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Taifun Soy Info

Taifun Zentrum für Sojaanbau

Specialist information for soy producers and processors

Ecological and social aspects of global soybean cultivation

Photo: Paulo Fridman / corbis

1. Introduction

The demand for soy has risen sharply over the last 30 years. During this time the production of soy has grown faster than that of other main crops such as wheat or maize (Tab. 1). The reasons for this lie in the growth of the world population, the increasing consumption of animal products and in recent years also biodiesel production.

Because the average soy yield per area is growing more slowly than the consumption, new areas are constantly being developed for soy production. An end to the soy boom is not in sight.

Table 1 Global soybean production

Global soy production (in million tonnes)

Crop	1984/85	2014/15	Growth
Soybean	93	320	244%
Maize	458	1013	121%
Wheat	512	727	42%

Source: Own presentation based on USDA figures

The soybean harvest is traded worldwide, yet the main cultivation area can be found in the American continent. The USA, Brazil and Argentina are the main producers, accounting for 81% of the world harvest (FAO Statistics, 2016). For a long time the EU has been the largest importer of soybeans. Yet, since the beginning of the new millennium, China has been importing ever growing amounts of soybeans and has overtaken the EU as the largest soy importer (Fig. 1).

Imported soy is mainly used as protein feed enabling non-land-based livestock production on the current scale

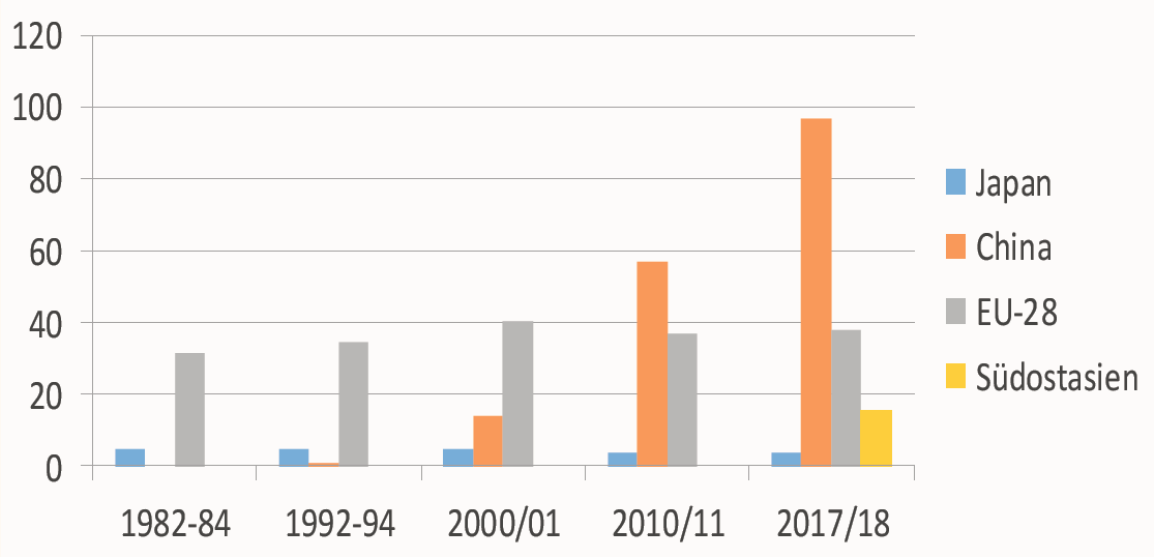


Figure 1: The biggest importers of soybeans and soybean meal. Source: Landwirtschaftskammer Oberösterreich.

However, the soy boom is causing a number of problems:

- Destruction of valuable ecosystems and serious environmental problems as a result of industrial cultivation methods (narrow crop rotations, high use of plant protection products and genetically modified organisms)
- Social problems in the South American growing countries
- Global nutrient shifts that can lead to nutrient depletion in the growing regions (Craswell et al., 2004) and eutrophication of European ecosystems.

2. Destruction of valuable ecosystems and environmental problems in the producing countries

In the past, increases in production could still be achieved through more efficient cultivation techniques. Accordingly, the annual soy harvest volume increased more than the cultivated area. In the meantime, however, it is hardly possible to increase productivity in the main growing regions. Growing demands can now primarily be fulfilled by expanding the areas under cultivation (WWF, 2011). This expansion often occurs at the expense of valuable and threatened ecosystems. The best-known example is the Amazon region. Yet, the situation is also serious in other areas such as the Brazilian tree savannah Cerrado, where a large part of the ecosystem has already been destroyed.

Soybean cultivation is directly and indirectly responsible for the destruction of these ecosystems.

Photo: BASTOS, Fabiano Marques Dourado

In many areas, e.g. in the Cerrado, previously unused land is being transformed into soybean fields. In other areas, such as in the Amazon region, other forms of land use such as pasture (Reichert & Reichardt, 2011) are being displaced by soybean cultivation. As a result, further areas are being developed by the displaced land users. Soybean cultivation in the Brazilian Amazon region, for example, is closely related to cattle breeding: soybean companies are increasingly taking over land that was previously used as pasture for livestock, while cattle breeders are clearing more forests (WWF, 2014). However, a correlation can also be observed nationwide: By displacing the rural population in other parts of the country, soy cultivation drives settlers into the Amazon region. To build a new life for themselves, more forest is cleared. In addition, the infrastructure in the new cultivation areas is being expanded to be able to trade the harvest more efficiently. In these remote areas, better accessibility is the first step towards further development and thus for the destruction of ecosystems.

The roads will provide access for illegal logging and later for livestock farming and settlement. Soybean cultivation is thus an important driver of rainforest destruction (WWF, 2014).

Not only in South America, but also in the USA, areas are being developed for soybean cultivation. The expansion is taking place in the grasslands of the Midwest, partly on highly erosion-prone soils and in wetlands. There is even talk of a new "Dust Bowl" (Lynn, 2013).

The massive expansion of soybean cultivation is thus responsible for the extinction of species, CO2 release and soil degradation in various ecosystems worldwide. For further information see the collection in chapter 7 "Further literature".

3. Social problems in the South American growing countries


Photo: Marco Keller

The expansion of soybean cultivation in South America (Brazil, Argentina, Paraguay, Bolivia), where the area under cultivation has increased sharply since the 1970s (e.g. by 123% in the period 1996-2004; WWF, 2014) is partly linked to serious social problems:

- Illegal land grabbing and sometimes violent eviction of previous users, including indigenous groups. This is favoured by the unclear land ownership situation in many areas of South America

- Threats and violence against critics of the soy industry

- Promotion of large estates and large agricultural enterprises, often from abroad

- Loss of jobs in the countryside because industrial soy cultivation is very labour-extensive. Often associated with migration to urban slums.

- Loss of food security and sovereignty. The soybean cultivation area (with the harvest being determined for export) is no longer available as arable land for local and national food production

- Massive and inappropriate use of plant protection products which threaten the health of the population as well as the local agriculture

Genetically modified soybeans are grown in South America since 1996 - today the majority of the cultivated soybeans in South America is genetically modified. As a result, the development towards large industrial agricultural companies has been further strengthened.

For more information see chapter 7 "Further literature".

4. Environmental problems caused by soy imports in Germany

Algae mats on the beach of Glowe on Rügen / Photo: Wera Leujak

Europe and China are the largest importers of soy. Soy imports make land-independent intensive livestock farming possible, since the arable land available in the EU is used to grow cereals rather than protein crops for animal feed. In land-dependent livestock farming, the number of animals on a farm is limited by the area available for growing fodder. If livestock farming is land-independent, fodder must be purchased. As a result, more animal excreta (mainly in the form of liquid manure) are produced than can be sensibly spread on existing farmland. This results in an oversupply of nutrients, especially nitrogen and phosphate, which now turn from being a valuable fertiliser into an ecological problem. Groundwater is polluted with nitrogen (Grenz et al., 2007) and surface water becomes eutrophic. In the Baltic Sea, for example, dead zones are the result of nutrient leaching from agricultural land (BSH, 2005).

In this context, one can speak of a global nutrient shift. When soybeans are imported, nutrients are simultaneously exported from the cultivating countries. In the growing regions, these nutrients are no longer available and nutrient depletion or a high demand for mineral fertiliser occurs. But not only nutrients are shifted. In part, soy is cultivated in areas with low precipitation where irrigation is necessary.

When these soybeans are exported, water is also exported ("virtual water"). Consequently, soybean cultivation can exacerbate the water shortage. Grenz et al. (2007) used Argentina, Brazil and Germany as examples to examine the global nutrient fluxes caused by soy trade. In 2005, for example, Argentina and Brazil exported 5.7 million tonnes of phosphorus, potassium and nitrogen through soybeans. Based on mineral fertiliser prices, the value of these nutrients is 2.4 billion euros - a sixth of the value of exported soybeans.

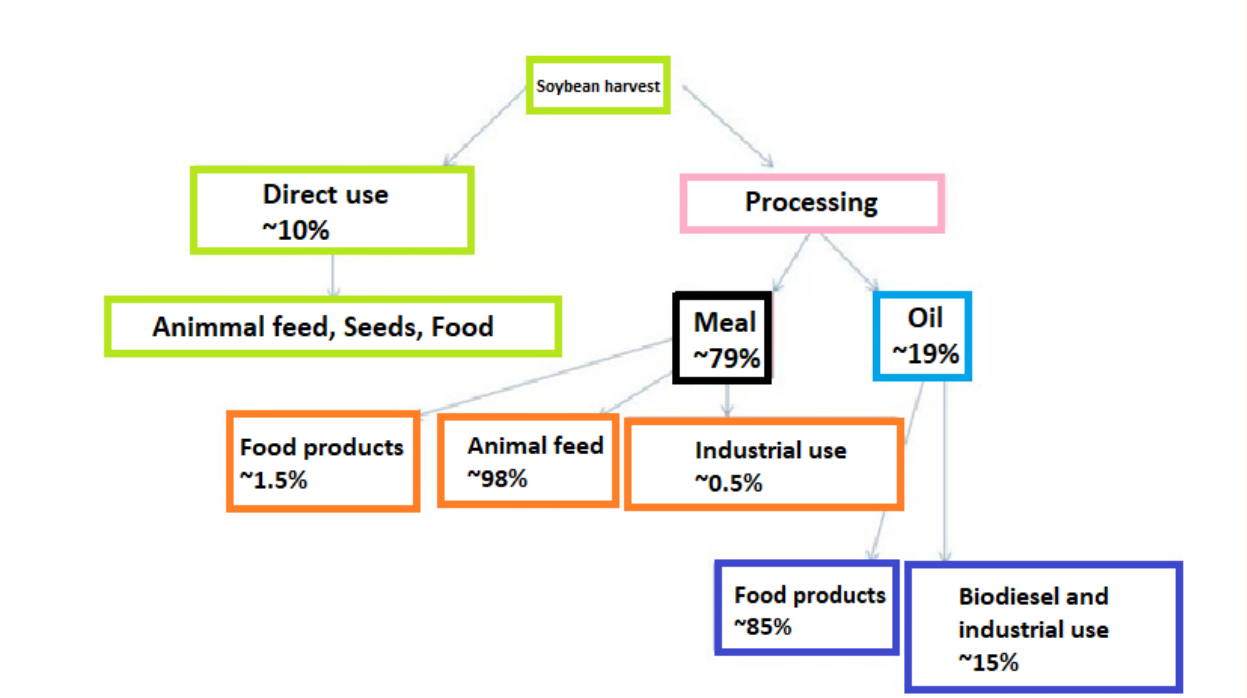
In addition to nutrients, water resources are under pressure. Germany "uses" around 180 billion cubic metres of virtual water through soy imports from Brazil and Argentina, which, with an annual precipitation of 700 mm, corresponds to the amount of rainfall over 70% of Germany's territory (Grenz et al., 2007). This does not mean that the water disappears from the ecosystem or is imported to Germany, but it is not available in the producing country for natural ecosystems or alternative crops during the soybean season. In addition, the water balance and natural water cycles can be severely disturbed and altered. This is especially true when, as in Brazil and Argentina, natural vegetation is removed at the expense of soybean cultivation.

5. Use of soy

Photos: Turi (left) / Budimir Jevtic (right) - fotolia.com

About 90% of the global soybean production is processed in oil mills (Fig. 2). In the oil mill, soybean oil is extracted (about 200 g per kg soybean) and soy extraction meal remains (about 800 g per kg soybean). Soybean oil is the most frequently used vegetable oil worldwide and is increasingly used to produce biodiesel and as raw material in industrial processes. The soy extraction meal is almost exclusively used in animal feed.

Only about 10% of the soybean harvest is used without prior industrial extraction - again mainly as animal feed. Furthermore, whole soybeans are used as seeds or for the production of human food such as tofu (Fig. 2). The proportion of soybeans used directly (i.e. without "detours through animal stomachs") for human nutrition is low. About 85% of soybeans are fed to animals (WWF, 2014).



Aus: *Economics of Soybean Production, Marketing, and Utilization*
in **Soybeans: Chemistry, Production, Processing, and Utilization**, S. 119
Quelle: U.S. International Trade Commission, 2003 und eigene Berechnungen des Autors (P. Goldsmith)

Figure 2: Uses of soybeans

6. Protein use efficiency

Due to their high protein content and above all due to their favourable amino acid composition, soybeans are very well suited as concentrated feed for pigs, poultry and high-performing dairy cows. The proportion of protein feed made from soy meal has been steadily increasing in Germany since the mid-1990s, while at the same time the production of pork and poultry meat has grown strongly in the EU (Reichert & Reichardt, 2011). In Germany, pig farming is the largest consumer of soy (WWF, 2012).

Feeding soybeans for the production of animal products is associated with high protein losses. For example, the production of one kilogram of edible protein requires about 6 kg of crude protein for pork and about 3.5 kg of crude protein for eggs (Flachowski, 2001). The protein efficiency (16.7% and 28.6% respectively) is thus significantly lower than in the production of plant-based foods. For example, in the production of tofu from soybeans, a protein utilisation efficiency of approx. 82% is achieved (Fig. 2).

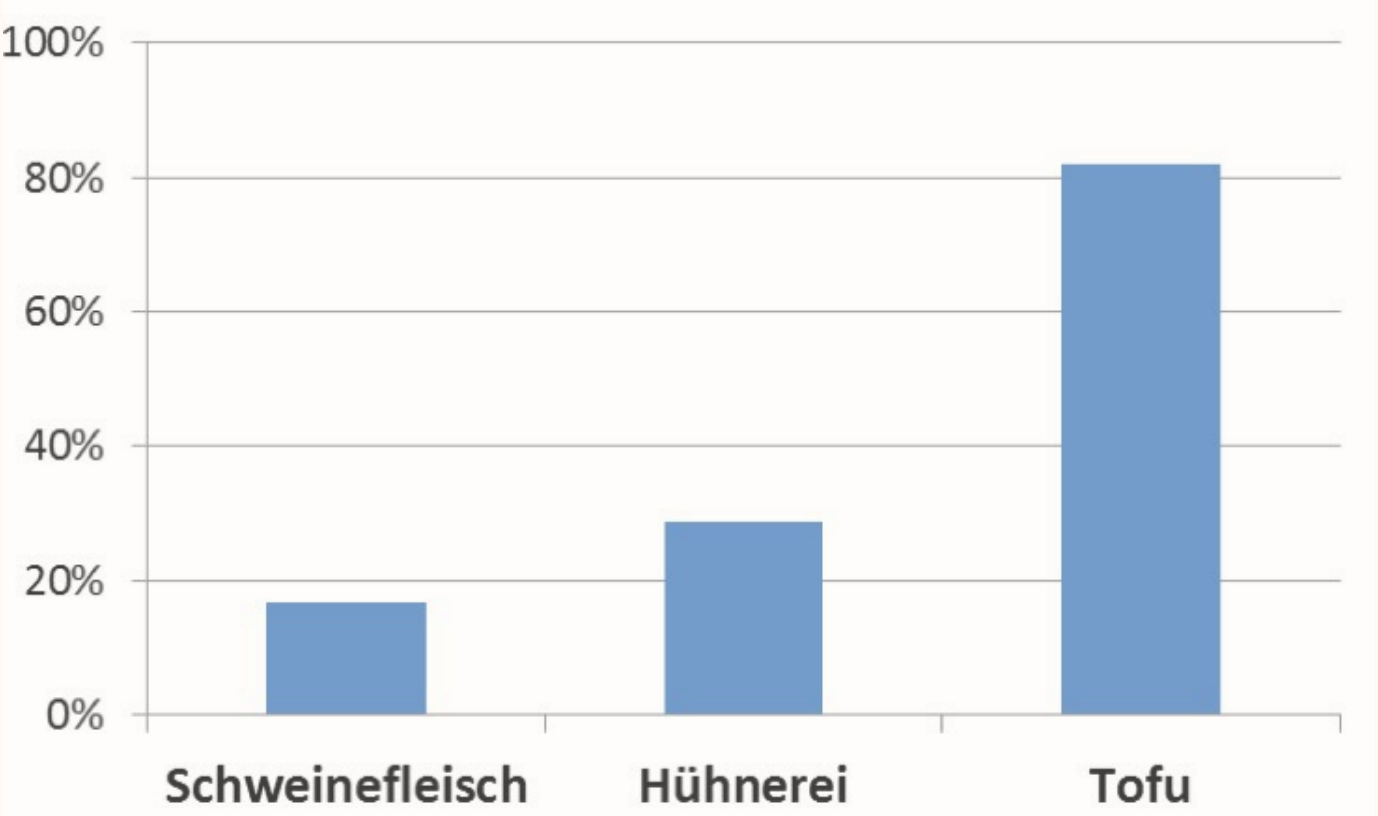


Figure 3: Protein use efficiency in the production of different foods. Source: Own calculations based on Flachowski (2001) and internal data from Taifun-Tofu GmbH. The value for "tofu" is estimated conservatively, as the by-product "Okara" was not included in the calculation; The inclusion of Okara would further increase the protein use efficiency for tofu.

In order to provide the same amount of protein for human consumption, far more resources are required for animal food products than for the production of plant-based food.

The high and globally rising consumption of animal food products is therefore a major contributory factor to the ecological and social consequences of global soybean cultivation described above.

7. Further literature (link collection)

7.1 Global soybean cultivation

The WWF brochure "Der Sojaboom - Auswirkungen und Lösungswege“
https://www.wwf.de/fileadmin/user_upload/20140312_WWF_Kurzfassung_Sojaboom_Auswirkungen_Loesungswege.pdf (in German)

The brochure "The Growth of Soy - Impacts and Solutions" includes other affected ecosystems such as the Gran Chaco in South America and the prairie landscapes of North America.
https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/20140312_WWF_TheGrowthOfSoy_Impacts_Solutions.pdf

A detailed description of the situation in the Cerrado, also from the WWF, can be found in the document "Soy and the Cerrado: Brazil's forgotten jewel”.
http://assets.wwf.org.uk/downloads/soy_and_the_cerrado.pdf

A study on the ecological consequences of German soy imports was carried out by the “Forum Umwelt und Entwicklung”, financed by the „Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit“ as well as the “Umweltbundesamt”: Saumagen und Regenwald http://germanwatch.org/de/3398

7.2 Social problems caused by soybean cultivation in South America

The film "Raising Resistance" shows the social problems of soybean cultivation and the struggle of the rural population against the developments in Paraguay.

A Spiegel article from 2006 (The greed for soy eats the rainforest) provides an insight into the situation in Brazil: http://www.spiegel.de/wissenschaft/ nature/Brazil-the greed for soy eats the rainforest a-456376.html (in German)

The report by the non-governmental organisation (NGO) "Grain" describes the social and ecological consequences of GMO soy cultivation in Argentina: "Twelve years of GMO soy in Argentina - a disaster for people and the environment”.

Fehler! Linkreferenz ungültig.http://www.grain.org/article/entries/706-twelve-years-of-gm-soy-in-argentina-a-disaster-for-people-and-the-environment

The film „Gutes Soja, Schlechtes Soja“
http://www.coreoperation.de/

Information on health risks from intensive herbicide use, using the example of an Argentinean city, can be found on the World Agriculture Report page and on the website of the Deutsche Welle:
http://www.weltagrarbericht.de/leuchttuerme/die-muetter-von-ituzaingo.html

7.3 Feeding and nutrition

Studies by the WWF on the potential of indigenous legumes in German livestock farming are available at the following links:

Poultry Feeding http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF_Feed_Report_Poultry.pdf

Dairy Cattle Feeding http://www.wwf.de/fileadmin/fm-wwf/Publications-PDF/WWF_Study_Alternatives_to_imported_soy_in_the_feeding_of_dairy_cattle_Abridged Version.pdf

More on animal husbandry on the website of the World Agriculture Report http://www.weltagrarbericht.de/index. php?id=2150

Information on the subject of animal food products and soy can be found in a leaflet from the INKOTA action network: (https://www.inkota.de/uploads/tx_ttproducts/datasheet/INKOTA_Infoblatt11_Futtermittelimporte_01.pdf) and in a report from the WWF on the effects and land consumption of global meat consumption in 2011: Meat eats land http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Natuerliche_Lebensraeume_in_Gefahr_13102011.pdf

Here you can find the long version of the WWF report: https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF_Fleischkonsum_web.pdf

Information on feeding with soy can be found in a WWF study on soy feeding and genetic engineering from 2012: "Soy boom in German stables" http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF-Studie_Sojaboom_in_deutschen_Staellen.pdf

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For comprehensive information on all aspects of soy cultivation visit:

www.sojafoerderring.de

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