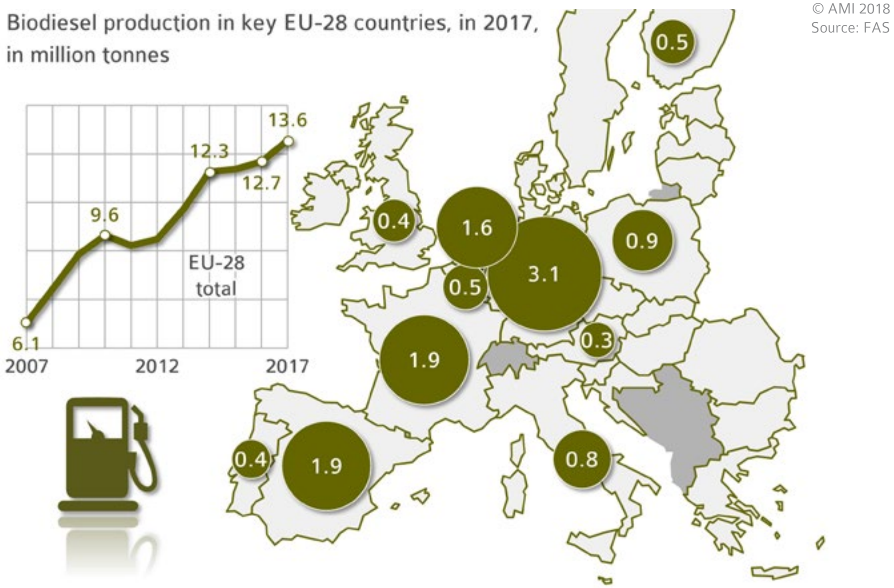
Above-average increase in biodiesel in the EU-28



» 2.1.2 Global output of biodiesel

↳ 2.1.2.1 Key EU-28 biodiesel producers

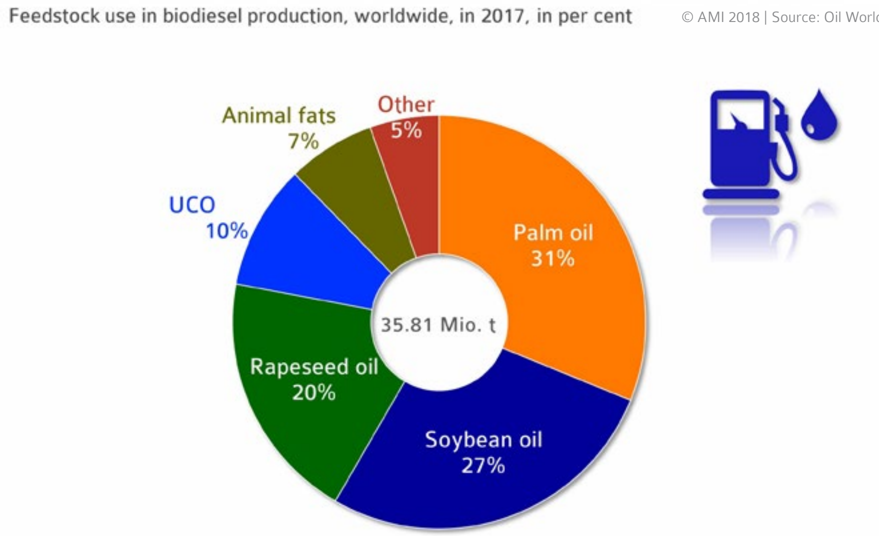
Germany produces one fourth of EU biodiesel



» 2.2.1 Global resource bases for biodiesel

Production of biodiesel, and, consequently, the use of feedstocks has increased all over the world. The percentages of feedstocks used remained virtually unchanged from 2016: palm oil accounted for just less than one third, soybean oil for just over one fourth, rapeseed oil for one fifth, used cooking fats for one tenth, etc. Waste vegetable oils (WVO) (used cooking oil), animal fats and other fats account for approximately one fourth of the resource basis for biodiesel production. Palm, soybean and rapeseed oil remained the most important feedstock sources. This will likely change in 2018, because prices for individual components vary quite considerably over 2017. Rapeseed oil has become comparatively expensive, whereas palm and soybean oil are comparatively low-priced. Production of biodiesel from soybean or palm oil in North and South America and Southeast Asia is expected to grow. In the EU-28, it remains to be seen whether the proportion of biodiesel from waste vegetable oils and fats will continue to rise at the expense of rapeseed oil. Feedstock percentages could also change in the wake of the smaller rapeseed harvest caused by drought, transport issues caused by low water in rivers, the transition to soybean processing and the EUR 300 per tonne price gap between palm oil and rapeseed oil.

Shares remained unchanged but total amount increased



UCO = used cooking oil

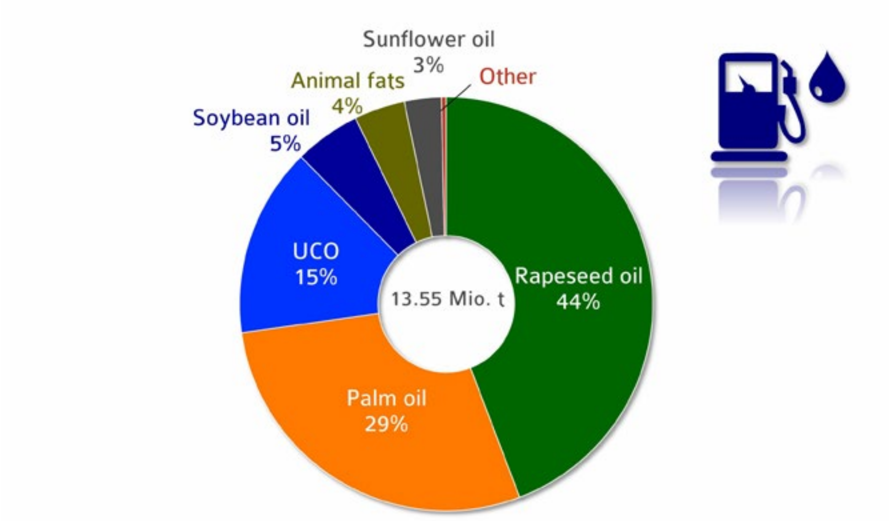
2.3 What feedstocks are used in European biodiesel fuel production?

» 2.3.1 Resource bases for biodiesel in the EU-28

Availability and selling prices of vegetable and animal oils and fats have a determining influence on the use of these commodities, including in biodiesel fuel production. Rapeseed oil is the primary feedstock source for biodiesel production in the European Union, but its share dwindles. In 2017 it fell to 44 per cent, from 48 per cent in 2016. Growing competition from low-price feedstocks from overseas combined with scarce and therefore expensive rapeseed oil resulted in declining market shares for EU sourced oilseed crop. More specifically, the share of palm oil from Southeast Asia in EU biodiesel production rose to 29 per cent. In countries such as Italy, Spain and the Netherlands, imported palm oil is the number one feedstock in biodiesel fuel production, whereas in Germany and France, the prime feedstock is rapeseed oil. By contrast, the use of used cooking oil has only seen a marginal increase, despite continued political demand for this. In the EU, with the exception of Germany, biofuels from waste and residues count double towards national quota obligations (in terms of energy), the purpose being to increase the percentage of renewable energy used in the transport sector to 10 per cent by 2020. This requirement is binding on all member states.

Rapeseed oil, the no. 1 biodiesel feedstock, in slight decline

Feedstock use in biodiesel production in the EU-28, in 2017, in per cent



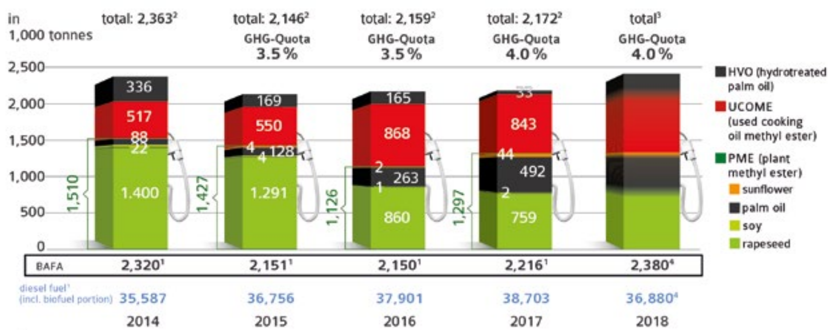
2.4 What feedstocks go into the production of biodiesel used in Germany?

» 2.4.1 Shares of feedstock in biodiesel consumed

In Germany in 2017, just over 2.22 million tonnes of biodiesel were used as a blending component in diesel fuel. This was up 3 per cent year-on-year. This figure reflects the raised energy-related cap on greenhouse gas (GHG) emissions. The cap was raised from 3.5 per cent to 4 per cent in January 2017. The mineral oil groups bound by the regulations have geared their purchasing strategy to comply with the requirement in the most cost and greenhouse gas-efficient manner. Providers of feedstock and biofuels compete for the lowest-cost GHG efficiency. The resulting shift to biofuels from used cooking oils became apparent in 2016 but hasn't continued since then. Quite the opposite, the quantity used in fact fell by 3 per cent. However, the share of biodiesel from used edible oils remained higher than the share of rapeseed oil-based biodiesel, which saw a 12 per cent decline. This is a result of the advantage these oils have when calculating greenhouse gas emission. These feedstocks, as waste, are accounted for at a „zero" CO2 greenhouse gas value, whereas vegetable oils are accounted for at the GHG value resulting from their production. The transition to the cap on greenhouse gas emissions has led to a higher feedstock efficiency, i.e. manufacturers require less feedstock to meet the obligation. Conversely, the quota on greenhouse gas (GHG) emissions could be raised as a result of the competition for efficiency, in which case biofuels could make a major contribution immediately towards reducing GHG in the transport sector. The German biofuels industry is therefore calling for a widening of the obligation to reduce greenhouse gas emissions.

More palm methyl ester (PME) in biodiesel in Germany

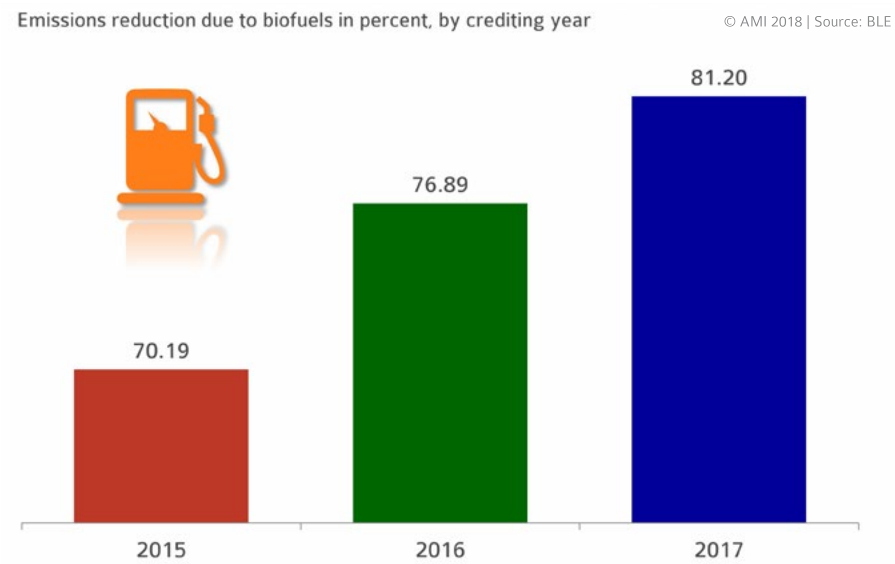
Domestic consumption 2014–2018[1] | Quota assessment[2]



2.4 What feedstocks go into the production of biodiesel used in Germany?

» 2.4.2 Greenhouse gas savings

Greenhouse gas savings increase to 81 per cent



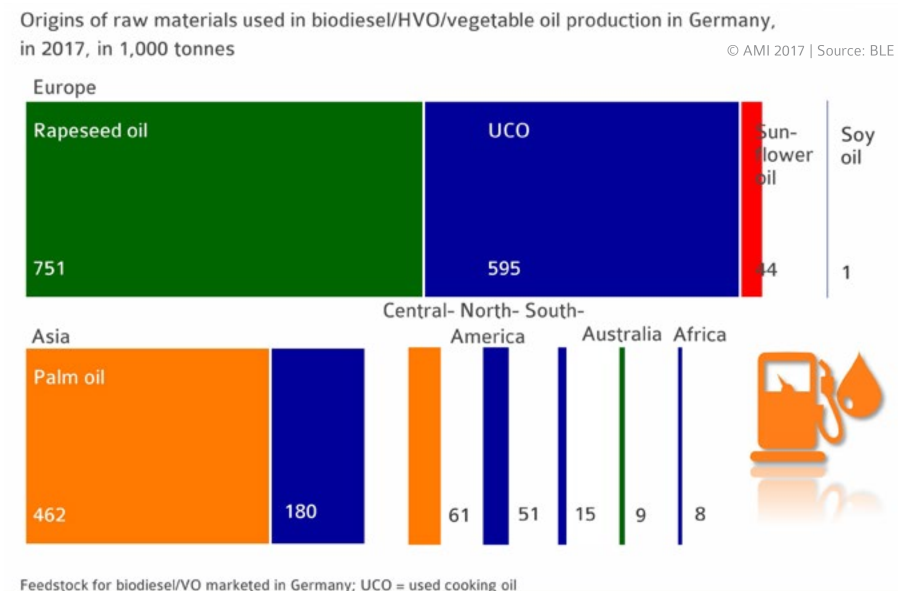
2.5 Where do the feedstocks for biodiesel at German petrol stations come from?

» 2.5.1 Origins of feedstocks for biodiesel used in Germany

In 2017, a total of 2.17 million tonnes of feedstocks were used to produce the biodiesel, HVO or vegetable oil. The majority (around 64 per cent) came from Europe, mostly from Germany. The use of rapeseed oil alone amounted to 760,000 tonnes, most of which was sourced in Europe. The amount of biodiesel from waste oils (used cooking fats, used deep-frying oils, etc.) also decreased from the previous year, but continued to exceed the amount of rapeseed oil-based biodiesel. The largest amount of imported used cooking oil came from China, and volumes actually increased. By contrast, deliveries from the US dwindled. Imports of palm oil, mainly from Indonesia and Malaysia, were raised to account for more than one fifth of the feedstock mix in 2017. Soybean oil from South America and even from European oil mills only played a secondary role.

Germany is the only country to systematically record high-quality information on biomass used in biofuel production. The data is stored in a database called Nabisy and published in the annual Experience and Evaluation Report of the Federal Office for Agriculture and Food (BLE). However, the unique traceability system exclusively centres on biofuels marketed as transport fuels and heating fuels (CHP plants). These biofuels can then be counted towards the quota of greenhouse gas (GHG) emission reduction. The diagram below only shows the part of feedstock origins used in biodiesel and HVO that was imported to Germany or processed for such use in Germany.

Most feedstock sourced in Europe



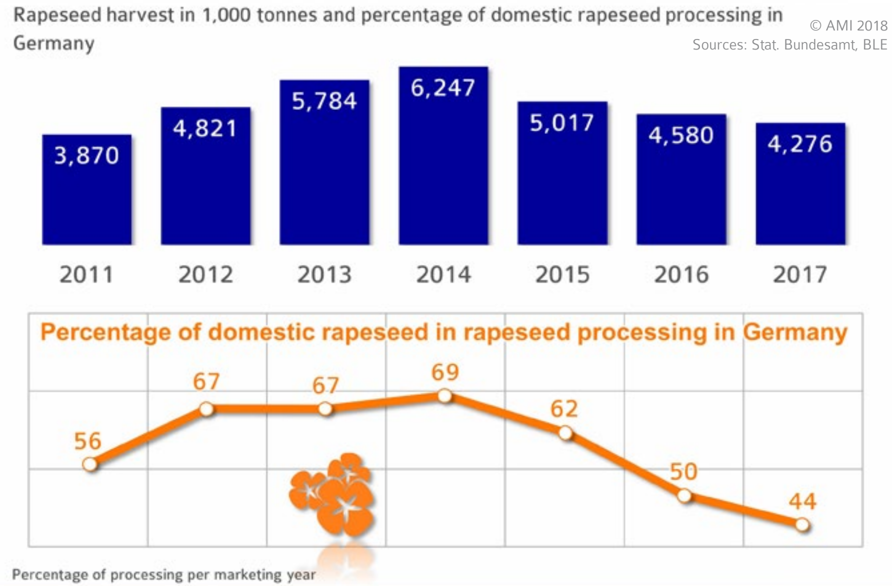
3 Food security

3.1 Is there sufficient rapeseed in Germany?

» 3.1.1 German rapeseed production and level of self-sufficiency

Supply of rapeseed depends foremost on the domestic harvest volume and consumption. One of the world's largest oilseed-processing countries, Germany needs imported oilseeds, mostly rapeseed (approximately 60 per cent), in addition to oilseeds from its domestic crop. In 2017, Germany processed 12.8 million tonnes of oilseeds, of which just over 70 per cent (approximately 9.2 million tones) were rapeseed. Unlike in previous years, 50 per cent of this demand was covered by rapeseed from abroad. The majority came from EU countries, as it did in previous years. A significant amount – almost 540,000 tonnes, or 175 per cent more than the previous year – came from Ukraine. The total amount of rapeseed processed in Germany yielded 4.05 million tonnes of rapeseed oil, more than needed for the production of food and transport fuels and for uses in the oleochemical industry. About 1.2 million tonnes of rapeseed oil went to the German food industry, another 1 million tonnes to the engineering sector. More than 1.1 million tonnes (net) of rapeseed oil were exported.

Smaller rapeseed harvest reduces share of processing



3.1 Is there sufficient rapeseed in Germany?

» 3.1.1 German rapeseed production and level of self-sufficiency

↳ 3.1.1.1 Output of rapeseed meal with and without biodiesel fuel production

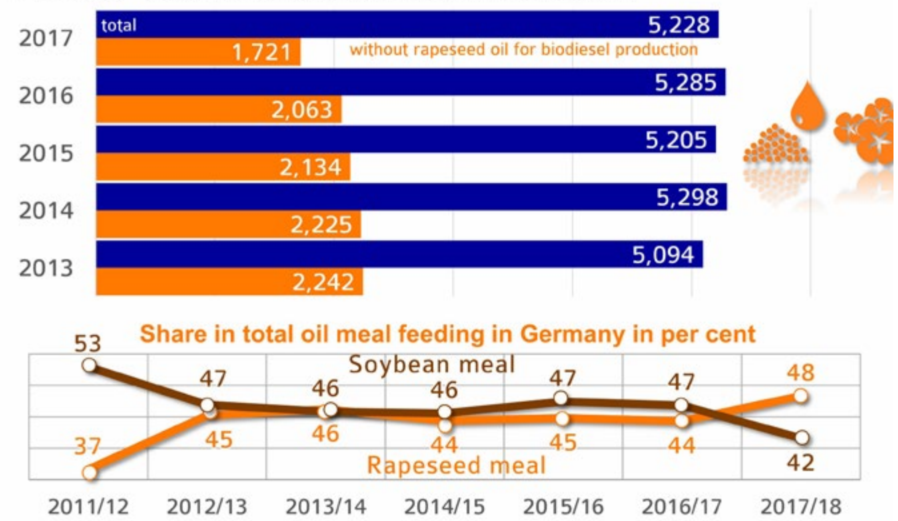
The feed market is one of the main beneficiaries of biodiesel production, because rapeseed meal is generated as a by-product of rapeseed oil production. And rapeseed meal is a key feedstuff. German rapeseed processing in 2017 amounted to 9.2 million tonnes, yielding just less than 4 million tonnes of rapeseed oil and 5.2 million tonnes of rapeseed meal. Since European rapeseed is produced without using genetic manipulation (GM), its by-product, rapeseed meal, is also classified as GMO-free. This classification promotes the use of rapeseed meal mainly in dairy feeding, where it can fully replace soybean meal and the corresponding imports from overseas. The key factor is demand for dairy products that qualify as "without GM". This means that rapeseed meal also significantly reduces the dependence on imports of GMO soy or GMO soybean meal.

If demand for rapeseed oil for use in biodiesel production will to shrink in the future, which would be the case if biodiesel is no longer seen as a contribution towards decarbonising the transport sector, more than 60 per cent of today's rapeseed meal production would no longer be available. More soybean imports would be required to fill this gap. To offset the gap left by rapeseed, soybean meal imports would have had to increase by 2.7 million tonnes annually – which would have required an additional soybean production area of approximately 1 million hectares. Consequently, the situation would reverse the trend of promoting domestic GM-free protein sources.

No rapeseed methyl ester – less rapeseed meal

Amount of rapeseed meal generated in German oil mills in 1,000 tonnes; total and – theoretically – if no rapeseed oil was needed for biodiesel production

© AMI 2018 | Source: BLE, AMI



3.2 Why is demand for oilseeds increasing?

» 3.2.1 Global consumption of meat by continent

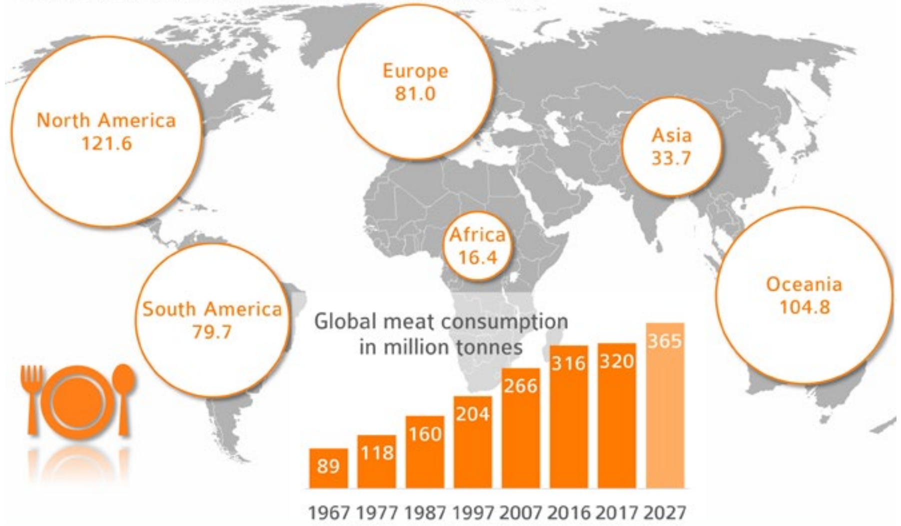
World meat consumption multiplied in the past 60 years to around 320 million tonnes and is set to increase further in the years to come. The rise is not only a result of the growth in the world's population. Meat consumption strongly depends on standard of living, eating habits, and on consumer price levels and macro-economic uncertainties. Compared to other raw materials, meat involves high production costs and is relatively expensive compared to other staple foods. As a result, demand for meat is related to higher incomes and the associated changes in diets that give preference to eating more protein from animal sources.

The growing demand for livestock provokes the need to produce more feed. Alongside grains, soybeans and rapeseed are the main crops used in feeds. Both soybeans and rapeseed are used to make protein feed meal. On a global scale, most soybeans are grown from genetically modified (GM) seed, as is rapeseed in Canada. Because of the global surge in meat consumption, demand for feed protein from oilseeds is set to rise further in future. The European Union exclusively grows GM-free oilseeds (rapeseed and sunflowers). Since demand for produce declared as "without GM" is growing, production of GM-free products is increasingly based on national or European oilseeds. This aspect will gain more and more importance as a result of climate protection policy that gears the cultivation of raw materials increasingly to sustainability and greenhouse gas reduction.

Meat consumption on a steady rise

Per capita consumption of meat in 2017, by continent, in kilogram per capita and development of consumption 1967-2027, in million tonnes

© AMI 2018
Source: FAO, UNO



3.2 Why is demand for oilseeds increasing?

» 3.2.2 Blending quotas for biodiesel

On a global scale, the largest driving force promoting biofuels are statutory blending requirements. The motivation of the various countries differs greatly. Whereas US and Brazilian interests focus on security of supply in the energy sector and reduction of fuel imports, the EU places great importance on climate protection and an increase in the overall proportion of renewable energy generated. The goals in Asian countries, such as Malaysia, Indonesia and China, but also in Argentina and Brazil, are different again. In these countries, the main objective is to reduce vegetable oil surplus in an effort to stabilise market prices. These countries' national mandates for shares of volume or energy in fossil-energy diesel fuel range from 1 to 30 per cent.

The obligation to reduce GHG emissions, which was introduced in Germany in 2015, is truly unique in the world. Distributors (i.e. the petroleum companies) must provide evidence of compliance. Bioethanol plays the most important role in the majority of countries that have quota requirements. Again, its use is driven by 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. The major exporters of agricultural produce in particular can be expected to continue to pursue their previous biofuels policies in the national action plans for decarbonising the transport sector they are required to provide by 2020 (Paris climate protection agreement).

Blending quotas promote use of biofuels

Quotas for ethanol and biodiesel by country, in 2018, in per cent

© AMI 2018 | Source: Biofuels Digest, FAS, Ländermeldungen

E=ethanol, B=biodiesel
Germany: 2018: 4 % GHG reduction; 2020: 6 % GHG reduction
EU-28: 10 % in transport sector by 2020
Norway: reaches 21 % in 2018 overall
Canada: E5-E8.5, B2-B4, depending on state
USA: 7 % overall by 2022
Argentina: E12, B10
Bolivia: E10
Brazil: E28, B10
Chile: E5, B2
Costa Rica: B20
Ecuador: E5, B5
Colombia: E10, B10
Mexico: Monterrey and in Guadlajara E10
Peru: E8, B5

E=ethanol, B=biodiesel
South Africa: 2 % overall
Kenya: E10 in Kisumu, B5
Angola: E10
Nigeria: E10
Malawi: E10
India: E2, B0, 1 (target 2022: E10, B5)
Indonesia: E2, B20 (target 2019: B30)
China: E10 in 10 provinces (target: 15), Shanghai B5
Philippines: E10, B2 (target 2020: E20, B10)
Malaysia: B10
South Korea: B3
Thailand: B10, trucks B20
Australia: New South Wales: E10, Queensland: 4 % overall

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

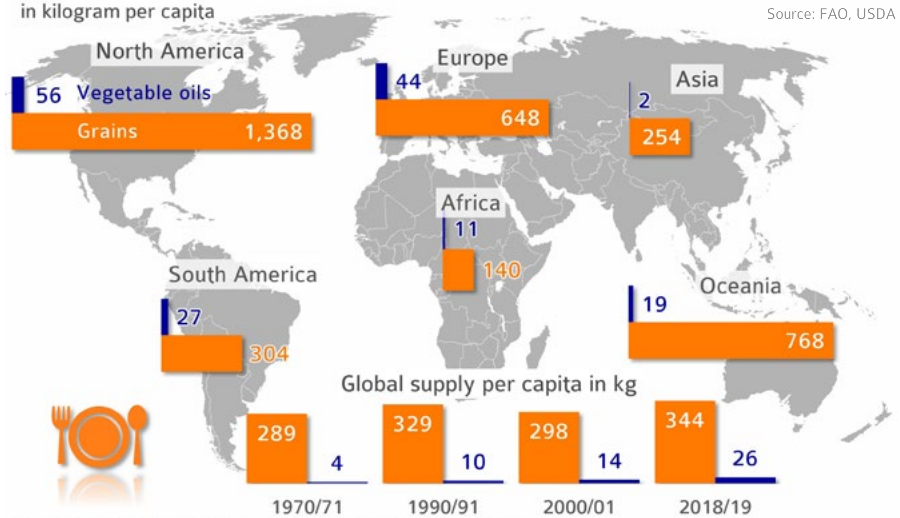
» 3.3.1 Supply per capita

Over the past 50 years the average per capita supply of the world's growing population of grain and vegetable oils was subject to fluctuations, but trended upward. Estimates for 2018 are 344 kg of grain and 26 kg of vegetable oil. These figures exceed the previous year's total of 364 kg per capita by 6 kg per capita. However, part of this supply is also used in feed production, for transport fuel blends (based on statutory quotas) or other industrial purposes. In purely arithmetic terms, food supply is sufficient to feed the world's population. However, there are huge differences between regions. The difference in availability of agricultural feedstocks is primarily a result of distribution issues, rather than a result of global undersupply due to competing fuel and feed uses. Moreover, there are substantial differences in purchasing power in the different countries. This calculation takes into account both the cost of living and rate of inflation in the countries included. However, we still need a comparison between specific shopping baskets and habits of consumption (e.g. cassava, millet in Africa) that would allow us to draw conclusions on per capita purchasing power. The currency to evaluate purchasing power is the international dollar, which has the same purchasing power as the US dollar. The World Bank put the per capita purchasing power in Germany in 2017 at around 51,680 international dollars. In contrast, the purchasing power in Liberia was only 710 international dollars. This means that the existing funds are insufficient for people to buy the amounts of food they need in countries with low purchasing power, although supply of agricultural products is adequate. Whereas in poorer countries of the world food takes up the biggest part of people's incomes, the population in industrial nations only spends a small part of their money on food. The UNO estimated the percentages in 2016 at on average 50 per cent for Africa, 15 per cent for the EU and 6 per cent for the US.

Food production increases with world population

Supply of grain and vegetable oils, in 2018/19, estimated by continent, in kilogram per capita

© AMI 2018
Source: FAO, USDA



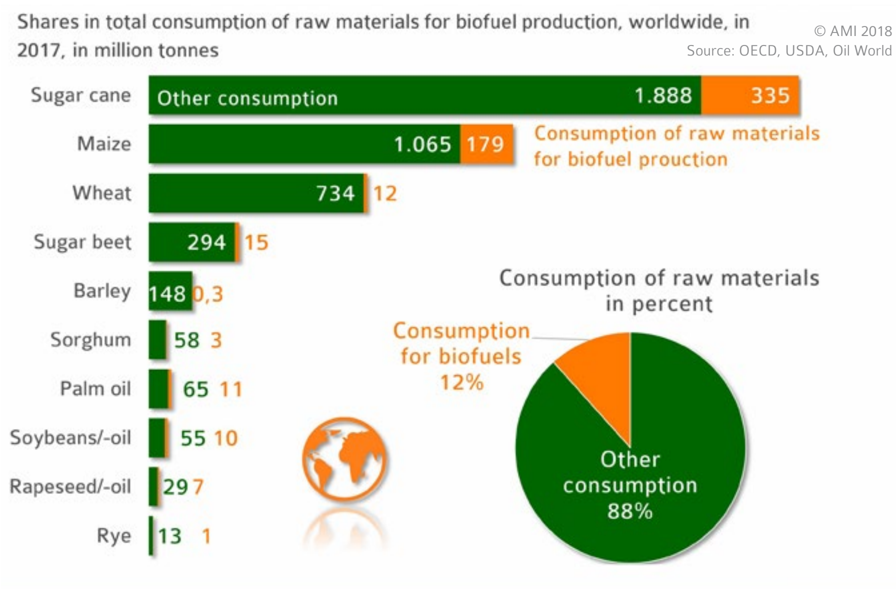
Grains = barley, oat, millet, maize, mixed grain, rice, rye, sorghum, wheat
Vegetable oils = cotton, coconut, olive, palm, palm kernel, peanut, rapeseed, soybean and sunflower oil

3.4 Is there enough food?

» 3.4.1 Use of feedstocks in biofuels production

Charity organizations and environmental associations, and also politicians, challenge – often very effectively – the importance and scope of feedstock production for global biofuels production. The ethical question is whether these feedstocks may be grown and processed for energy purposes. The fact is that in terms of total world production, the share of agricultural feedstock used in biofuels production is small. Sugar cane and maize do make up a significant share, but just a small proportion of maize is used in food production. At the same time, the processing of grain into bioethanol yields a considerable amount of Dried Distillers Grains with Solubles (DDGS). This is the equivalent to rapeseed and soybean meal as by-products of processing of oilseed into oil and biodiesel. Consequently, using agricultural feedstocks for energy purposes can even help to cope with the world's current biggest challenge – to reduce the protein deficit. The share of agricultural feedstock used in biofuels production amounts to only 12 per cent of global use and ranges from 0.2 to 24 per cent for specific feedstocks. 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 in terms of quantity. Conversely, this confirms the structural surplus, particularly of carbon hydrates, that exists in the countries where these crops are grown.

Significant use for biofuels production only in the cases of sugar cane and maize



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. Along with climate change and natural disasters, wars and forced migration are the main factors stoking hunger in the world. On top of this, international terrorism has become an increasing risk to people's lives and safety in a growing number of countries. The more people are involved in producing food, the more serious the setbacks in food production caused by political crises or conflicts. It is sadly true that to this day more money is spent on maintaining and spreading violence than on peace.

There are also other multiple and complex reasons for the shortage of food, such as climate change, dry spells, unjust distribution and 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 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 such as 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 could 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.

Distribution issue just one of multiple reasons

© AMI 2018
Source: World Bank, USDA

Largest producers of wheat, rye, millet, rice und edible oils in 2017/18, in million tonnes, and 2017 per capita income in international dollars

Country	Food production	Per capita income
World	1,539	16,906
China	316	16,760
India	235	7,060
EU-28	173	41,010
Russia	91	24,890
Indonesia	81	11,900
USA	74	60,200
Pakistan	36	5,830
Canada	34	46,070
Bangladesh	34	4,040
Ukraine	33	8,900
Argentina	31	20,270
Japan	10	44,850
Ethiopia	9	1,890
Uzbekistan	7	7,130
Afghanistan	5	2,000
Republic of Korea	4	38,340
Belarus	3	18,140
Laos	2	6,650
Turkmenistan	1	17,320
Gambia	0,1	1,670
Namibia	0,01	10,320
Singapore	<0,01	90,570
Qatar	<0,001	128,060

Gross national income (GNI) per capita at purchasing power parity

» 3.5.2 Battle for water

Water is indisputably a core essential to life. However, this precious resource is growing scarce. As early as in the 1990s, experts predicted that in the 21st century wars would no longer be waged for oil but for water. And indeed, there have been repeated conflicts over this most coveted resource, especially where countries are forced to share water from the same sea or river.

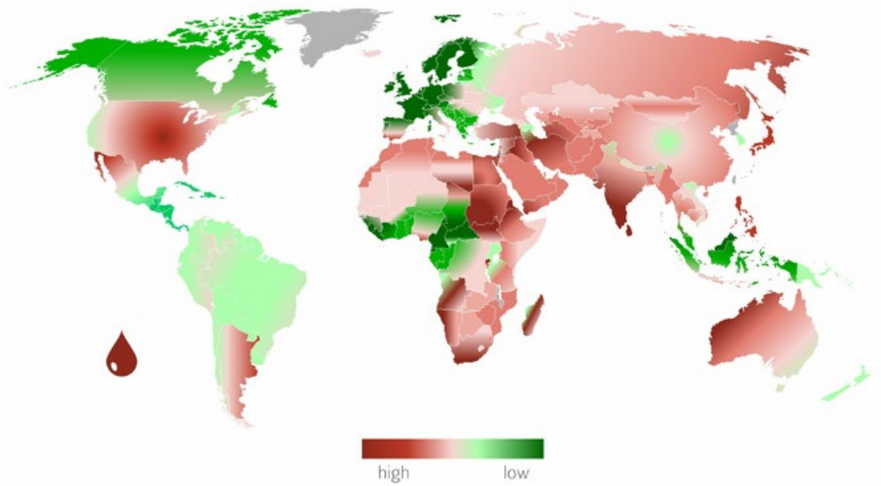
One of many examples is the political conflict between Israel and its neighbour states, which is exacerbated by disputes over water from the River Jordan. Scientists fear that such conflicts will become more frequent as the climate changes. Above all, scarce water reserves, high population density, imbalances of political power and climate stressors are the key factors causing water-related tension in these countries. Global warming and demographic growth in particular are set to lead to a growing scarcity of water, consequently toughening competition for the precious resources. This development will inevitably also increase the risk of conflicts. Such risk could, however, be minimized if the countries affected are well prepared and willing to cooperate.

The hot spots for water conflicts are located in the water catchment area of the River Nile and the areas around the Ganges Delta and Indus River. In Asia the situation is exacerbated by the fact that a lot of water is required in farming, on which people there are extremely dependent economically. Countries bordering with the Euphrates and Tigris rivers are also seen to be particularly vulnerable to water conflicts. The chances are that the Colorado River, which flows through the US and Mexico, and whose waters are fiercely contested even now, could also become another hot spot.

Hot spots of future water conflicts

Risk of conflicts over water resources

© AMI 2018
Source: EU Commission



» 3.5.3 Food availability and climate change

The implications of climate change, which vary locally, will have an impact on agricultural output.

In many regions, the adverse impact of climate change on crop yields and agricultural production could be partially offset by intensifying agricultural land management or expanding agricultural land. At the same time, small family farms have little access to innovative technologies and plant production methods, which makes it harder for them to adapt to a changing climate.

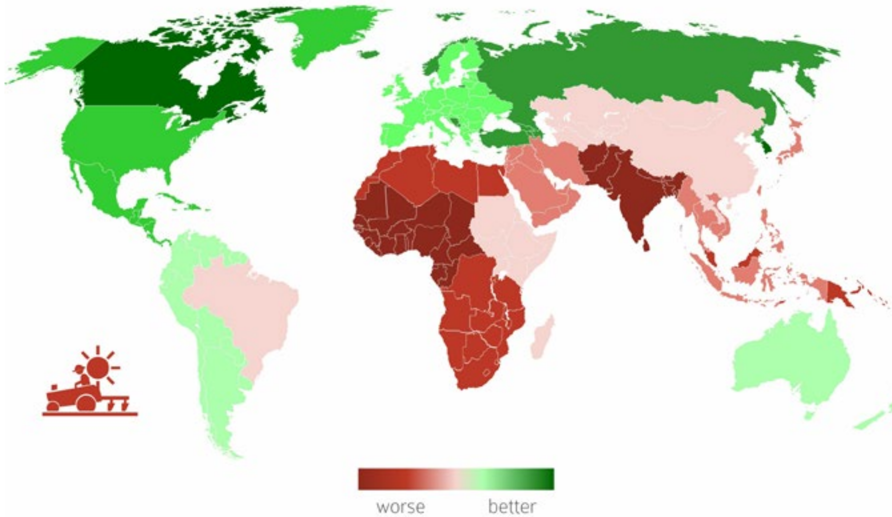
In comparison with the status quo, model calculations project that climate change will cause a falloff in agricultural output in many parts of Africa, the Middle East and India and South and Southeast Asia. By contrast, for countries in more northern latitudes the forecast is that higher temperatures will lead to a rise in agricultural output, for example in Canada and the countries of the Russian Federation.

Differences in access to markets and technologies within and between countries will likely enhance the impacts of climate change and could cause the gulf between industrial and developing countries to widen further.

Changes in production due to climate change

Changes in agricultural production in 2050 due to climate change versus status quo

© AMI 2018
Source: FAO



4 Use of land

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

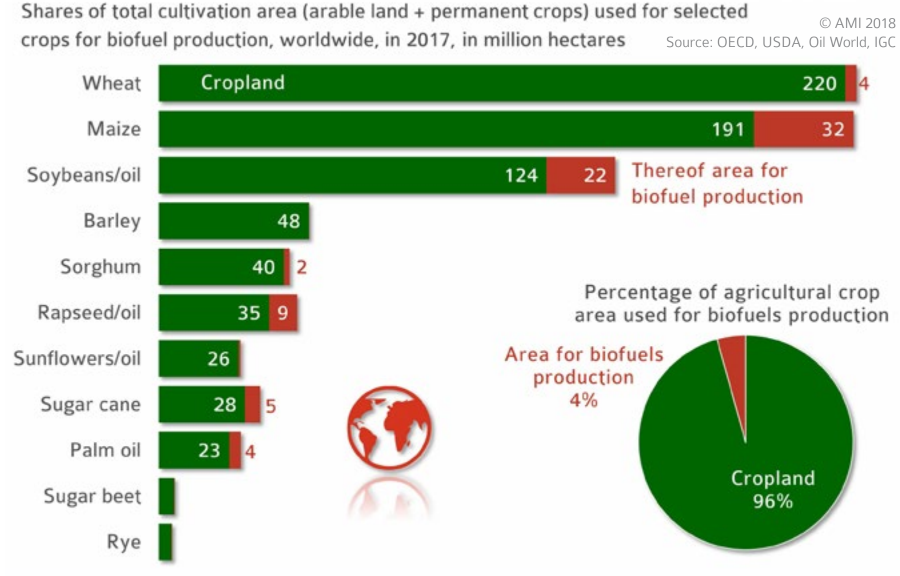
» 4.1.1 Shares of land used for biofuels production

Crop plants are grown on more than 1.6 billion hectares worldwide. These include – among others – grain, oilseeds, protein, sugar and fibre plants, fruits, vegetables, nuts and others. Most of this produce is used as food. Only around 4 per cent go into biofuels production.

At the same time, biofuels production is in most cases very obviously located in places where there is a surplus of feedstock anyway. If the surplus were not used to produce biofuels, it would have to be placed on the global market, where it would weigh heavily on feedstock costs. The use in biofuel production reduces the production overhang, generates extra value added and reduces the need for foreign currency for imports of crude or fossil fuels. The latter is primarily a problem in poorer countries. Another advantage is the amount of high-quality protein feed that is generated, demand for which is steadily increasing. The amount and quality of these protein feeds have a strong influence on feedstock prices. Consequently, they also determine the amount of land dedicated to growing the feedstocks. In other words, biofuels are by no means the price drivers in the commodities markets.

Biofuels take up little space

Shares of total cultivation area (arable land + permanent crops) used for selected crops for biofuel production, worldwide, in 2017, in million hectares



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

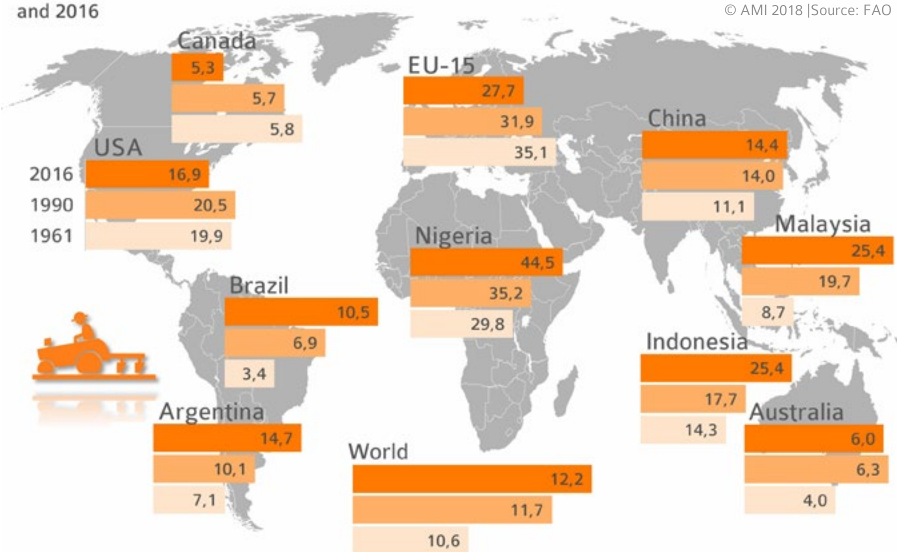
» 4.1.2 Development of cropland

The production of grain and rice more than doubled between 1960 and 2014 from 1.3 billion tonnes to 2.6 billion tonnes, and the output of vegetable oils increased even twelve-fold. In the southern hemisphere, this growth is first and foremost based on an expansion of agricultural land, along with technical progress in production methods.In the northern hemisphere, cropland is decreasingresult of farmers' high levels of qualification, good professional support and prompt implementation of new insights. The conversion of primeval forest and other land required to protect the environment and climate is increasingly meeting with strong public and political resistance. For this reason, there is a need to create sustainability requirements that are binding on all growing areas. Based on these requirements, biomass production must be certified to allow it to be traced back to its origin. In the southern hemisphere, the implementation of social standards and the issues of land acquisition and ownership are paramount for sustained biomass production. A stop must be put to illegal clearings of primeval forest or changes in land use to create new palm oil plantations or expand soybean cultivation. In the revision of the European Renewable Energy Directive (RED II), the EU's biofuels policy defines more stringent documentation requirements and greenhouse gas reduction requirements, for the first time also for solid biomass. At the same time, in light of the changes in land use in South America and Asia (clearing primeval forest), there are growing calls to develop these system requirements further – irrespective of final use – and lay them down in legislation. The aim should be to create a level playing field for global fair competition without any environmental or social dumping.

Less land in agricultural use in the northern, increasingly more in the southern hemisphere

Shares of agricultural land and plantations in total land area, in per cent, in 1961, 1990 and 2016

© AMI 2018 |Source: FAO



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

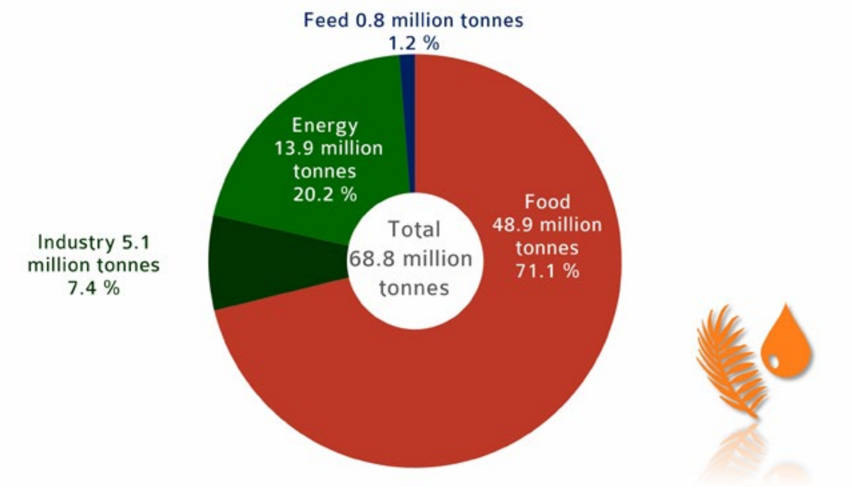
» 4.2.1 Global use of palm oil

Oil palm is the single most important oleaginous fruit crop in Southeast Asia, but is also grown to a considerable extent in Colombia and Nigeria. On a global scale, palm oil is the most important vegetable oil with an annual output of more than 70 million tonnes. Like other vegetable oils, it is ideal for a wide range of uses – in food, oleochemical items or as a feedstock for biofuel. Global palm oil consumption in 2018 is estimated at just less than 69 million tonnes. The majority is used as edible oil in Southeast Asia. Food uses account for 71 per cent, energy uses for 20 per cent (e.g. biodiesel) and oleochemical uses for 7 per cent of overall consumption. World palm oil production increases each year due to the expansion in area by clearing primeval forest legally and illegally, replantings and the use of new hybrid varieties with a high yield potential. However, the growth in global demand is lagging behind. This has the result that more and more palm oil surplus is processed into biodiesel in the main palm oil producing countries and governments are raising blending quota requirements step by step. In Indonesia, the quota for non-public transport is already at 20 per cent. By contrast, the EU aims at curbing the use of palm oil in biodiesel. Plans are to end counting palm oil in biofuels in the achievement of EU climate targets. However, fuels at European petrol stations will not be entirely free of palm oil until 2030. The incorporation rate is to be frozen at the level of 2019 and then gradually reduced from 2023 onwards. On a global scale, palm oil consumption is likely to increase over the coming years, especially, it can be assumed, in the food sector. At the same time, the individual sectors are poised to make increasing use of 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 primarily food

Shares of various uses of palm oil, worldwide, in 2018, estimated, in million tonnes and per cent

© AMI 2018 | Source: Oil World, USDA



5 Development of prices

5.1 Do biofuels push food prices up?

» 5.1.1 Comparison of prices of bread and grain

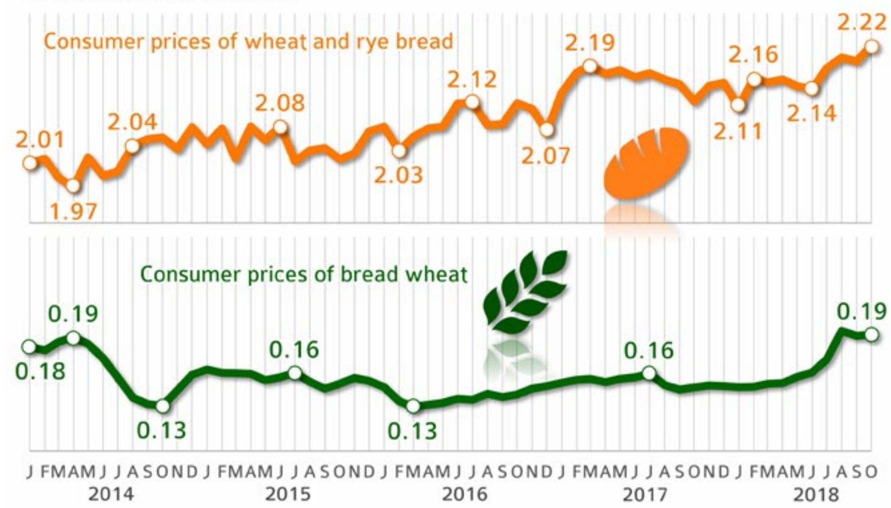
Wheat is used both for food and bioethanol production, with use in transport fuel production currently stagnating. Many people argue that production of biofuels causes a shortage in this feedstock for food production and drives wheat prices. Although prices for wheat and rye bread did increase in the second half of 2018, biofuel production had little to do with the increase. In fact, the rise was prompted by a significant surge in wheat prices in response to smaller harvests. The main reason for consumer price increases of soft wheat-based products, e.g. wheat-rye bread, has been rising costs for labour, rents, energy etc. The explanation is that raw material only accounts for approximately 15 cents of the costs in a one-kilo loaf of wheat-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. However, the real causes of price increases in these countries are primarily found in government interventions in the markets, high freight costs, poor infrastructure and inadequate market access.

Bread price versus grain price

Consumer prices of wheat and rye bread and ex-farm prices of bread wheat, in Germany, in EUR per kilogram

© AMI 2018 | Quellen: AMI/LK/MIO, AMI Consumer Price Panel



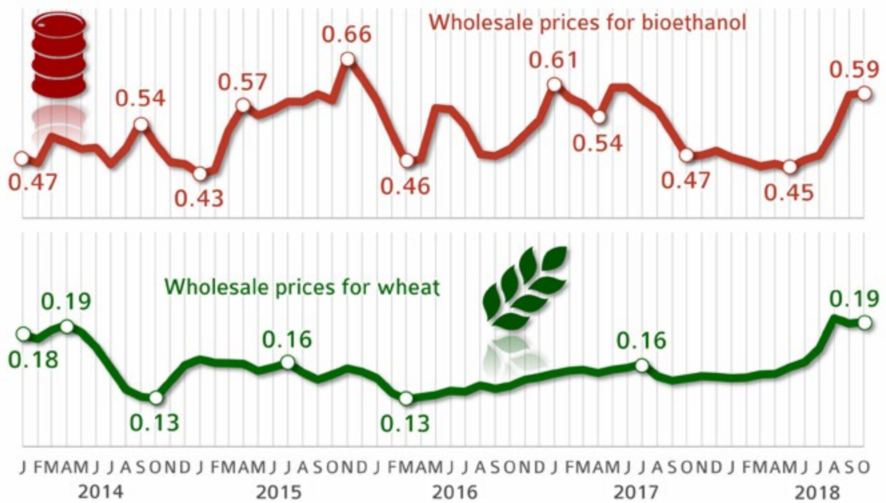
» 5.1.2 Comparison of prices of bioethanol and grain

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 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.

According to FAO, suppliers have "responded" with intensification and yield increases. For several years now, bumper crops have led to global oversupply and, as a consequence, a build-up of stocks at high levels. 2018/19 grain harvests are exceptionally small in many parts of the world due to adverse weather conditions. As a consequence, production is unlikely to cover annual demand. Nevertheless, overabundant stocks will close the gap – there can be no question of grain supplies being short. As the charts show, the increase in demand for agricultural feedstocks for use in biofuels production only has a minor inflationary impact on prices. Although both wheat and bioethanol prices went up, there is no direct correlation between the two. In the wake of the trade conflict between the US and China and the associated increase in crude oil prices, bioethanol prices increased whereas prices of wheat were driven by harvest losses in Europe. To sum up, bioethanol does not lead to rising prices of wheat; instead, demand for biofuels stabilizes producer prices, even to the benefit of agriculture in developing countries.

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



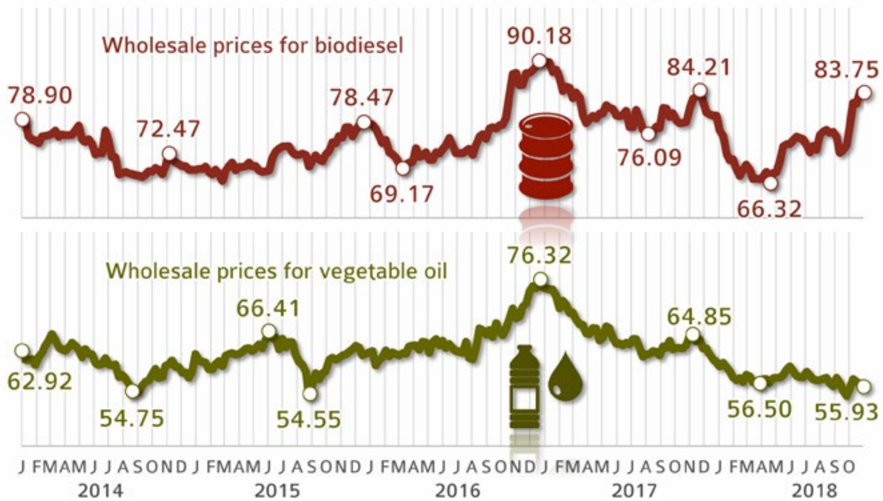
Lower-quality wheat

» 5.1.2 Comparison of prices of bioethanol and grain

↳ 5.1.2.1 Comparison of prices of biodiesel and vegetable oil

Biofuels have little influence on commodities

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



6 Statistics

6.1 General notes on handling statistics

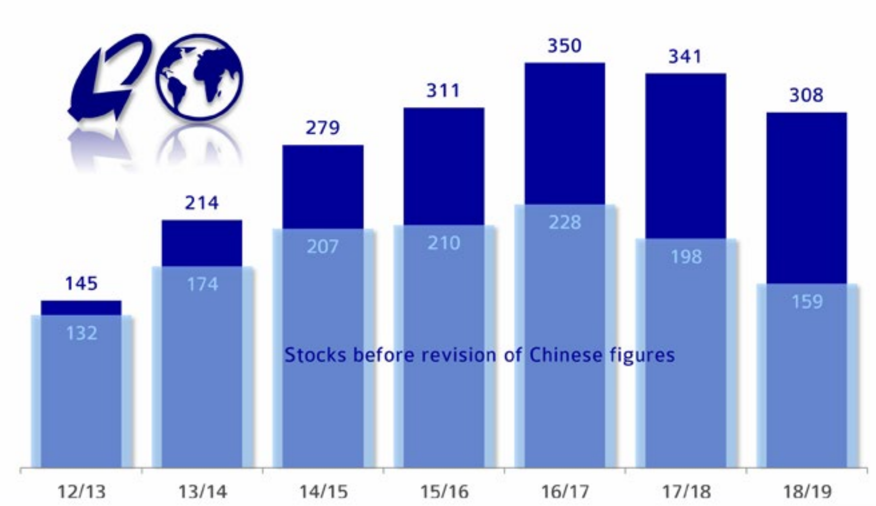
» 6.1.1 Pitfalls of statistics

Each case made should be based on reliable figures, especially in the debate on benchmark decisions about medium and long-term supply with food. However, it isn't as easy as it sounds. Decision-makers frequently act according to the motto: "I don't trust any statistics I didn't falsify myself." How trustworthy is the source? Which intention does the data provider represent with the information given? And even if the information is neutral, the question is, is the glass half full or half empty? Figures can often be interpreted in different ways. And finally, how exact is "exact"? This problem can be seen especially in statements of quantity.

For example, figures relating to production and processing are always fraught with uncertainty. The maize crop outlook for China is a recent example. For many years it was too low, because the assumed acreage it was based on was too small. The figures had to be raised following an agricultural survey. More specifically, the authority in charge revised the ten-year statistics for maize upwards by up to 40 million tonnes per year. At the same time, adjustments of consumption figures have been inadequate. This has led to an unexpected swelling of global maize stocks. Not even the USDA could blind itself to these facts and revised its global supply/demand balance for maize substantially in November 2018.

All figures are relative

Global maize stocks, in million tonnes, before and after revision of the Chinese stock figures, USDA information, 2017/18 estimate, 2018/19 forecast



Sources

AMI Consumer Price Panel	Weekly survey of consumer prices in Germany, AMI GmbH, Bonn	www.ami-informiert.de/ami-maerkte/maerkte/ami-maerkte-verbraucher/meldungen.html
AMI/LK/MIO	AMI Producer Price Collection in cooperation with Landwirtschaftskammern, Bayerischer Bauernverband, Badischer Landwirtschaftlicher Hauptverband e.V., Landesbauernverband in Baden-Württemberg e.V., Landesbetrieb Landwirtschaft Hessen, Marktinformationsstelle Ost	www.ami-informiert.de
AMIS Market Database	Agricultural Market Information System, Rom	statistics.amis-outlook.org/data/index.html
BAFA	Federal Office for Economic Affairs and Export Control (BAFA), Eschborn official data mineral oil	www.bafa.de/DE/Energie/Rohstoffe/Mineraloelstatistik/mineraloel_node.html
Biofules digest	online publication www.biofuelsdigest.com	www.biofuelsdigest.com/bdigest/2018/01/01/biofuels-mandates-around-the-world-2018/
BLE	Federal Office for Agriculture and Food, Bonn Evaluation and Progress Report 2017 Statistics oils and fats, monthly results	www.ble.de/SharedDocs/Downloads/DE/Klima-Energie/Nachhaltige-Biomasseherstellung/Evaluationsbericht_2017.html www.ble.de/DE/BZL/Daten-Berichte/Oele-Fette/oele-fette_node.html
DESTATIS	German Federal Statistical Office, Wiesbaden Agriculture and Forestry, Field crops and grassland	www.destatis.de/DE/Publikationen/Thematisch/LandForstwirtschaft/ErnteFeldfruechte/FeldfruechteAugustSeptember.html www.destatis.de/DE/Publikationen/Thematisch/LandForstwirtschaft/Bodennutzung/AnbauAckerlandVorbericht.html
European Commission	DG AGRI, Brussels Agriculture and rural development; Cereals, oilseeds and protein crops, rice JRC, Ispra, Italy	ec.europa.eu/agriculture/cereals/development-of-plant-proteins-in-europe_en www.sciencedirect.com/science/article/pii/S095937801830253X?via%3Dihub
FAO	Food and Agriculture Organization of the United Nations, FAO, Rom Food Outlook FAO Cereal Supply and Demand Brief The state of agricultural commodity markets FAO database	 www.fao.org/3/CA2320EN/ca2320en.pdf www.fao.org/worldfoodsituation/csdb/en/ www.fao.org/3/I9542EN/i9542en.pdf www.fao.org/faostat/en/#data
FAS	USDA Foreign Agricultural Service, Washington D.C. EU Biofuels annual 2018	www.fas.usda.gov/data/eu-28-biofuels-annual-0
Handbuch der Lebensmitteltechnologie Nahrungsfette und -öle	by Michael Bockisch, Verlag Eugen Ulmer, ISBN 3-8001-5817-5 Chapter 4: Pflanzliche Fette	
IGC	International Grain Council, London Grain Market Report, 11/2018, Industrial use of grains	www.igc.int/en/default.aspx
OECD	Organisation for Economic Cooperation and Development, Paris Agricultural Outlook	stats.oecd.org/viewhtml.aspx?QueryId=76858&vh=0000&vf=0&l&il=&lang=en
Oil World	ISTA Mielke GmbH, Hamburg Oil world statistics update	www.oilworld.biz
UNO	United Nations Organization, New York UN Statistics Division	data.un.org/Data.aspx?q=world+population&d=PopDiv&f=variableID:12;crID:900
USDA	United States Department of Agriculture, Washington D.C. Marktet and trade data, PSD online	apps.fas.usda.gov/psdonline/app/index.html#/app/advQuery www.fas.usda.gov/data
World Bank	The world bank, Washington D.C. database	data.worldbank.org/indicator/NY.GNP.PCAP.PP.CD

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Union zur Förderung von Oel- und Proteinpflanzen e. V.
Claire-Waldoff-Straße 7 · 10117 Berlin

info@ufop.de
www.ufop.de
twitter.com/ufop_de