# BREAKING DOWN FATS AND OILS

## A CATALYST TO TRANSFORM THE GLOBAL EDIBLE FATS AND OILS SYSTEM

Date published: 7th July 2021

# ABOUT THE EDIBLE FATS AND OILS COLLABORATION

This report was commissioned and guided by the Edible Fats and Oils Collaboration. Our global multi-stakeholder initiative focuses on accelerating the sustainable production and use of edible fats and oils. The collaboration was founded by:

There's a clear lack of centralised information about the sustainability and nutritional profiles of edible fats and oils. Our collaboration is the only holistic framework assessing the importance and sustainability of fats and oils within the food system. We believe that by filling the information gap, we can help decision makers in the food industry make better-informed policy, sourcing and investment decisions.

This report is part of a broader movement for change in the industry and the second in a series of publications and pilot projects.

If you work in an ambitious organisation with a desire to influence the sector, we'd love to hear from you. Get in touch with us at v.toledo@forumforthefuture.org.

## How the edible fats and oils collaboration came about

In 2015, Volac Wilmar and Forum for the Future recognised something needed to be done to recalibrate the polarised debate about fats and oils, which already centred on the connection between palm oil and deforestation.

After some stops and starts, we joined with WWF UK to carry out a scoping study in 2018. The results caught the attention of Marks & Spencer who were challenged by many of the issues described in that early report. Unilever joined soon after.

In 2019, we published a Case for Action, outlining the anticipated drivers of change for fats and oils and identifying areas for collaborative action. One recommendation was to bridge the information gap in the market by developing and communicating detailed profiles of the major fats and oils used around the world. That information can be found in this report.

Since then, Upfield and IUCN NL have also joined the Steering Group. Together, we work to identify the opportunities and strategies that will create a more sustainable fats and oils system.

# ABOUT THIS REPORT

**In this report, all the major vegetable oils and animal fats consumed globally have been analysed as one system – the first time this has ever been done.**

**Until now, understanding and comparing the environmental, social, nutritional and financial impacts of fats and oils used in foods was difficult because the information didn't exist in one place. This report, authored by the Edible Fats and Oils Steering Group, provides industry stakeholders with the information they need to gauge the true cost of the oils and fats we eat.**

As with our broader food system, an informed and balanced description of the fats and oils sector should contain nuance, context and an in-depth assessment of the environmental and nutritional factors (both positive and negative) associated with each ingredient.

This report aims to provide that. It's a contribution towards a more sustainable food system which takes sustainability and health into account together, leading to more considered decisions about the oils and fats used in product formulation, sourcing, investment and policies.

## Here's what's inside:

**Section 1 - edible fats and oils:** an overview, outlines key data, such as where fats and oils are produced, how they're typically used and what their functional and nutritional properties are.

**Section 2 - understanding the major edible fats and oils today,** presents impact profiles of all major oils and fats by global production volume. We hope these profiles throw some light on the main impacts of these ingredients and enable improved decision-making about what to use and when.

We also highlight information about the interchangeability of edible oils and fats and the financial risks associated with the sector.

**Section 3 - novel fats and oils in development,** explores the promise of lab-grown and less prevalent alternatives. In recent years, candidates ranging from algae and yeast to coffee grounds and insects have been touted as replacements for edible oils, particularly palm oil.

Whilst there are some exciting developments, they all face systemic issues – cost, physical properties, market readiness, scalability – to get them ready to replace an established ingredient like palm oil.

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# EXECUTIVE SUMMARY

## KEY FINDINGS

1. As with all agricultural commodities, there's no such thing as a good or bad oil. However, within each oil type there is a range of good and bad practices and production. All vegetable oils and animal fats present both advantages and disadvantages. While there's no simple, risk-free option, there are ways to make better choices that account for interconnected environmental, nutritional and social effects. It's vital to view edible fats and oils as one subsystem of our food system: focusing on single crops may produce unintended impacts elsewhere.

2. The food system's entire value chain must align around the same goal: feeding a growing population in a way that's nutritious, equitable and within planetary boundaries. This report recommends specific starting points for food companies.

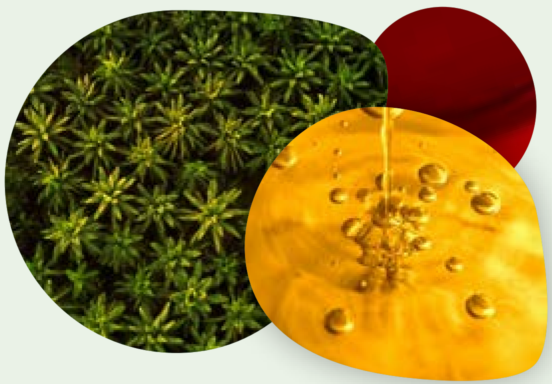
3. Demand for oil crops is rising, largely driven by continued growth in both population and western-style diets containing a greater proportion of processed foods and animal products. To reduce pressure on the system, it's essential that rather than simply increasing production we eliminate food waste and support sustainable, healthy diets.

4. Millions of people around the world rely on growing oil crops for their livelihood. However, too many of them live in poverty and work in extremely poor conditions.

5. The expansion of oil crop production onto areas of native vegetation affects indigenous peoples and local communities who may be evicted from the land and lose their livelihoods.

6. Palm oil is by far the world's most productive oil crop. Substituting it with another oil or fat may increase environmental impacts elsewhere. However, we must continue to ensure good social and environmental governance wherever palm oil is grown, in a similar way to all other sources of oil.

7. Innovation in novel oils may offer lower impact alternatives, but their greatest potential lies in non-edible uses, such as animal feed, cosmetics and biofuels.



# EXECUTIVE SUMMARY

## Oil all around us

We don't really notice fats and oils much in our lives, but our daily routines are full of them: everything from soap to cereal, butter to petrol and perhaps even the ground you walk on contains fats and oils.

Edible fats and oil are a large and growing global market and critical to certain economies. In Indonesia and Malaysia, which produce around 80% of the world's palm oil, a total of 4.5 million people work in the palm oil sector.

Asia-Pacific is a consumption hotspot, consuming more than 30% of the global market share of edible fats and oils by 2018. This is due to its growing population, plus a rise in both disposable income and rapid urbanisation contributing to changing diets.

In their edible form, fats and oils are essential for health and wellbeing, supporting cell growth, organ function, nerve nourishment and cardiovascular health. Fats also provide energy and help us absorb many other nutrients.

## The complicated truth, not the simple story

This report brings nuance and balance to what has become a binary debate. You're probably familiar with the narrative about palm oil and its associated imagery: the charred remnants of a tropical forest; an orangutan clinging to a solitary remaining tree branch. But here's a challenging thought: replacing palm oil with another oil or fat is likely to make things worse.

Businesses are under pressure to boycott palm oil, but, if many do, it's likely to exacerbate issues, such as deforestation and biodiversity loss. No oil crop is nearly as productive as palm. There's no such thing as a good or bad oil.

Through this report, we aim to challenge the overly simplistic media and campaign messages that could have unintended consequences. We want to seed a new narrative, underpinned by a systemic approach, that considers vegetable oils and animal fats as part of the same, interlinked market. We hope to make clear the trade-offs of using one product over another.

## Many factors determine how we use edible fats and oils:

- Functionality – for example, providing texture or flavour
- Cultural acceptance and taste preferences
- Nutritional profile
- Local regulatory landscapes for different oil crops
- Reputation – particularly relating to environmental and social factors
- Price

These factors also influence how easily one ingredient can be substituted for another. We examine them across the nine major global fats and oils by production volume in our profiles section.

# EXECUTIVE SUMMARY

## Profiling the major fats and oils: no risk-free options

From their unique nutritional properties and physical characteristics to their environmental impacts, economic drivers and labour conditions, the complex individual profiles of fats and oils need to be carefully examined. There are no risk-free choices.

Soybean production in Brazil and Argentina and palm oil production in South East Asia have expanded rapidly since the 1970s. Unsustainable sourcing has led to forests and other important ecosystems being cleared at a large scale across the world for these oils, leading to the destruction of biodiversity and contributing to climate change. The production of oilseeds, dominated by soy and palm, drives almost one fifth of annual deforestation.[1] Industrial farming methods, such as mono-cropping and the use of synthetic fertilisers, degrade soil health, exacerbating climate change and pollution.

While oil and fat production provides livelihoods for millions, large-scale deforestation and land conversion for soy and palm continue to violate the human rights of local communities and indigenous people. This often results in the loss of livelihoods, leading to poverty and forced, exploitative working conditions.

## We must see the bigger picture

Food service companies, manufacturers and retailers should carefully consider the impacts of all the oils and fats used in their product mix. We must recognise that an ingredient with a lower footprint in one area often has a higher impact in another.

We should also question the overall product mix as part of wider food system challenges and take a joined-up approach. How might we inspire consumers to eat healthier, more plant-based diets with lighter environmental and social footprints? Are fats and oils being used in healthy or unhealthy products?

And how can we conceptualise the interdependent sustainability, nutrition and social impacts of fats and oils as a whole? From producers to traders, investors and regulators, the full value chain must play an active role in reappraising our food system.

Whatever political agreements are made, unless we make dramatic changes to our food system, we can't restrict our planet to 1.5˚C of global warming. Oils and fats are an integral subsystem within our food system. Changes to one part of the system impact the whole. We need to work towards a common goal of feeding a growing population in a way that is nutritious, equitable and within planetary boundaries.

[1] Florence Pendrill et al (2019) https://ourworldindata.org/drivers-of-deforestation
The major drivers of deforestation globally are for beef (around 40%), for oilseeds (around 18%), and forestry for paper and wood (around 13%).

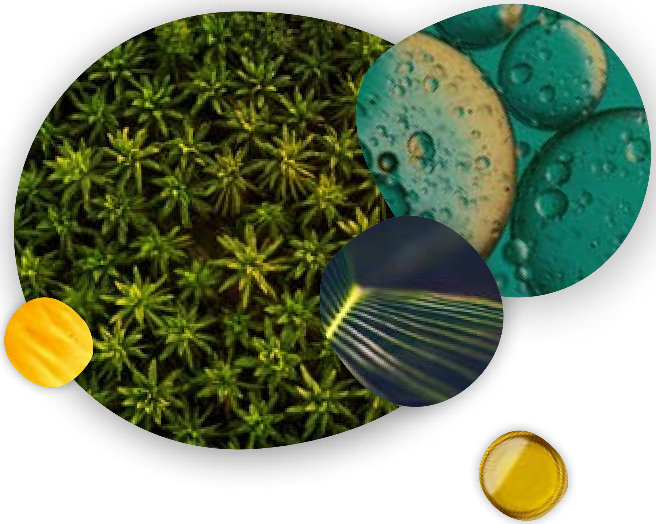
# EXECUTIVE SUMMARY

## Watch this space: new frontiers of innovation

There has been huge investment in developing novel alternative oils, such as algal oils, insect-derived oils and yeast oils. However, our food system is largely designed to produce food cheaply, and novel oils face serious barriers in this regard. On a purely financial basis, it's currently impossible to produce a novel oil with similar properties to palm or rapeseed oil at anywhere near a viable cost.

Some of these products may be able to compete in non-food applications, though. In cosmetics, for example, margins are often higher and regulatory barriers lower.

However, with increasing calls to shift a proportion of our food production from land to lab, emerging solutions and changes in enabling conditions could significantly disrupt the current fats and oils system.



## Call to action: What you can do now

Every major fat and oil has social, environmental and health benefits and risks. We need to radically improve the sustainability profiles of all fats and oils.

Here's how to start:

- Develop a fats and oils policy to assess and address the full picture of environmental and social risks.
- Select suppliers with robust and sustainable supply chains.
- Actively engage with and assist organisations and companies driving sustainable production. The foundations exist – while bodies like the Roundtable on Sustainable Palm Oil (RSPO), Sustainable Coconut and Coconut Oil Roundtable, and the Round Table on Responsible Soy (RTRS) aren't perfect, but they're our best building blocks.
- Educate consumers on the issues. Help change the one-dimensional narrative about the sustainability of edible fats and oils.
- Examine the sustainability of your overall product portfolio. Make sure it's structured to support sustainable outcomes, with priority given to plant-forward foods.

There's no risk-free option when it comes to financing, producing, sourcing and using fats and oils. But these four actions can help set us on a more sustainable path. We hope that the information we've brought together in this report helps raise awareness about the complexity of the issues and facilitates better decision-making.

Part 1.

# EDIBLE FATS AND OILS: AN OVERVIEW

## How we use edible fats and oils in food

- Fats are flavour: how we use edible fats and oils in food

## The global production and consumption picture

- A surge in oil: the global picture of edible fats and oils production
- Map: the top vegetable oil and animal fat producing markets
- The increasing prevalence of fats and oils: why global consumption continues to grow

## Why all fats and oils have sustainability impacts

- Beware of overly simple solutions: why all edible fats and oils have sustainability impacts, and it's not as simple as good oil versus bad

## Nutrition and functionality of fats and oils

- The fats of the matter: edible fats and oils nutrition and functionality in everyday life
- Table: Nutrition and functionality

## Environmental, social and financial impacts

- The consequences of the fats of the land: the environmental, social and financial impacts of edible fats and oils
- Environmental impacts
- Social impacts
- A spotlight on the financial risks of unsustainable vegetable oil and animal fat production

## The role of voluntary standards

- Are the tools we have up to the job? The limitations and potential of voluntary standards

# FATS ARE FLAVOUR

## HOW WE USE EDIBLE FATS AND OILS IN FOOD

Fats and oils aren't only reserved for human food: they're also used extensively in a range of other products, such as cosmetics, laundry detergent, shampoo, animal feed and biofuels.

This report focuses on the food uses of vegetable oils and animal fats, including cooking, spreading, baking and processed food production.

### PROCESSED FOODS

In processed foods, fats and oils enhance texture, extend the shelf-life of products and add flavour. Palm, rapeseed, sunflower and soybean account for the majority of global oil consumption. Their widespread usage as edible oils is driven in large part because of their role in fuel, animal feed and other non-food products.

Animal fats, primarily butter and ghee (clarified butter), as well as lard, are also widely employed in processed foods, particularly baked goods, for the richness and flavour they provide.

In conjunction with these major oils, specialist oils are often added to provide texture, flavour or additional functionality. Sometimes, these less common oils are used as direct replacements – coconut oil, shea butter and cocoa butter, for example, all share similar qualities to palm oil.

### COOKING

In home cooking and food service preparation, cultural tastes and regional availability often determine oil choice, although price and specific usage (for example, salad dressings, frying or baking) also play a part. In Europe, for instance, rapeseed, sunflower and olive are popular cooking oils consumed and grown in the region.

Increasingly, demand is growing for oils grown elsewhere too, such as coconut, particularly in response to trends like plant-based diets. In Asia and Africa, on the other hand, palm oil predominates for cooking. Consumers there have access to other oils grown in the continent, such as mustard seed, cotton and safflower.

# A SURGE IN OIL

## THE GLOBAL PICTURE OF EDIBLE FATS AND OIL PRODUCTION

Global population growth paired with already high, growing demand for oils that serve both health and functional needs is projected to see the sector continue its expansion.[1]

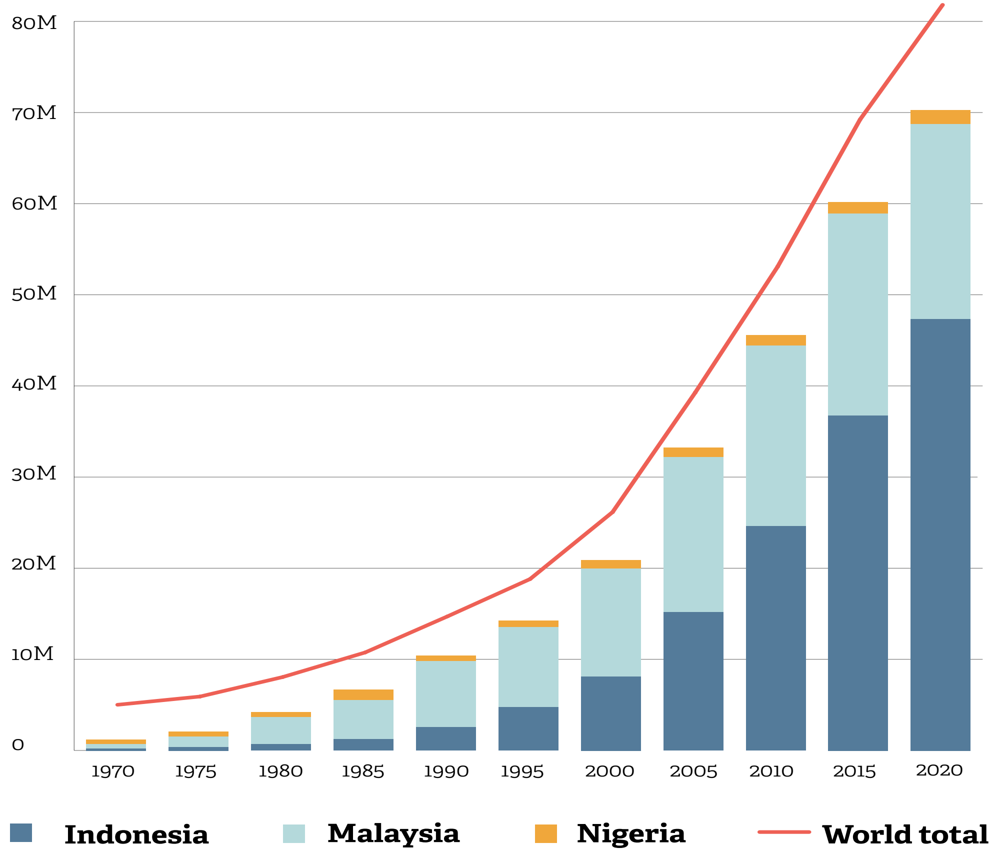
Oil crops are prized for their protein, fibre and fatty acid content which contributes to their prevalence.

Crucially, fats and oils make a major contribution to global income and employment. In Indonesia and Malaysia, which together produce around 80% of the world's palm oil, around 4.5 million are directly employed in the palm oil sector [2], and many millions are indirectly involved in its production. Elsewhere, despite increasing global demand for coconut, some 90% of coconut production is carried out by smallholder farmers, most of whom live below national and global poverty lines.[3]

### The explosion of palm oil production since the 1970s

Source: www.gro-intelligence.com | Data: USDA, PS&D, Gro Intelligence

Major Producers of Palm Oil (Crude and Kernel) (1970-2020), (in million metric tonnes)




[1] https://www.millioninsights.com/industry-reports/global-edible-oil-fats-market?utm_source=prnewswire&utm_medium=referral&utm_campaign=prn_05May2020_edibleoilfats_rd2 \

[2] https://www.rspo.org/about

[3] http://www.fao.org/3/af298e/af298E17.htm

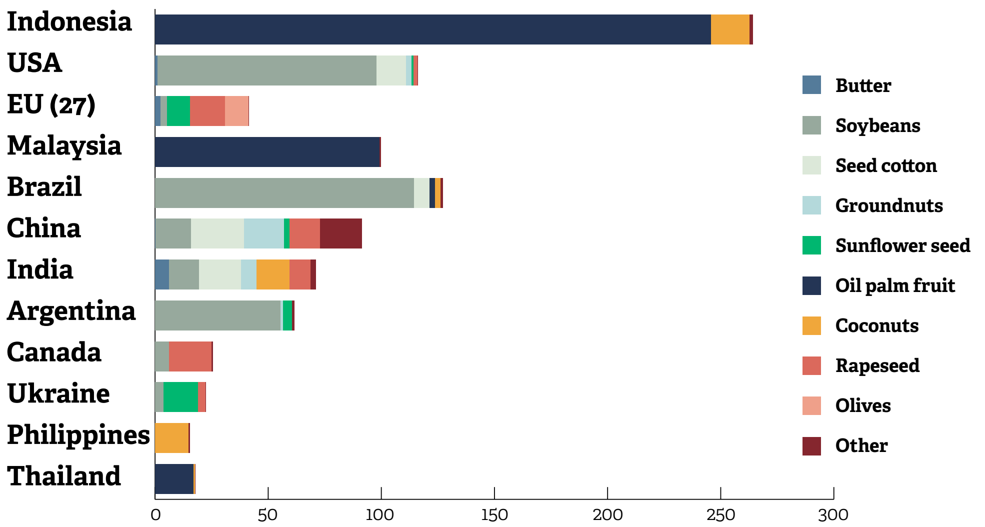
[4] https://gro-intelligence.com/insights/articles/palm-oil-production-and-demand

# A SURGE IN OIL

## THE GLOBAL PICTURE OF EDIBLE FATS AND OIL PRODUCTION

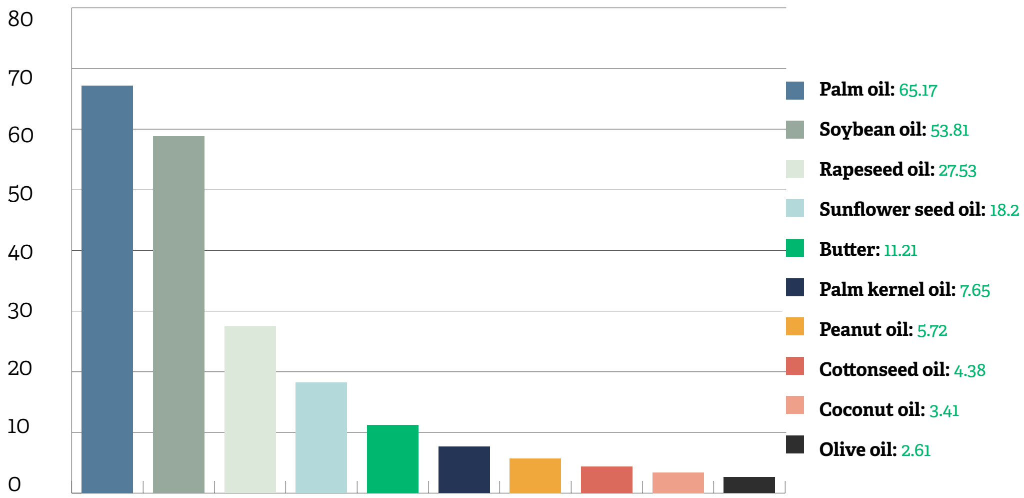
### Top 12 oil producing countries and what they produce (million metric tonnes)

Sources: Oil crops: FAOSTAT 2019,
Butter: US Department of Agriculture; Economic Research Service; 2020



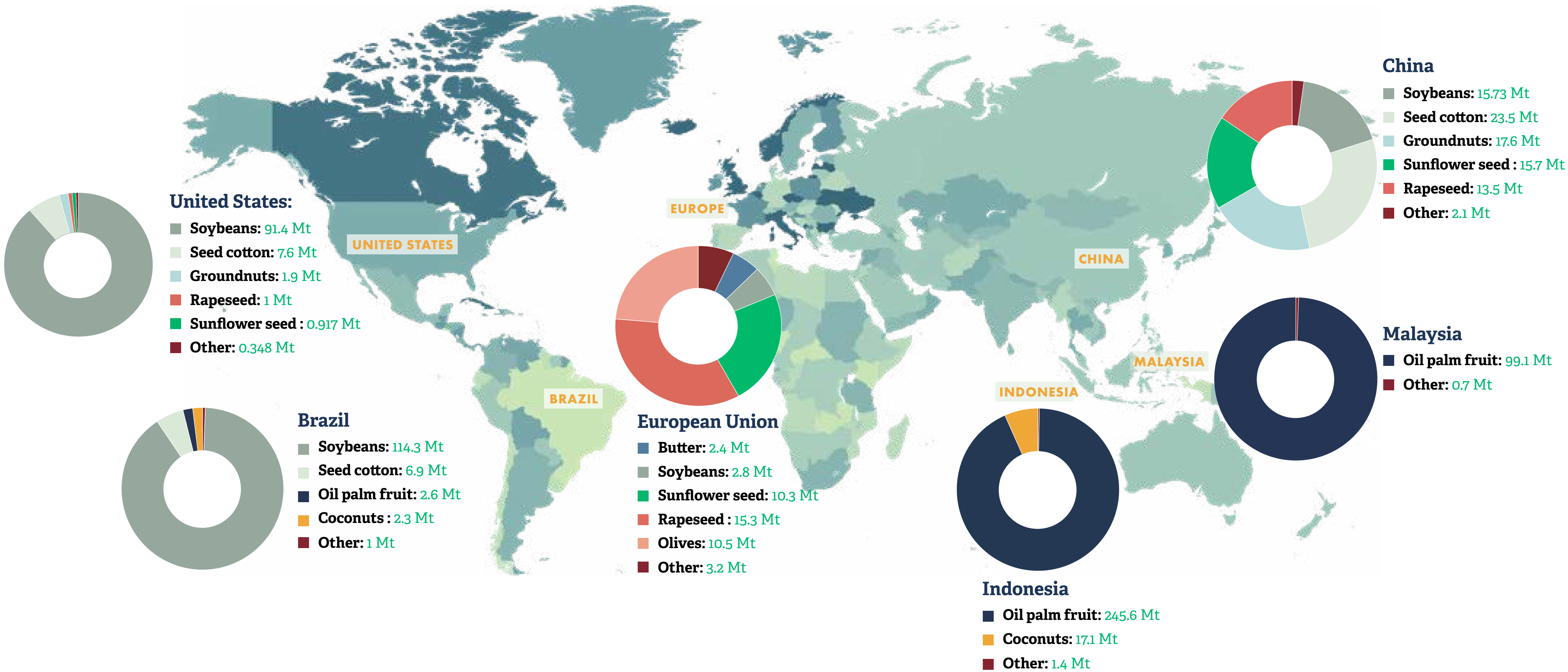

### Production of major vegetable oils and animal fats worldwide 2020/21 (million metric tonnes)

Sources: Oil crops: FAOSTAT 2019,
Butter: US Department of Agriculture; Economic Research Service; 2020



# THE TOP VEGETABLE OIL AND ANIMAL FAT PRODUCING MARKETS

Based on total crop production before oil extraction. FAOSTAT, 2019.
Butter production figures from US Department of Agriculture; Economic Research Service; 2020
Mt = Million metric tonnes



# THE INCREASING PREVALENCE OF FATS AND OILS

## WHY GLOBAL CONSUMPTION CONTINUES TO GROW

The global market for vegetable oils is anticipated to grow by 3.3% per year between 2020 and 2027.[1]

The main drivers for this growth are:

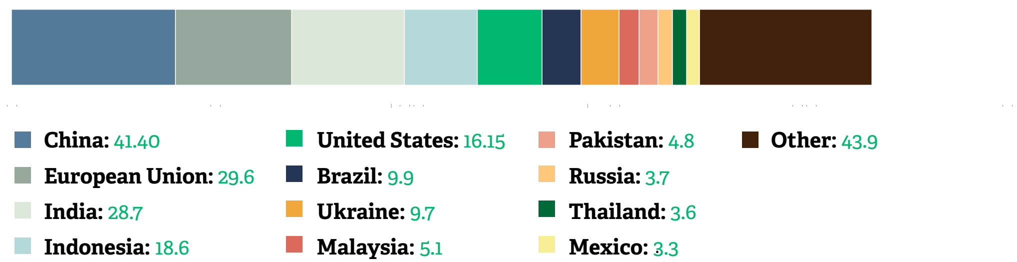
- The growing use of vegetable oil in the food industry, particularly in countries with growing economies and population, such as China and India;
- Additional demand for vegetable oils in the biofuel industry;
- Greater awareness of the health properties of vegetable oils.

The Asia-Pacific region has been consuming more than 30% of the world's edible fats and oils since 2018. A growing population, a rise in disposable income and rapid urbanisation mean the region is expected to lead continued growth.[2] However, as the global rate of population growth begins to slow, demand for food – including for fats and oils – should slow down too.

Yet, as we've mentioned, much of the modern demand for vegetable oils has been for non-food purposes, such as soy used in high-protein content oil meals for animal feed.[3] In 1995, the consumption ratio of soybean, palm, rapeseed and sunflower oil between food and other uses was 75:25. Just 15 years later, the ratio had become 50:50.[4] Other non-food industrial uses include paints, detergents, lubricants, oleochemicals and biodiesel, with China and the EU pushing this demand.[3]

### Domestic consumption of major vegetable oils* and butter 2021/21 - the top 12 markets (million metric tonnes)

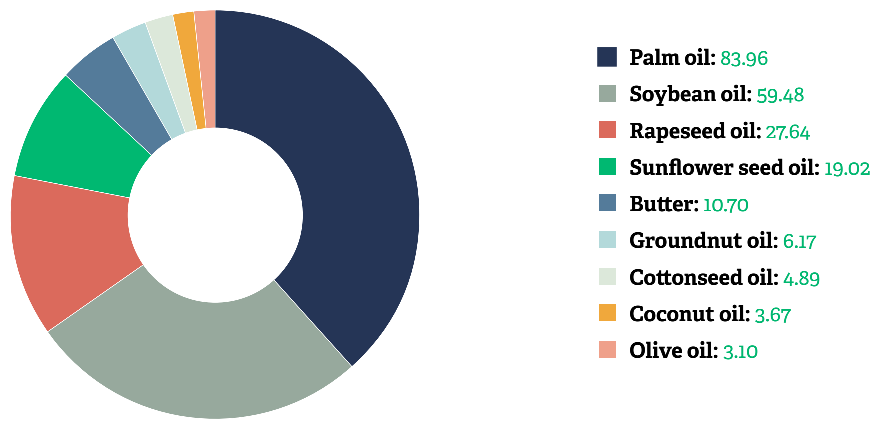
Source: USDA 2020/21




* Major vegetable oils includes coconut, cottonseed, olive, palm, palm kernel, peanut, rapeseed, soybean, and sunflowerseed oil

### Consumption of vegetable oils and butter globally 2020/21 (million metric tonnes)

Sources: Vegetable oils: US Department of Agriculture; USDA Foreign Agricultural Service, 2020/21
Butter: US Department of Agriculture; Economic Research Service, 2020




[1] https://www.globenewswire.com/news-release/2021/03/02/2185174/0/en/Global-Vegetable-Oil-Market-2020-to-2027-Increasing-Demand-for-Vegetable-Oils-in-the-Biofuel-Industry-is-Driving-Growth.html

[2] https://www.millioninsights.com/industry-reports/global-edible-oil-fats-market?utm_source=prnewswire&utm_medium=referral&utm_campaign=prn_05May2020_edibleoilfats_rd2

[3] http://www.fao.org/fileadmin/templates/esa/Global_persepctives/world_ag_2030_50_2012_rev.pdf

[4] Parcell, Joe. (2018). Global Edible Vegetable Oil Market Trends. Biomedical Journal of Scientific & Technical Research. 2. 10.26717/BJSTR.2018.02.000680.

# BEWARE OF OVERLY SIMPLE SOLUTIONS

## WHY ALL EDIBLE FATS AND OILS HAVE SUSTAINABILITY IMPACTS, AND IT'S NOT AS SIMPLE AS GOOD OIL VERSUS BAD

This report aims to raise awareness of the potential impacts of simply swapping one type of oil or fat for another. Palm oil, in particular, has become the environmental villain in recent years, leading to it being replaced in some food products. Our report demonstrates that the social and environmental costs of oils are much more complex than they may at first appear.

So what influences the choice of and potential for interchangeability between edible fats and oils? There are six main factors to consider [1]:

- Cultural and societal acceptance (e.g. taste and reputation)
- Health benefits and nutritional profile (e.g. proportions of fatty acids)
- Functionality and potential for substitution
- Market price
- Environmental and social impacts
- Regulatory or company policy differences between oil crops (e.g. soy or palm oil sourcing policies)

In terms of sustainability, individual vegetable oils and animal fats can, to some extent, be seen as part of a larger whole.

All oils and fats, not just palm, soy or butter, merit attention for their sustainability at farm or local landscape level. However, assessing the sustainability of single vegetable oils should also involve addressing the far-reaching implications of replacing them.

For example, palm oil has been associated with deforestation, peatland degradation and related greenhouse gas emissions by the European Commission. As a result, palm oil has been singled out as a risk commodity for biofuels under current European policy.

Palm oil is also increasingly seen as a contentious ingredient by consumers, particularly in Europe, leading to some food businesses removing it from products. Yet replacing highly productive palm oil on a large scale is unlikely to reduce greenhouse gas emissions or lessen the impact on biodiversity.

In fact, it may result in much more land being cleared elsewhere simply to produce the same volume of oil. Or, for oils such as coconut, production may take place under less strict environmental or social conditions and less public scrutiny [2].

By way of illustration, rapeseed requires five times as much land to produce the same volume of oil as palm. Additionally, unlike palm, rapeseed is generally grown in non-tropical environments, meaning that the negative impacts associated with growing oil crops would be displaced to other ecosystems, rather than being solved. Choosing soybean oil instead would need around eight times as much land.[3]

This is an indication of course, these crops have other uses too. By far the largest volume of soy is the meal and hulls mainly processed for feed. Indeed, about 70% of the soybean's value comes from meal used for this purpose.[1] However, this quick comparison demonstrates that there are no simple, large-scale solutions for substituting palm oil without creating fresh impacts on land use, biodiversity and social conditions.

Beyond searching for like-for-like substitutions to mitigate the impacts of certain crops, other aspects of resource efficiency need to be considered, not least reducing over-consumption. If more oil crops went directly to feeding people as part of a more balanced, plant-based diet, this would greatly reduce pressure on land.

[1] Van den Hombergh, H et al (forthcoming, 2021), The communicating vessels of the vegetable oils; the challenge of arranging for sustainability of palm oil in a global context. Amsterdam: IUCN National Committee of the Netherlands.

[2] Meijaard, E. et al (2018), IUCN Oil Palm Situational Analysis, Gland: International Union for the Conservation of Nature. And other recent article.

[3] https://www.iucn.org/theme/science-and-knowledge/our-work/culture-science-and-knowledge/palm-oil-and-biodiversity-conservation/infographic

PART 1. EDIBLE FATS AND OILS : AN OVERVIEW

# THE FATS OF THE MATTER

## EDIBLE FATS AND OILS' NUTRITION AND FUNCTIONALITY IN EVERYDAY LIFE

Fats and oils are critical for human health and each contain different, useful functional properties. As such, these are highly important factors in selecting which animal fats and vegetable oils to use for cooking and food manufacturing.

However, deciding which oil or fat is most appropriate is not always easy. Ingredients such as palm oil and butter, for example, are regularly used in baked goods because of the texture and taste they provide, yet both contain higher levels of saturated fats which can raise blood cholesterol levels. Similarly, consumers may reach for healthier olive oil for frying foods without realising that if it reaches smoking point it can produce toxic substances.

### NUTRITION

Fats and oils are an essential part of our diet, supporting cell growth, organ function, nerve nourishment and cardiovascular health. Fats also provide energy and are stores for excess food energy, enabling us to draw on reserves when food is in short supply. Many nutrients need the presence of fat to be properly absorbed by the body.

Vegetable oils, specifically soybean and palm, are two of the eight ingredients, alongside wheat, rice, maize, sugar, barley and potato, that are estimated to now provide 85% of the world's calories.[1]

Some oils and fats are considered healthier than others. In the context of a balanced diet, with adequate physical activity, the main nutritional considerations are the quantities consumed, and the proportions of saturated, poly-unsaturated and mono-unsaturated fatty acids (Table 1). Other important health considerations are their micronutrient content (i.e. vitamins and essential fatty-acids), presence or absence of trans-fats and appropriate use, for example the avoidance of oxidation during cooking.

[1] Parcell et al. 2018, Global Edible Vegetable Oil Market Trends

## NUTRITION (contd.)

Edible fats and oils also play a critical role in global food security: these calorie rich substances have been vital for providing minimum daily energy needs (national average kcal/person/day).

Although today's global market is dominated by palm, soy and rapeseed oils, more small-scale and traditional oil crops continue to be important parts of food supply and security in many countries. For instance, sesame seed oil is a key staple in Sudan and South Sudan, groundnut oil in Myanmar, coconut oil in the Philippines and cottonseed oil in Pakistan.[1]

How fats and oils are used has an important bearing on nutrition. Globally, an increasing number of people are adopting 'western-style diets' generally recognized as diets characterised by higher than average intakes of calorie-dense foods, saturated and trans fats, free sugars and salt/sodium. At the same time many people do not eat enough fruit, vegetables and other dietary fibre such as whole grains. A critical question therefore is whether fats and oils are used in food products that support good nutrition, or exacerbate health problems?

### Fatty acid breakdown

Most health guidelines encourage the consumption of unsaturated fats, particularly polyunsaturated, and warn against overconsumption of saturated fats. Poly-unsaturated fats, omega-3 and omega-6 can't be produced by the body, so we must obtain them from external sources.

Monounsaturated and polyunsaturated fatty acids
Sometimes referred to as 'good fats', monounsaturated fatty acids (MUFA) and polyunsaturated fatty acids (PUFA) are important in nutrition. These fats are essential building blocks for cells in our body and play an important role in the maintenance of normal blood cholesterol levels beneficial to heart health.

MUFA and PUFA are typically found in plant oils and products made from plant oils, as well as in nuts, seeds and fatty fish.

### Saturated fats

Saturated fatty acids (SAFA) are found in both animal and plant fats, and their increased consumption is linked to a higher risk of cardiovascular disease. Swapping SAFA for PUFA and MUFA reduces this risk. Higher levels of SAFA are found in full-fat dairy products, such as butter and ghee, fatty meats, cakes, biscuits and savoury foods.

Products containing plant oils and fats can have high or low levels of SAFA. The presence of any specific plant oil in an ingredients list is not an indication of SAFA levels. Instead, it's important to check the product's nutrition table for definitive information.

Table 1 shows that some vegetable oils, such as palm and coconut oil, as well as animal fats, contain higher levels of saturated fats.

### Trans fats

Trans fatty acids (TFA) are found in fats obtained from ruminant animals, such as cows and sheep. High levels of TFA can therefore be found in lamb, beef, butter and ghee as well as foods made with partially hydrogenated vegetable oils. Whether from animal or vegetable sources,TFA is found to raise levels of 'bad' cholesterol and so is a risk factor for cardiovascular disease. The World Health Organization (WHO) has called for the elimination of industrial TFA from partially hydrogenated vegetable oils and several countries have implemented legislation to drive this.

[1] http://www.fao.org/fileadmin/templates/esa/Global_persepctives/world_ag_2030_50_2012_rev.pdf

## NUTRITION (contd.)

### Optimum fat intake

Optimal fat intake is one of the most researched topics in nutrition of the last two decades. The World Health Organisation recommends that total fat should not exceed 30% of total energy intake.

Although not all processed food is unhealthy, and a large proportion of food products are processed to some degree, in general, people consuming diets containing large quantities of processed foods are at a greater risk of consuming unhealthy fats in the form of trans fats and an excess of saturated fat. Such diets generally contain much lower levels of healthy mono- and polyunsaturated fats.

Highly processed food products may also contain high levels of sugar or salt, contributing to poor diets.

### Box 1: Avoiding trans fats

The levels of trans fats from partially hydrogenated vegetable oils (PHVO) in foods has significantly decreased over the past 10 to 15 years. This is due to major reformulation efforts by the food industry, driven in part by WHO calls to eliminate industrial trans fats from PHVO usage.

However, there are no such recommendations regarding trans fats from animal sources. Some countries don't permit trans-fat content to appear on food labels, so concerned consumers must draw their own conclusions from ingredient lists.

## FUNCTIONALITY

Animal fats and vegetable oils have different functional properties useful for cooking and manufacturing food, but there's generally little public understanding about which oils or fats are used for which purpose.

Fats not only provide vitamins like vitamin E but also improve the bioavailability of other fat-soluble vitamins from the diet.

### Flavour and texture

Oils and fats influence the texture, flavour and mouthfeel of foods – whether they're made at home or on an industrial scale. Fats that are solid at room temperature provide important structural properties in foods such as cakes or pastries. Most vegetable oils – coconut and palm being exceptions – are liquid at cooler temperatures.

The level of refinement and filtration of fats influences their flavour. Unrefined fats and oils will retain their natural aroma whereas refined oils adopt a more neutral flavour.

## FUNCTIONALITY (contd.)

### Smoke Point

There's some evidence to suggest consumers are aware that overheated oils can cause health issues when consumed over longer periods.

The smoke point is the temperature at which fats and oils begin to burn and produce a visible smoke. An oil's smoke point determines its suitability for high-temperature cooking.

Impurities in unrefined oils, such as olive oil, cause them to have a low smoke point. This can be problematic in cooking because at high temperatures these impurities burn and the oil becomes unpalatable. Some of the substances formed are harmful if consumed over extended periods.

Fats and oils with high smoke points, such as coconut and palm oil, are more suitable for high temperature cooking. They also tend to be naturally higher in saturated fats.

### Suitability for manufacturing processes

Fats and oils used in highly processed foods often need to be solid to hold texture and maintain appearance. This is one reason why highly versatile palm oil has become so prominent in the food processing industry.

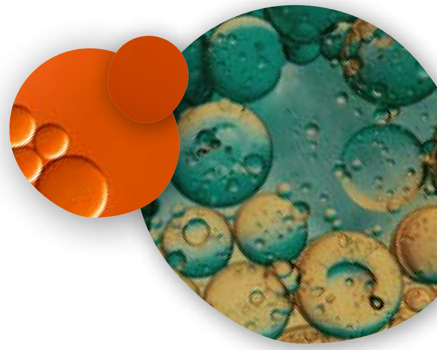
The use of solid fats, which have high levels of saturation, to maintain texture, for example, partly explains why some foods are unhealthier.

### Smoke Point

The smoke point of fats and oils determines which are more suitable for high-temperature cooking. The smoke point is the temperature at which fats and oils begin to burn and produce a visible smoke. This is most relevant for frying, baking and other cooking applications.

Presence of impurities such as free fatty acids in unrefined oils causes them to have a low smoke point. At high temperatures these impurities burn, and the oil becomes unpalatable.

Fats and oils with a low smoke point, such as olive oil, can be problematic when used in cooking because when fats and oils burn and begin to smoke, some of the substances formed are harmful if consumed over extended periods. Fats and oils with high smoke points are more suitable for high temperature cooking, and tend to be naturally saturated, such as coconut oil and palm oil.



# TABLE 1: NUTRITION & FUNCTIONALITY

Table 1 gives an overview of nutrition and functionality for a wide range of fats and oils.

| | FATTY ACID BREAKDOWN | SOLID OR LIQUID AT ROOM TEMPERATURE | SMOKE POINT (°C) (REFINED) | FLAVOUR WHEN UNREFINED | COMMON USES IN FOOD |
|---|---|---|---|---|---|
| Palm oil |  | solid | | Strong, savoury (but usually refined) | Commercial food production, e.g. bakery, confectionary |
| Palm kernel oil |  | solid | 235 | Subtle and nutty | Commercial cooking |
| Soybean oil |  | liquid | 234 | Usually refined with neutral flavour | Food manufacturing |
| Rapeseed oil |  | liquid | 204 | Subtle, neutral taste, can be slightly grassy or nutty | Mixed use, depending on level of refinement |
| Sunflower oil |  | liquid | 227 | Neutral flavour | Shallow frying, light salad dressings, food manufacturing |
| Groundnut oil |  | liquid | 232 | Nutty / peanut (less strong than sesame oil) | Often used in Asian cuisine, e.g. stir-fries and salads. |
| Cottonseed oil |  | liquid | 220-230 | Mild taste | Food manufacturing and sometimes as a frying oil in restaurants. |
| Coconut oil |  | solid | 232 | Fairly neutral, mild and sweet | Common in baked goods, pastries, sautés and snack foods |
| Butter |  | solid | 150 | Buttery | As a spread and suitable for baking and sauteeing |
| Olive oil |  | liquid | 199-243 | Mild and fruity to robust, distinctive and peppery | Unrefined: marinades, dressings. Refined: shallow frying, sauteeing |
| Safflower oil |  | liquid | 266 | Mild, sweet nutty taste | Cold pressed: salads and dressings |
| Corn (maize) oil |  | liquid | 230-238 | Neutral flavour | Frying, baking |
| Lard (pig) |  | solid | 190 | Savoury | Often used in bakery |
| Shea butter |  | solid | | Neutral | As a cooking oil in west Africa and in confectionary products |
| Cocoa butter |  | solid | 230 | Cocoa flavour and aroma | Common in chocolate |
| Plant-based spread (26-39% fat) |  | solid | | | As a spread, for home cooking |
| Plant-based spread (62-75% fat) |  | solid | | | As a spread, for home cooking |

- TFA
- SFA
- PUFA (Linoleic acid/omega 6)
- PUFA (Alpha-linolenic acid/omega 3)
- MUFA (Oleic acid / omega 9)

- solid
- liquid

# THE CONSEQUENCES OF THE FATS OF THE LAND

## THE ENVIRONMENTAL, SOCIAL AND FINANCIAL IMPACTS OF EDIBLE FATS AND OILS

Unfortunately, producing all vegetable oils and animal fats, like all foods, generates environmental and social issues. These issues need to be considered carefully and holistically: often, a crop with a lower footprint in one area could have a higher impact in another. The overall impacts of oils also vary considerably depending on how they're produced. We have highlighted some of the most significant impacts for the main fats and oils however the list for each is not exhaustive.

## ENVIRONMENTAL IMPACTS

### Land-use change

Every year, millions of acres of forests and other ecosystems are cleared across the world for food. Deforestation and conversion destroy the habitats of wild animals and lead to a decline of biodiversity, especially in fragile ecosystems in biodiversity-rich areas. Land-use change also increases the likelihood of natural disasters like floods and landslides.

### Vulnerability to climate change

The effects of climate change, already visible, will affect everyone with increasing severity. However, the impacts will be much more serious for certain people and places.

The changing climate will cause rising sea levels, flooding, drought and unpredictable weather patterns that will lower crop yields, diminish food supplies and limit access to clean water. Without concerted action to support vulnerable people, it will exacerbate inequalities and poverty among farming communities.

A further consequence will be increased migration as people are displaced by harsh conditions. The World Bank estimates that climate change could create more than 140 million new migrants in sub-Saharan Africa, South Asia and Latin America by 2050.[1]

The effects of climate change on agriculture and farming communities are already underway and will become increasingly profound. The groups most vulnerable to the impacts of climate change – the poor, women, indigenous peoples, children, the elderly, racially marginalised people, those with disabilities and LGBTQ+ people – are already the most marginalised in society.

[1] https://time.com/5621885/climate-change-population-growth/

# ENVIRONMENTAL IMPACTS (CONTD.)

## Greenhouse gas emissions

Deforestation and clearing of (often carbon rich) native vegetation or other natural ecosystems, such as grasslands and savannahs, contribute to climate change. Cultivating large tracts of crop land with machinery and nitrogen fertiliser releases yet more carbon emissions into the atmosphere. The primary greenhouse gases resulting from agriculture are, in descending order of intensity, methane, nitrous oxide, and carbon dioxide.

## Water depletion

The volume of water used in the production of crops varies greatly but can be a major driver of water scarcity. Large volumes of freshwater are withdrawn for irrigation, predominantly in water-scarce areas and when rainfall is lower. The source of the water intake has a big impact on the severity of water scarcity that it creates. For example, water for crops could come from surface water, ground water, rainwater, treated effluent or municipal water.

## Chemical inputs and pollution

Many oil crops are sprayed with pesticides and herbicides. While this may protect crops and increase yield, the practice can pollute soils and waterways, contaminating drinking water and harming aquatic life if mismanaged. Spraying can also cause direct human health impacts when carried out without adequate protection.

## Biodiversity loss

Biodiversity loss has many, often linked, causes. Producing oil crops can lead to land conversion that destroys ecosystems and alters the availability of water. Chemical usage can also decimate certain species (e.g. native plants, insects and wild bird populations) and invasive, herbicide-resistant species of weeds can thrive where other flora once flourished.

## Soil health

Soil health is the capacity of soil to function as a vital living ecosystem for animals and plants. Certain farming practices used in the production of oil crops, such as monocropping and synthetic fertilisers and chemicals, degrade soil health, thus contributing further to climate change.

# SOCIAL IMPACTS

### Workers' rights[1]

While vegetable oil and animal fat production provides livelihoods for millions of people, some communities that support the industry still live in poverty and poor conditions, receiving meagre wages for their work. As such, workers are vulnerable to exploitation and abuse of their rights, including:

1. Child labour
2. Forced and compulsory labour
3. No freedom of association or collective bargaining
4. Discriminatory practices
5. Abusive practices and a lack of disciplinary procedures
6. A disregard for the norms of legal and decent working hours
7. Unsafe and unhealthy workplaces
8. Poverty wages and an absence of benefits

### Rights of indigenous peoples and local communities[2]

Indigenous peoples and local communities are particularly vulnerable within agricultural and forestry supply chains. This includes abuses of their rights to:

1. Property
2. Livelihoods and food security
3. Self-determination, self-governance, and culture

When indigenous people and local communities do face abuses of their rights, they may not receive compensation. People may face violent attacks when resisting land grabs and forest clearing for agriculture.

### Health issues

Farmers may be at risk of exposure to harmful chemicals, particularly from spraying pesticides, when health and safety standards are not enforced. In intensively farmed areas, pesticides and chemical fertilisers can run off into water courses, potentially polluting local drinking water.

In the case of palm oil plantations, local communities suffer from a range of health issues linked to air pollution from the forest fires used to clear land for cultivation. In the case of coconut farming, workers face safety risks from working at height to dislodge coconuts or due to injuries from falling coconuts.

# OTHER KEY IMPACTS

While animal welfare isn't an environmental impact, it's still a materially important issue for consumers.

Animal fats, such as butter, ghee, and lard, are used widely in food supply chains. Therefore, the systems that raise the livestock to produce these fats, and their impacts on animal health and welfare, must be taken into consideration. The welfare standards associated with these production systems vary considerably around the world.

[1] Workers' rights definition from the Accountability Framework Initiative: https://accountability-framework.org/operational-guidance/workers-rights/

[2] Respecting the Rights of Indigenous Peoples and Local Communities from the Accountability Framework Initiative: https://accountability-framework.org/operational-guidance/respecting-the-rights-of-indigenous-peoples-and-local-communities/

# A SPOTLIGHT ON THE FINANCIAL RISKS OF UNSUSTAINABLE VEGETABLE OIL AND ANIMAL FAT PRODUCTION

The financial sector is increasingly paying attention to the impact of climate and ecological risks on agricultural supply chains. Sustainable animal fat and vegetable oil production isn't just a matter of corporate social responsibility – it's also a key part of maintaining a financially healthy company over time.

All types of risks translate into costs, financial losses or even unstable business, if not managed well, including those related to unsustainable production.[1]

## Physical risks

Physical or operational risks are directly related to production, such as declining harvests or unavailability of an oil crop. Soy production in Latin America, for example, can suffer from restricted water availability, flooding or extreme local weather conditions. Caused, or aggravated by, the lack of vegetative cover, the result is low or even failing harvests.

Forest and shrub vegetation around rivers and streams, or vegetation that acts as a protective windbreak or protects soils from erosion, can help stabilise productive conditions. Lack of investment in such protective vegetation leads to production risks.

Deforestation as a driver of climate change is a severe material risk to financial institutions. For this reason, in 2019, 57 investors, representing approximately $6.3 trillion in assets, issued a statement to businesses urging them to avoid deforestation in soy production.[2]

## Transitional risks

Transitional risks refer to policies and legislation which may become stricter and more demanding, particularly for companies exposed to high-carbon industries. Such risks are sometimes referred to as regulatory or litigation risks if they relate to non-compliance laws, or market-access risks if they concern buyers' rules. An example is No Deforestation, No Peat and No Exploitation (NPDE) policies

[1] Dutch Central Bank & PBL 2020, https://www.pbl.nl/en/publications/indebted-to-nature.

[2] https://www.ceres.org/news-center/press-releases/investors-63-trillion-assets-call-companies-cut-climate-deforestation

# A SPOTLIGHT ON THE FINANCIAL RISKS OF UNSUSTAINABLE VEGETABLE OIL AND ANIMAL FAT PRODUCTION

by companies using oils to make products. NDPE policies have already had a significant impact on some palm oil businesses. When palm oil producers failed to comply with these policies, they lost a large number of clients and suffered significant financial losses.

The growing incentivisation of less carbon-intensive food also poses a risk to high-carbon industries, just as dietary guidance is already shifting consumer behaviour towards more plant-based diets.

Another clear example of transitional risk is the upcoming set of European financial regulations, and new EU regulation on forest and ecosystem risk commodities. The changes brought about by new regulation may lead to non-compliance and the loss of European market access for many companies in the near future. The European feed and oils sectors are preparing themselves for stricter rules by offering buyers voluntary screening tools on ecosystem conversion risks.

## Reputational risks

Crops associated with risks of deforestation, human rights violations, land grabs and animal welfare continue to come under strong public scrutiny. This brings reputational risks for the ingredient. This has already encouraged supermarkets and brands to offer palm-oil free products or adopt policies discouraging soy imports.

As we outlined in the section on interchangeability, replacing one oil or fat with another doesn't always solve unsustainability. However, reputation is crucial for consumer-facing companies.

Financial institutions investing in commodities associated with deforestation and other sustainability concerns, including soy, palm oil and animal agriculture, have been heavily criticised.

One response to this is the FAIRR initiative. FAIRR is a global network of investors that raises awareness of the environmental, social and governance risks and opportunities brought about by intensive animal agriculture – an industry that relies heavily on soy for feed.[1]

It is important for all actors to tell a more balanced story of the sustainability of oils and fats so that people can make better-informed decisions.

As all crops have potential risks and impacts each should be considered in the context of the wider food system, and for their individual social and environmental sustainability. Investing in quality certification, supporting smallholder capacity building and landscape-wide sustainability efforts will help continue to improve all crops.

Vegetable oils and animal fats are a closely related family of ingredients. Together, they constitute a vital food category for human health and nutrition and have a significant role to play in the environmental, social and financial wellbeing of people and planet. As such, they deserve care and investment to secure their long-term sustainability, productivity, market and regulatory acceptance, and reputation.

[1] https://www.fairr.org/

# ARE THE TOOLS WE HAVE UP TO THE JOB?

## THE LIMITATIONS AND POTENTIAL OF VOLUNTARY SUSTAINABILITY STANDARDS

Voluntary standard systems for oils, such as those set out by the Roundtable for Sustainable Palm Oil (RSPO), the Roundtable for Sustainable Biomaterials (RSB), the Roundtable on Responsible Soy (RTRS) and Rainforest Alliance (RA), were born out of a need: the governance gap to ensure sustainable commodity production.

Over recent years, multiple stakeholders have been involved in negotiating the principles, criteria and controls for these standards. These processes have often resulted in a set of integrated criteria that can be called 'best-in-class' governance tools at farm level. While the resultant standards are applicable to single farms, they can also guide good land governance more widely, to an entire landscape.

### Assuring compliance is difficult

At landscape and corporate level, more work is needed to ensure sustainability, such as legal compliance, forest and ecosystem conservation and cross-commodity land-use planning. Certified farms can't make a huge difference if they remain islands in a sea of weak governance.

Compliance assurance remains a challenge. As a consequence, some people have become disillusioned by certification as a tool for social change. Furthermore, as application remains voluntary, it's hard to scale up certification as compliance usually costs more than non-compliance, where there be no control of legality at all.

### Standards are still a vital tool

Yet, sustainability standards are vital tools for good land governance across the world, not only in the tropics but also in other growing regions such as Europe.

Because the social and environmental challenges linked to edible fats and oils are global and systemic, the industry needs significant transformation beyond the boundaries of certified farms or supply chains.

It's essential, therefore, that companies collaborate with each other and invest in projects that look after smallholders and ecosystems.

Policy and legislation can help level the field by setting universal mandatory minimum criteria. Quality standards can act as both templates and compliance tools for implementing such criteria.

# ARE THE TOOLS WE HAVE UP TO THE JOB?

## THE LIMITATIONS AND POTENTIAL OF VOLUNTARY SUSTAINABILITY STANDARDS

### What can standards do?

- Guide farmers to where improvements are needed
- Improve farm management practices, resulting in economic benefits
- Recognise, and pay a premium for, good social and environmental practices and animal welfare
- Assure buyers that products are made according to a set of basic requirements

### Features of good quality standards include:

- Good checks on legality
- Integrated criteria ensuring social and environmental responsibility
- Strong requirements to assure compliance.

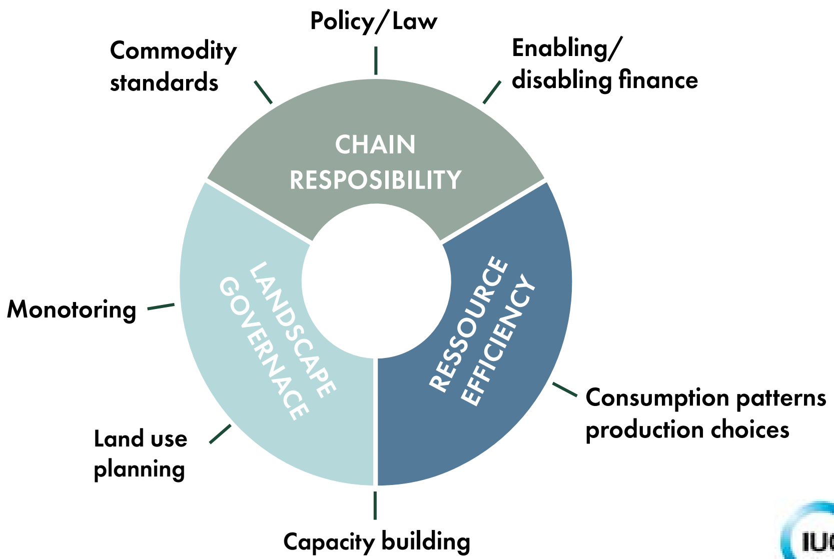
This last point is often forgotten. But criteria are just paper promises without these requirements.

Roundtable standards (such as RSPO, RTRS) often score relatively high in benchmarks,as they are heavily negotiated between stakeholders with different backgrounds, transparent and under more public scrutiny than, for example, company standards. ISEAL is the quality benchmark of standards as such, and a community of continuous improvement [2].

### Recommendations for companies producing and purchasing vegetable oils and animal fats

- Invest in good compliance
- Become a supporting member of quality roundtables to help avoid risks
- Collaborate with others in the value chain to ensure standards are fully adopted across as broad an area as possible.

### Overall vision on agro commodities



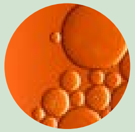

[1] https://rspo.org/impact/research-and-evidence/benchmark-reports.
https://www.iucn.nl/en/updates/iucn-nl-compares-sustainability-certification-for-biomass
https://www.iucn.nl/files/publicaties/setting_the_bar_for_deforestation_free_soy_190606_final.pdf
[2] https://www.isealalliance.org/. https://www.isealalliance.org/iseal-community-members?field_code_compliant=1

Part 2.

# UNDERSTANDING THE MAJOR EDIBLE FATS AND OILS TODAY

In this section we give an overview of the nine most significant vegetable oils and animal fats by production volume, including the most common social and environmental risks and sustainability standards.

We present nine profiles that go into more detail about each of the major edible fats and oils.



**Palm oil**

**Groundnut oil**

**Olive oil**

**Soybean oil**

**Cottonseed oil**

**Table:** Profile summary - major vegetable oils and animal fats

**Rapeseed oil**

**Coconut oil**

**Chart:** Oil yield by crop type (tonnes per ha) and lifecycle impacts per litre of oil or fat.

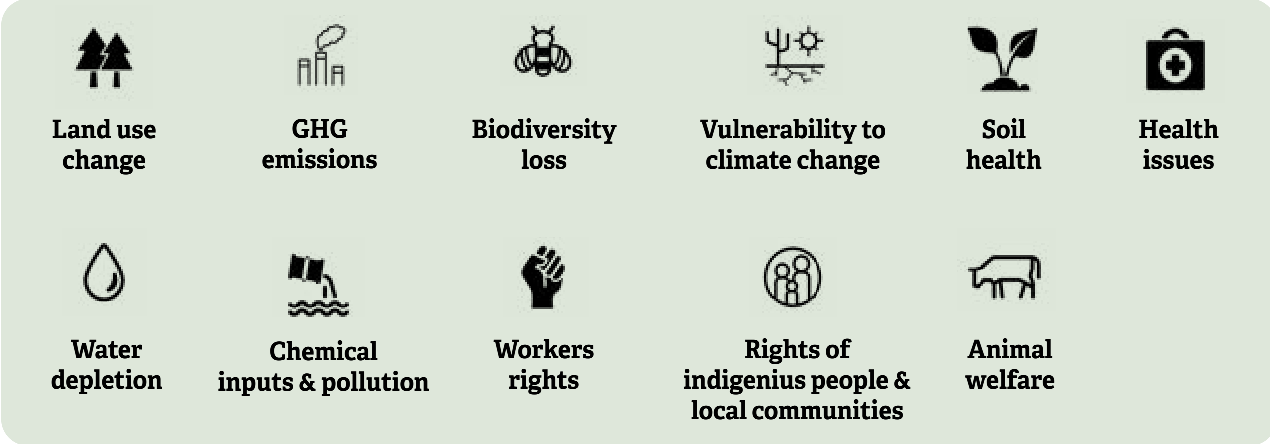
**Sunflower oil**

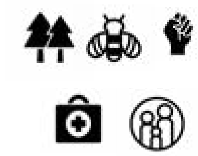
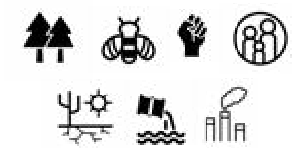
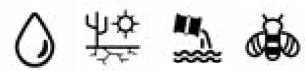
**Butter / ghee**

**Compare the profiles**

# PROFILE SUMMARY

## MAJOR VEGETABLE OILS AND ANIMAL FATS

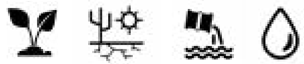



| | FUNTIONALITY | FATTY ACID PROFILE<br>Saturated;<br>Poly-unsaturated<br>Mono-unsaturated | OIL YIELD (TONS PER HECTARE) | NOTABLE ENVIRONMENTAL AND SOCIAL IMPACTS | KEY SUSTAINABILITY STANDARDS |
|---|---|---|---|---|---|
| **PALM OIL** | Versatile, solid, high smoke point, mild flavour; palm kernel oil used in processed foods | <br>(palm oil)<br><br>(pko) | 4,02 |  | RSPO; POIG; ISPO; MSPO; ISCC (Supported by NDPE policy and traceability) |
| **SOYBEAN OIL** | Versatile, liquid, mild flavor |  | 0,44 |  | RTRS; ISCC, Proterra, Danube Soya Standard |
| **RAPESEED OIL** | liquid, high smoke point, mild flavour |  | 0,69 |  | ISCC |
| **SUNFLOWER OIL** | liquid, high smoke point, mild flavour |  | 0,69 |  | ISCC |

# PROFILE SUMMARY

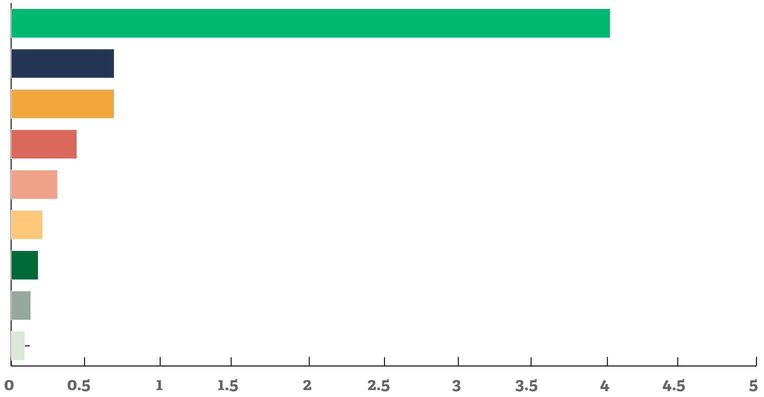
## MAJOR VEGETABLE OILS AND ANIMAL FATS

- Land use change
- GHG emissions
- Biodiversity loss
- Vulnerability to climate change
- Soil health
- Health issues
- Water depletion
- Chemical inputs & pollution
- Workers rights
- Rights of indigenius people & local communities
- Animal welfare

| | FUNTIONALITY | FATTY ACID PROFILE<br>Saturated;<br>Poly-unsaturated<br>Mono-unsaturated | OIL YIELD (TONS PER HECTARE) | ENVIRONMENTAL AND SOCIAL IMPACTS | KEY SUSTAINABILITY STANDARDS |
|---|---|---|---|---|---|
| **GROUNDNUT OIL** | Liquid, high smoke point, mild flavour |  | 0,18 |  | None at present |
| **COTTONSEED OIL** | Liquid, high smoke point, mild flavour |  | 0,13 |  | None at present |
| **COCONUT OIL** | Solid, low smoke point, neutral to mild flavour |  | 0,21 |  | Rainforest Alliance |
| **BUTTER, GHEE** | Solid, ghee has high smoke point, butter has lower one, medium flavour |  | |  | None at present |
| **OLIVE OIL** | Liquid, low smoke point, strong flavour |  | 0,31 |  | None at present |

# COMPARING THE ENVIRONMENTAL IMPACTS OF OILS AND FATS

## Oil yield by crop type (tonnes per ha)



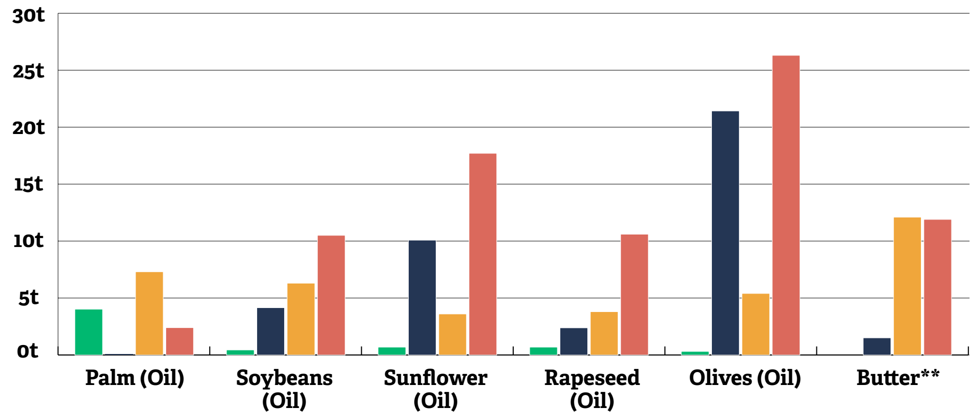

- **Palm oil:** 4.02
- **Rape and mustard oil:** 0.69
- **Sunflower oil:** 0.69
- **Soybean oil:** 0.44
- **Olive oil:** 0.31
- **Coconut oil:** 0.21
- **Groundnut oil:** 0.18
- **Cottonseed oil:** 0.13
- **Sesameseed oil:** 0.09

**Oil yield data**

Calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO)

https://ourworldindata.org/grapher/oil-yield-by-crop?tab=chart&country=~Other%20oilcrops

## Lifecycle impacts per litre or kg of oil or fat




- **Yield (tonnes per hectare) ***
- **Water use (litres per litre oil) (1 unit = 100L)**
- **GHG emissions (kg CO2eq per litre)**
- **Land use (m2*year per litre)**

**LCA info**

Veg oils: Poore J, Nemecek T, Science 360, 987–992 (2018)

Butter: Liao X, Gerichhausen MJW, Bengoa X, et al, Int J Life Cycle Assess 25, 1043–1058 (2020).

* Yield data not available for butter

** The lifecycle impacts of butter vary considerably depending on the production system used

Comparable data not available for groundnut, cottonseed and coconut oil.

# PALM OIL

## (PALM OIL AND PALM KERNEL OIL)

The world's biggest edible oil crop by production volume. High yielding and highly versatile in its usage. Palm oil has a similar nutritional profile to other edible oils but has relatively higher levels of saturated fat. Palm oil production is one of the top four drivers of tropical deforestation (along with beef, soy and wood products) and is linked to serious human rights abuses and other social violations. In 2019 the European market imported 86% RSPO certified sustainable palm oil.

### Stats & figures

**Annual production**:
75.5 million metric tons (2020)

**Fatty acids (g/100g):**
Palm oil:
Palm kernel oil:

**Typical yield**: 4.02 tonnes per hectare (very high)

**Greenhouse gas emissions**: 7.3kg $CO_2$ equivalent per litre

**Water use**: 6.4 litres per litre. Water use is lower than other oil crops as palm is almost entirely rainfed, whereas other oil crops rely on irrigation.

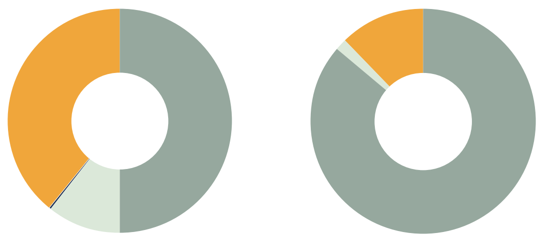
**Land use**: 2.4 m2 / year per litre (low)

**Agrochemicals**: Low use of fertiliser and pesticides

**Production climate:** Tropical

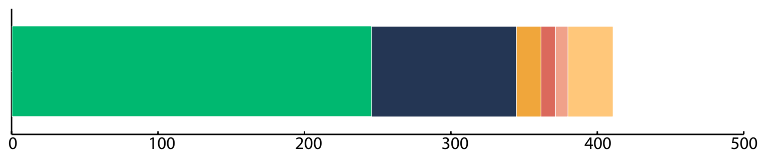
### Fatty acids (g/ 100g)

**Palm oil** **Palm kernel oil**



- **SFA:** 48.8 / 81.5
- **PUFA (Linoleic acid/omega 6):** 10.1 / 1.6
- **PUFA (Alpha-linolenic acid/omega 3):** 0.3
- **MUFA (Oleic acid / omega 9):** 37.1 / 11.4

### Global production - oil palm fruit (million metric tonnes)




- **Indonesia:** 245.6
- **Malaysia:** 99.1
- **Thailand:** 16.8
- **Nigeria:** 10
- **Colombia:** 8.4
- **Other:** 30.8

Annual production: USDA 2020, https://apps.fas.usda.gov/psdonline/circulars/oilseeds.pdf

Environmental impacts (GHGs, water use, land use): Poore & Nemecek, 2018, Science
All environmental impacts are per litre or kilogram of vegetable oil or animal fat. They represent the supply chain from inputs production to retail and include losses (consumer losses and cooking are excluded). All data are global averages.

Oil yields: Calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO) https://ourworldindata.org/grapher/oil-yield-by-crop?tab=chart&country=~Other%20oilcrops

# PALM OIL

# (PALM OIL AND PALM KERNEL OIL)

## Primary uses

A highly versatile crop processed into multiple derivatives. Palm oil is often used for edible purposes while palm kernel oil is mainly used for non-edible purposes, such as making soaps, cosmetics and detergents. Around 65% is used in food, in particular as a cooking oil, most notably in Asia. It's odourless and semi-solid at room temperature, making it suitable for use in processed food products such as baked goods, spreads and confectionery. It has a natural preservative effect that extends the shelf life of products.

## Other uses

Industrial uses, including cosmetics, personal care, biofuels and animal feed account for around 31% of consumption. There's an increasing number of uses for waste products from palm oil production. For example, empty fruit bunches can be turned into biofertilisers to reduce usage of chemical fertilisers. Waste products can also be converted into biofuel.

## Production method

Palm oil comes from the palm fruit, while palm kernel oil is extracted from the palm seed. The cold pressed oil from the fruit is called red palm oil. White palm oil is the result of processing and refining. Palm fruit is typically grown in monoculture plantations, although smallholder models (around 40% of production) incorporate more crop diversity. Often delivered to markets unrefined and piped directly into refineries situated next to the port.

## Key Impacts

### Land-use change, GHG emissions and biodiversity loss

Due to its high yield and adaptability as a cooking agent, palm oil has increased more than any other oil in recent years. Its rapid expansion in tropical regions drives high rates of deforestation and the conversion or degradation of peatland.

This leads to the release of greenhouse gases through slash and burn techniques, especially in peatlands. There is also a loss of biodiversity and carbon sequestration capabilities.

Sustainable certification is increasing – around 19% of palm oil produced is certified as sustainable. However, greater demand for certified oil is needed, along with stronger action from producer governments, companies and producers, to protect valuable carbon ecosystems.

### Workers' rights

Around 40% of palm oil is grown by smallholders, many receiving low wages and living on the poverty line.

### Rights of indigenous people and local communities

Rapid expansion of palm oil production can lead to land grabs and violent conflict. Local communities may lose their homes, livelihoods and land, as well as access to food, medicines and materials. As a result, inequality spreads and people are forced into exploitative work. Women and indigenous communities are especially affected by the loss of forest resources, land and water brought about by the privatisation or theft of land by agribusinesses.

### Health issues

Forest fires burn as land is cleared for palm oil production, resulting in deaths and large-scale medical assistance for people affected by haze and smoke. Deforestation and land drainage leads to water and food shortages for local people.

### Other impacts

Lower than expected yields, an ageing crop profile and a lack of replanting.

# PALM OIL

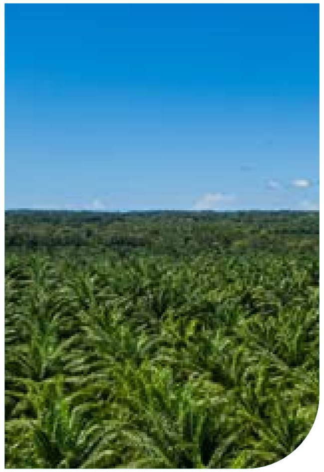
## SIGNALS OF CHANGE

Ecuador is seeking a jurisdictional Roundtable on Sustainable Palm Oil certification for the whole country after successful pilots in Brazil. Under the proposal, stakeholders across all commodities within a district or state work together to keep the entire region deforestation-free.

Source : https://news.mongabay.com/2017/04/jurisdictional-certification-approach-aims-to-strengthen-protections-against-deforestation/

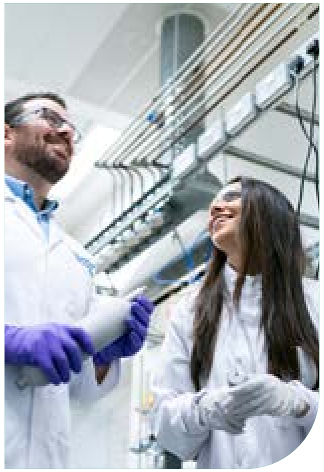
To drive demand for certified sustainable palm oil, RSPO is piloting a requirement that commits members from the downstream market to increase their uptake of certified palm oil each year.

Source : https://rspo.org/news-and-events/news/what-are-the-new-shared-responsibility-rules



In 2020 Sime Darby Plantation published its oil palm genome research in the hope of speeding up progress on developing traits such as climate resilience and disease resistance. The genome has already enabled the company to significantly increase oil palm yields on its existing land.

Source : https://www.forbes.com/sites/emanuelabarbiroglio/2020/07/08/new-research-on-oil-palm-genome-wants-to-revolutionize-production/?sh=61ff5299599b



C16 Biosciences is producing a synthetic alternative to palm oil. Genetically engineered microbes convert food waste and industrial by-products into a product that's chemically similar to natural palm oil. However, it is not yet available at commercial scale.

Source : https://www.bbc.com/news/business-55016453

Rimba Collective is an initiative led by buyers and processors of palm oil to collectively support long-term, sustainable conservation, and restoration of forests. It aims to provide US$1 billion to protect or restore 500,000 hectares of forest, supporting 32,000 individuals in forest communities in Southeast Asia over 25 years, starting in Indonesia.

Source : https://lestaricapital.com/mechanisms/rimba-collective/

# SOYBEAN OIL

Soy is valued for its high oil and protein content. As an edible oil, soybean oil is mild in flavour, versatile in food processing and contains healthy proportions of fats. Soybean has an oil content of around 30%. Soy production is one of the top four drivers of tropical deforestation (along with beef, palm oil and wood products) and land conversion, largely because the protein meal is a major animal feed ingredient.

## Stats & figures

**Annual production**:
56.5 million metric tons (2020)

**Fatty acids (g/100g):**

**Typical yield**: 0.44 tonnes oil per hectare

**Greenhouse gas emissions**: 6.3kg CO2 equivalent per litre

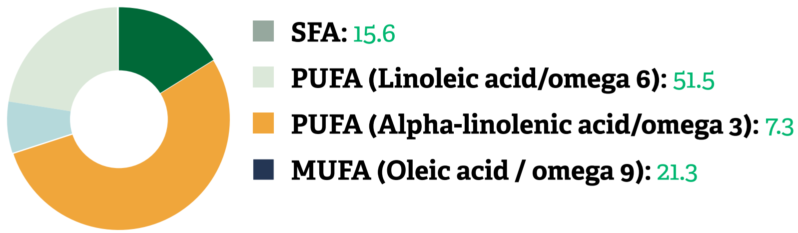
**Water use**: 415 litres per litre (approximately 75% stems from processing)

**Land use**: 10.5 m2 / year per litre

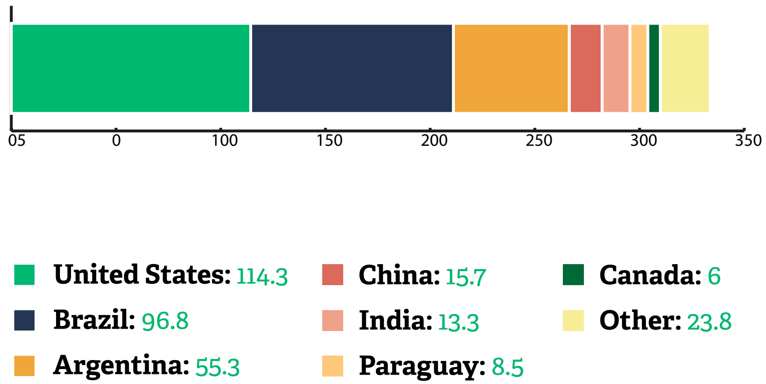
**Agrochemicals**: High usage of pesticides, especially with certain genetically modified varieties

**Production climate:** Temperate or tropical; almost anywhere with a warm growing season, ample water and sunlight.

## Fatty acids (g/ 100g)




## Global production - soybeans (million metric tonnes)




Annual production: USDA 2020, https://apps.fas.usda.gov/psdonline/circulars/oilseeds.pdf

Environmental impacts (GHGs, water use, land use): Poore & Nemecek, 2018, Science
All environmental impacts are per litre or kilogram of vegetable oil or animal fat. They represent the supply chain from inputs production to retail and include losses (consumer losses and cooking are excluded). All data are global averages.

Oil yields: Calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO)
https://ourworldindata.org/grapher/oil-yield-by-crop?tab=chart&country=~Other%20oilcrops

# SOYBEAN OIL

## Primary uses

Valued as a protein and oil crop. Some 70 to 75% of soy protein goes to animal feed, particularly poultry and pork. About 6% goes directly into food products for human consumption.

## Other uses

Biofuels, however the EU is phasing out the use of biofuels with a high risk of indirect land-use change. Soybean oil has various applications in chemical and technical industries, including varnish, lacquers, adhesives and solvents.

## Production method

As a legume, it economises on nitrogen and often fits into a rotation with corn or wheat. Typically grown in extensive monoculture systems with low crop diversity. More than 70% of soybean grown worldwide is now genetically modified.

## Key Impacts

### Land-use change, GHG emissions and biodiversity loss

The expansion of soybean production for animal feed in Brazil and Argentina, in particular, has led to extensive deforestation and the conversion of highly sensitive ecosystems, including the Amazon, Cerrado (which hosts about 5% of the world's species) and Gran Chaco biomes. These changes severely deplete wildlife and biodiversity and contribute to climate change. The risks of land-use change remain high unless there's greater uptake of responsible, deforestation- and conversion-free soy production and more sustainable livestock systems.

### Vulnerability to climate change

Climate change is suppressing soybean yields. In the US, for example, higher temperatures and changing rainfall patterns are restricting production.

### Chemical inputs & pollution

The heavy reliance on and inefficient use of agrochemicals, such as pesticides and synthetic fertilisers, is reducing soil quality and increasing pollution of water courses in production regions.

### Workers' rights

For people working on soy farms, risks include child labour, low wages and injuries from exposure to agrochemicals.

### Rights of indigenous people and local communities

Large-scale deforestation and land conversion for soy production is violating the human rights of local communities and indigenous peoples.

Local communities may lose their homes, livelihoods and land, as well as access to food, medicines and materials. As a result, inequality spreads and people are forced into exploitative work. Women and indigenous communities are especially affected by the loss of forest resources, land and water brought about by the privatisation or theft of land by agribusinesses.

Community resistance to land grabs and forest clearing can result in the perpetration of violence against community leaders, human rights defenders and activists.

# SOYBEAN OIL

## SIGNALS OF CHANGE

The Roundtable for Responsible Soy and other soy sustainability platforms and standards have joined forces under the umbrella of the Collaborative Soy Initiative. The CSI seeks to inform stakeholders and find synergies between initiatives to achieve 100% conversion-free sustainable soy and encourage greater market uptake.

Source: https://thecollaborativesoyinitiative.info/

A letter from some of the world's largest food companies and grocers has urged commodity suppliers to stop trading soybeans associated with deforestation in Brazil's Cerrado region. The letter was sent in 2020 by more than 160 signatories of the Consumer Goods Forum's Cerrado Manifesto Statement of Support.

Source:

https://en.mercopress.com/2020/12/16/food-companies-and-grocers-urge-commodity-suppliers-to-refuse-soybeans-from-deforested-areas-in-brazil

In 2020, plant-based spreads producer, Upfield, launched a three-year programme in Kansas with non-profit No-till on the Plains to improve soil health and reduce erosion of soybean fields. The programme supports farmers with soil health education and shares the costs of planting cover crops across 13,000 acres in the first year.

Source:

https://upfield.com/press/country-crock-and-no-till-on-the-plains-introduce-cover-crop-collaboration/

Nearly 40 UK food businesses threatened to stop sourcing products from Brazil over proposed land reforms in 2021. An open letter called on Brazil's legislature to reject a bill which could legalise the private occupation of public land. The vast majority of land in the Amazon is cleared either to graze cattle for beef exports, or to grow soy, which goes in to animal feed.

Source : https://www.independent.co.uk/climate-change/news/supermarkets-brazil-boycott-amazon-deforestation-b1842086.html

# RAPESEED OIL

Also known as oilseed rape or canola, which is the primary variety of rapeseed grown globally. Rapeseed contains low levels of saturated fat compared to other oils. Neutral in flavour and light in colour, rapeseed oil is highly versatile and can be used in frying, baking and dressings.

## Stats & figures

**Annual production**:
27.7 million metric tons (2020)

**Fatty acids (g/100g):**

**Typical yield**: 0.69 tonnes per hectare

**Greenhouse gas emissions**: 3.8 kg $CO_2$ equivalent per litre

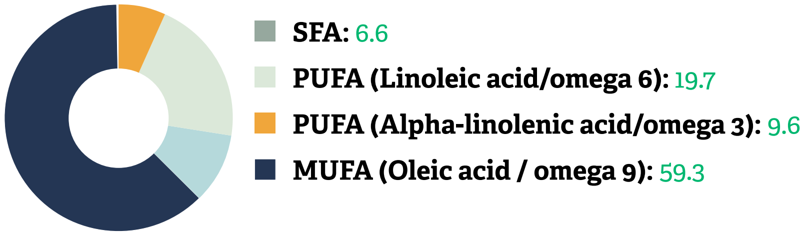
**Water use**: 238 litres per litre (50% stems from processing)

**Land use**: 10.6 m2 / year per litre

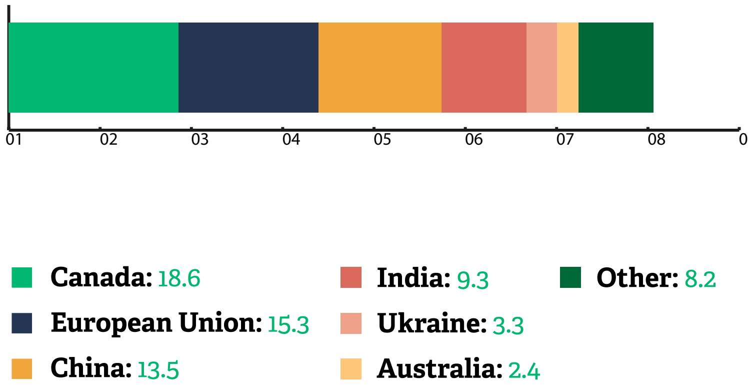
**Agrochemicals**: High levels of pesticide and fertiliser use (especially nitrogen)

**Production climate:** Almost anywhere with a warm growing season

## Fatty acids (g/ 100g)




## Global production - rapeseed (million metric tonnes)




Annual production: USDA 2020, https://apps.fas.usda.gov/psdonline/circulars/oilseeds.pdf

Environmental impacts (GHGs, water use, land use): Poore & Nemecek, 2018, Science
All environmental impacts are per litre or kilogram of vegetable oil or animal fat. They represent the supply chain from inputs production to retail and include losses (consumer losses and cooking are excluded). All data are global averages.

Oil yields: Calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO)
https://ourworldindata.org/grapher/oil-yield-by-crop?tab=chart&country=~Other%20oilcrops

# RAPESEED OIL

## Primary uses

Almost anywhere with a warm growing season

## Other uses

The oil is the primary product of the plant, used mainly as an edible oil, in cosmetics and blended with diesel. Some 60% of rapeseed oil produced in Europe is used in biodiesel.

## Production method

An annual crop that suits rotation with wheat or as a double crop with beans, buckwheat and sorghum. The oil is extracted from the seeds of the plant and the meal by-product can be used in animal feed.

## Key Impacts

### Vulnerability to climate change

Climate change is decreasing the number of suitable areas for growing rapeseed, particularly in Europe. Changing weather patterns, increased heat and flooding will affect farmers and their surrounding communities.

### Chemical inputs & pollution

Chemical inputs & pollution: Pesticides and nitrogen and sulphur fertilisers are used to maximise crop yields, but this has made growing rapeseed economically unviable for some smallholders. Agrochemical inputs can run off in high rain or leech through the soil and into water courses.

### Soil health

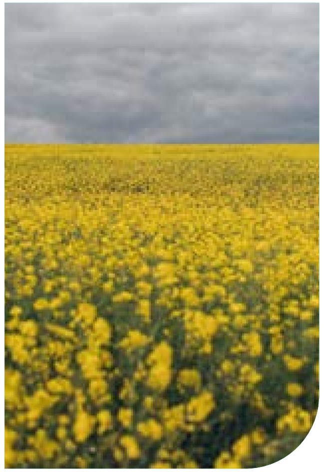
With crop rotation cycles shortening from five to three years in an attempt to maximise yields, soil-borne diseases are becoming more frequent. This results in greater pesticide use.

### Biodiversity loss

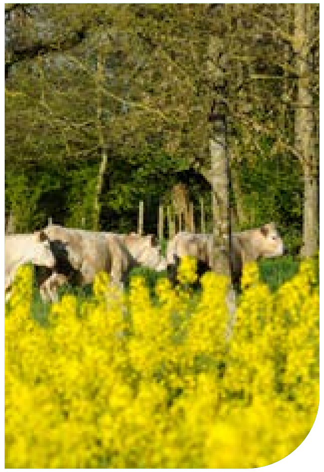
The use of pesticides and herbicides on crops has negative effects on wild plants, birds and insect species such as bees, butterflies and beetles. Where these chemicals run off into water sources, this can harm aquatic species such as fish and amphibians.

# RAPESEED OIL

## SIGNALS OF CHANGE



Some farmers are adopting longer crop rotations to improve soil health, reduce the ability of pests to breed and decrease soil compaction.



This protein-rich by-product of rapeseed oil is currently used in animal feed. Now, though, it's becoming possible to turn it into a protein for use in human foods. Soy is a source of protein in both animal feed and plant based foods, and in some regions is a major driver of deforestation and land conversion. Rapeseed, if produced sustainability, could provide a nutritious alternative to soy.

# SUNFLOWER OIL

A light coloured, neutral flavoured oil with very low cholesterol and high unsaturated fat levels, sunflower is regarded as a 'heart-healthy' oil. Sunflower oil is widely used in food manufacturing and is suitable for frying and salad dressings.

## Stats & figures

**Annual production**:
19.4 million metric tons

**Fatty acids (g/100g):**

**Typical yield**: 0.69 tonnes per hectare

**Greenhouse gas emissions**:
3.6kg CO2 equivalent per litre

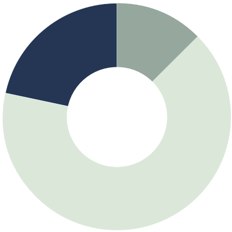
**Water use**: 1008 litres per litre (high). 50% stems from processing

**Land use**: 17.7 m2 / year per litre

**Agrochemicals**: High usage of pesticides and fertilisers (especially potassium)

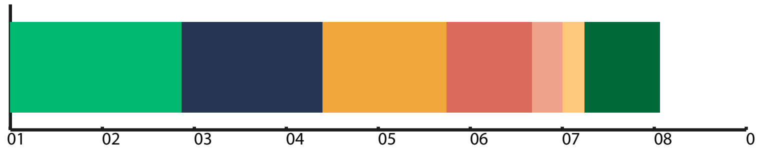
**Production climate:**
From arid (under irrigation) to temperate

## Fatty acids (g/ 100g)



**SFA:** 86.5
**PUFA (Linoleic acid/omega 6):** 1.5
**MUFA (Oleic acid / omega 9):** 6

## Global production - sunflower seeds (million metric tonnes)




**Russia:** 15.4
**Ukraine:** 15.3
**European Union:** 10.3
**Argentina:** 3.8
**China:** 2.4
**Other:** 8.9

Annual production: USDA 2020, https://apps.fas.usda.gov/psdonline/circulars/oilseeds.pdf

Environmental impacts (GHGs, water use, land use): Poore & Nemecek, 2018, Science
All environmental impacts are per litre or kilogram of vegetable oil or animal fat. They represent the supply chain from inputs production to retail and include losses (consumer losses and cooking are excluded). All data are global averages.

Oil yields: Calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO)
https://ourworldindata.org/grapher/oil-yield-by-crop?tab=chart&country=~Other%20oilcrops

# SUNFLOWER OIL

## Primary uses

The seeds of the sunflower plant can be eaten by humans or provided as birdseed. The oil is extracted from the seeds for use in food and biodiesel. The meal by-product can be used as animal feed.

## Production method

The annual crop is typically grown in a three to five year rotation with wheat, soy or sorghum. However, three-year rotations don't give soils sufficient time to recover between crops. Sunflowers are mostly grown by large agricultural enterprises. For example, in Ukraine, enterprises are responsible for 88% of the country's production, whereas smallholders produce just 6%[2].

[1] http://www.neoda.org.uk/sunflower-oil

[2] http://www.fao.org/fileadmin/user_upload/tci/docs/RS2-Ukraine_Review%20of%20the%20Sunflower%20Oil%20Sector.pdf

## Key Impacts

### Chemical inputs & pollution

Agrochemical runoff and poor practice when cleaning spraying equipment, often rinsed in local rivers, causes pollution. A lack of knowledge about compliance with environmental regulations also contributes to contamination of water courses.

### Soil health

The trend towards planting sunflowers on a three-year rotation, rather than five, is negatively affecting the quality of soil, increasing the risk of soil-borne disease (e.g. sclerotinia) and depleting soil moisture.

### Biodiversity loss

The use of pesticides and herbicides on crops has negative effects on wild plants, birds and insect species such as bees, butterflies and beetles. Where these chemicals run off into water sources, this can harm aquatic species such as fish and amphibians.

### Water depletion

Sunflower oil requires a relatively large volume of water to produce, half of which is used in processing. It requires more water to produce than palm oil, soybean oil and rapeseed oil, but less than olive oil.

# GROUNDNUT OIL

Also known as peanut oil and valued for its nutty flavour. It's the fifth most important edible oil and third most important source of vegetable protein in the world[1]. It contains healthy proportions of fats but is considered an allergen.

## Stats & figures

**Annual production**:
6.12 million metric tons (2020)

**Fatty acids (g/100g):**

**Typical yield**: 0.18 tonnes oil per hectare

**Greenhouse gas emissions**:
Comparable data not available

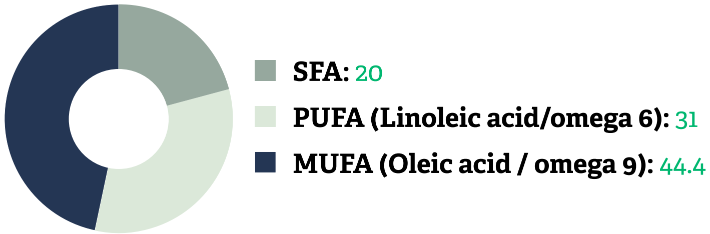
**Water use**: Comparable data not available. 50% stems from processing but it's also resource intensive for the amount it yields.

**Land use**: Comparable data not available. Due to its low yield, it needs relatively more land to cultivate than palm, soybean, rapeseed and sunflower.[2]

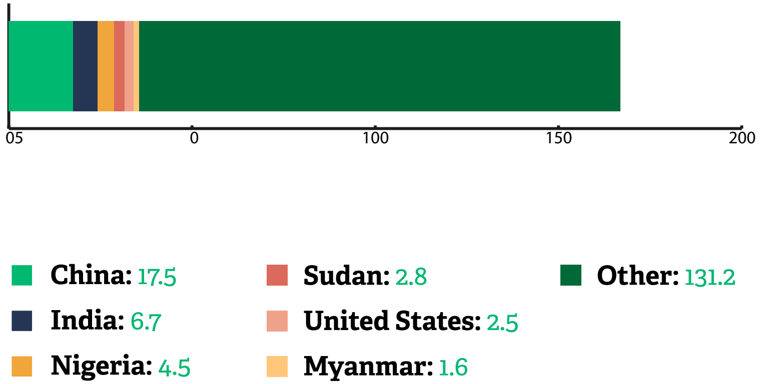
**Agrochemical use**: Varies

**Production climate:** Widely cultivated in tropical, subtropical and warm temperate regions

## Fatty acids (g/ 100g)




## Global production - groundnuts (million metric tonnes)




[1] http://apeda.gov.in/apedawebsite/HACCP/2018_Groundnut_Survey_Report.pdf

[2] https://lca-net.com/files/Paper-no-165_Munoz_et_al.pdf

OIl yields: Calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO) https://ourworldindata.org/grapher/oil-yield-by-crop?tab=chart&country=~Other%20oilcrops

# GROUNDNUT OIL

## Uses

The groundnut plant and its products have a wide range of uses including food, feed and fuel. It's a rotation crop; the plant's roots help return nitrogen to soil. The plant's vines can be used as animal fodder, and peanuts can be consumed directly. It's used to produce edible oil and biodiesel, and its protein meal can be used as animal feed.

## Production method

Oil is extracted from the nut and can be refined to remove any proteins that constitute an allergen.

Roughly half of crops are produced from smallholder farms (less than 2 ha). Typically grown as a monoculture crop.

[3] https://www.allergyuk.org/information-and-advice/statistics

## Key Impacts

### Land-use change, GHG emissions

The low yield of groundnut oil (relative to palm, soybean, rapeseed and sunflower) makes its life-cycle emissions the highest of the top five vegetable oil crops per litre of oil (2). This is due to the production method and area of land needed for cultivation.

### Workers' rights

Around 50% of groundnut oil is grown by smallholders, many receiving low wages and living on the poverty line.

### Rights of indigenous peoples & local communities

Groundnut is increasingly seen as a valuable cash crop for food use and biodiesel. As such, a rise in production can lead to land grabs and reduced food security for local communities, with women, in particular, at risk.

### Allergen

The prevalence of peanut allergies in a country's population is estimated to range from 10% to 40%. Peanut or tree nut allergies in children occur at a much higher prevalence and are estimated to be increasing.[3]

### Biodiversity loss

The use of pesticides and herbicides on crops has negative effects on wild plants, birds and insect species such as bees, butterflies and beetles. Where these chemicals run off into water sources, this can harm aquatic species such as fish and amphibians.

PART 2. EDIBLE FATS AND OILS PROFILES

# COTTONSEED OIL

The cotton crop is primarily valued for fibres, although the majority of the crop is used for animal feed and to produce cottonseed oil for human consumption. The oil contains high levels of antioxidants and polyunsaturated fat but also has relatively high levels of saturated fat. Cottonseed oil has a mild, nut-like taste and is clear with a light golden colour, making it very versatile.

## Stats & figures

**Annual production**:
5.12 million metric tons (2020)

**Fatty acids (g/100g):**

**Typical yield**: 0.13 tonnes oil per hectare

**Greenhouse gas emissions**: Comparable data not available

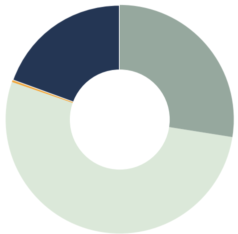
**Water use**: Comparable data not available. Cotton is, however, one of the world's most water-intensive crops.

**Land use**: Comparable data not available.

**Agrochemical use**: High. Cotton covers 3% of the world's cultivated land, yet it accounts for 24% of global insecticide use [1]

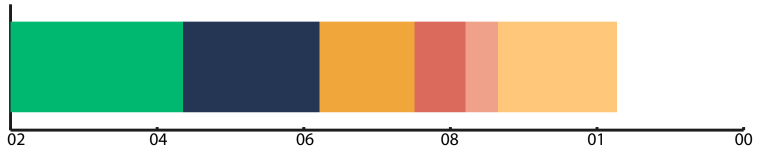
**Production climate:** Tropics and subtropics

## Fatty acids (g/ 100g)



**SFA:** 26.1
**PUFA (Linoleic acid/omega 6):** 50.1
**PUFA (Alpha-linolenic acid/omega 3):** 0.1
**MUFA (Oleic acid / omega 9):** 18.3

## Global production - cottonseed (million metric tonnes)




**India:** 17.5
**China:** 6.7
**United States:** 4.5
**Brazil:** 2.8
**Pakistan:** 2.5
**Other:** 1.6

[1] https://www.idhsustainabletrade.com/sectors/cotton/

Oil yields calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO)
https://ourworldindata.org/grapher/oil-yield-by-crop?tab=chart&country=~Other%20oilcrops

# COTTONSEED OIL

## Uses

Fibre, fuel and feed. Cotton fibre and linters are produced from the cottonseed hull, while the kernel contains protein and oil. Cottonseed oil can, therefore, be produced as a food co-product of cotton fibre and of protein-rich meal that can be used as animal feed.[2]

## Production method

Around 90% of cotton is grown by smallholders. Most cottonseed oil is extracted through chemical processes, such as solvent extraction. Oils extracted from cottonseed must be refined to remove gossypol, a naturally occurring toxin that protects the cotton plant from insect damage. Three quarters of the world's cotton is genetically modified, predominantly the insect-resistant Bt strain.[4]

[2] http://www.cicr.org.in/pdf/cottonseed_oil.pdf

[3] https://bettercotton.org/resources/key-facts/fact-6-genetically-modified-gm-cotton/

[4] https://www.worldwildlife.org/industries/cotton

## Key Impacts

### Workers' rights

Low income and dangerous working conditions are common. The enforcement of safety and health standards have been poor in India. Cotton workers in India routinely interact with pesticides, causing a range of human health problems. Pesticide exposure is increasingly linked to immunosuppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer.

Around 90% of cotton farmers live in poorer countries on smallholder farms, regularly working for very low incomes. The minimum wage law is often not enforced in India.

### Child Labour and forced labour

Child labour is prevalent in the cotton industry, particularly in India where minimum ages and child labour laws do not apply to family-run enterprises. Some 20% of the world's cotton is produced in the Uyghur region of China using forced labour of mainly Muslim ethnic minorities. This is taking place alongside a campaign of genocide.

### Chemical inputs & pollution

Runoff of pesticides, fertilisers and minerals from cotton fields contaminates rivers, lakes, wetlands and underground aquifers. Pesticides threaten the quality of soil and water.

### Soil health

Cotton cultivation severely degrades soil quality.

### Water depletion

Cotton is a highly water-intensive crop often grown in water-scarce areas. Inefficient irrigation projects waste large volumes of water because many farmers use flood rather than drip irrigation.

### Biodiversity loss

Pesticides and herbicides threaten biodiversity both in cotton fields and downstream. Their use on crops has negative effects on wild plants, birds and insect species such as bees, butterflies and beetles. Where these chemicals run off into water sources, this can harm aquatic species such as fish and amphibians.

# COTTONSEED OIL

## SIGNAL OF CHANGE

In Uzbekistan, the International Labour Organisation is working with the government and garment producers to eradicate forced labour in the cotton harvest. The partnership promotes structural change, global commitments, reform of recruitment practices and third-party monitoring.

# COCONUT OIL

Virgin coconut oil is rich in antioxidants and minerals with a fairly neutral, mild and sweet flavour, whereas normal coconut oil is refined under heat, with a more neutral flavour. Coconut oil contains high levels of saturated fat, making it less healthy than other vegetable oils. There has been high growth in demand for coconut in recent years, far outstripping growth in supply. [1]

## Stats & figures

**Annual production**:
3.62 million metric tons (2020)

**Fatty acids (g/100g):**

**Typical yield**: 0.21 tonnes oil per hectare

**Greenhouse gas emissions**: Comparable data not available. Biggest contributor is processing

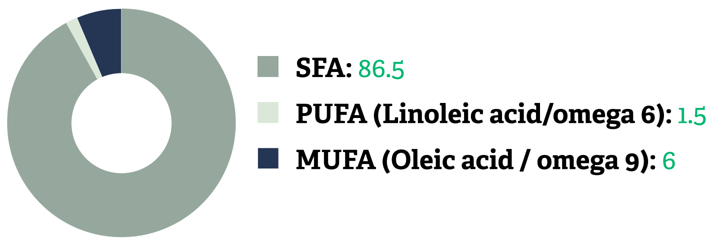
**Water use**: Comparable data not available. However, 75% stems from processing

**Land use**: Comparable data not available.

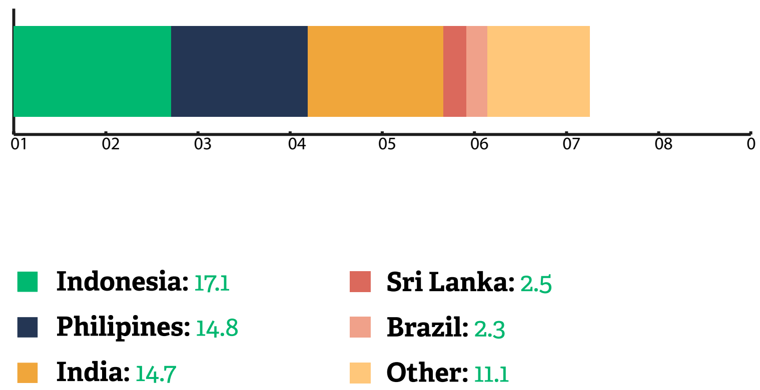
**Agrochemical use**: Minimal use of fertilisers and pesticides

**Production climate:** Tropical

## Fatty acids (g/ 100g)




## Global production - coconuts (million metric tonnes)




[1] https://www.360marketupdates.com/global-coconut-market-14858078

Oil yields calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO)
https://ourworldindata.org/grapher/oil-yield-by-crop?tab=chart&country=~Other%20oilcrops

# COCONUT OIL

## Primary uses

Coconuts have multiple uses, producing milk, meat (copra) and oil. The oil is used primarily for confectionery, cosmetics and cooking. In confectionery, coconut is often employed as an alternative to palm kernel.

## Other uses

Coconut produces a large number of useful by-products from its meat, shell, husk and water. These can be used for fuel, animal feed, water filtration or even horticulture.

## Production method

Some 90% of coconuts are farmed by smallholders[2]. Coconut requires less intensive management than palm, leaving time and resources for other economic livelihoods. Coconuts are still largely monocropped.

Virgin oil is produced without heat and extracted from coconut milk. Normal coconut oil comes from the dried meat of the plant (copra), which is milled to extract oil then further refined. Much of the crop's value comes from processing the raw coconut into products, such as coconut oil or coconut water.

[2] http://www.fao.org/3/af298e/af298E17.htm

## Key Impacts

### Vulnerability to climate change

Pests can quickly and severely damage trees, and their prevalence will increase as temperatures rise. Extreme weather conditions also pose a risk. In 2013, Super Typhoon Yolanda damaged 33 million trees and caused $369 million of losses to farmers in the Philippines [3]. More than 6,300 people lost their lives.

### Workers' rights

Despite increased demand for coconut, the average coconut farmer lives below national and global poverty lines. Coconut farming is at risk of being abandoned as farmers seek other cash crops providing higher incomes. Farmers have limited market participation, producing mainly raw materials without value-adding activities such as processing the coconuts into products for market.

There are multiple drivers of poverty, including land tenure issues, limited access to market information and new technologies. Farmers lack the finance or support to diversify their income and implement environmentally sound practices, such as intercropping, wildlife corridors or climate-smart agriculture.

Workers face safety risks from working at height to dislodge coconuts or due to injuries from falling coconuts.

### Declining productivity

Around 50% of the world's coconut trees are older with low productivity. Despite growing global demand for coconut, poverty means farmers are often unable to invest in new trees and are considering alternative cash crops

# COCONUT OIL

## SIGNALS OF CHANGE

The Sustainable Trade Initiative, IDH, and its partners provided a $2m loan in 2017 to help smallholder coconut farmers in the Philippines intercrop cocoa into their farms and access the related planting material and inputs. The goal of the loan is to increase farmers' income and resilience.

Source:
https://www.idhsustainabletrade.com/news/giant-leap-forward-30000-smallholders-philippines/

The Sustainable Coconut and Coconut Oil Roundtable was launched in 2019 by the chocolate manufacturer, Barry Callebaut, and USAID. The organisation aims to prevent a global coconut shortfall and achieve 100% sustainable coconut sourcing by 2025.

Source:
https://www.sustainablecoconutcharter.com/

# BUTTER AND GHEE

Derived from animals, including cows, sheep, goats and buffalo, butter is made by converting milk fat into a solid, and ghee is made by clarifying butter to remove the water phase. Butter and ghee are high in saturated fats and contain some trans fats. Butter is used as a spread, in cooking and in baking. Ghee is often used in place of butter in cooking and has a lower lactose content.

## Stats & figures

**Fatty acids (g/100g):**

**Typical yield**: Data not available. Varies according to production system.

**Greenhouse gas emissions**: 12.1kg $CO_2$ equivalent. GHG emissions vary considerably depending on the production system used.

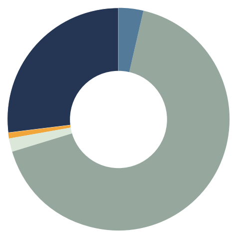
**Water use**: 150 litres / kg (stemming from the water embedded in animal feed and processing).

**Land use**: 11.9 m2 / year per kg

**Agrochemicals**: Dependent on production system and the type of feed used

**Production climate:** Varied

## Fatty acids (g/ 100g)



- **TFA:** 2.87
- **SFA:** 52.09
- **PUFA (Linoleic acid/omega 6):** 1.41
- **PUFA (Alpha-linolenic acid/omega 3):** 0.68
- **MUFA (Oleic acid / omega 9):** 20.91

## Global production - butter (million metric tonnes)


- **India:** 6.1
- **Eauropean Union:** 2.43
- **United States:** 0.96
- **New Zealand:** 0.53
- **Russia:** 0.28
- **Mexico:** 0.23
- **Other:** 0.67

Production chart shows data including: butter and ghee, sheep milk; butter of goat milk; butter, buffalo milk; butter, cow milk; ghee, butter of cow milk; ghee, of buffalo milk

GHGs, water use, land use figures: Liao X, Gerichhausen MJW, Bengoa X, et al (2020), The International Journal of Life Cycle Assessment

# BUTTER AND GHEE

## Primary uses

Livestock are farmed for their meat, skin and milk. They're also a source of power, transport and fertiliser. Around 30% of milk produced globally goes on to be processed into products such as butter, cheese and whey powder.[1]

## Production method

Some 80 to 90% of milk in developing countries comes from small-scale dairy producers.[2] In much of the rest of the world, the pressure to reduce costs and compete in a global marketplace has led to rapid intensification, focused on high yields. Major shifts include advances in genomics and a trend towards large, concentrated feedlot operations rather than extensive grassland or rangeland systems. Globally, the number of dairy farms has reduced while herd size has grown over recent decades. In 2017, the 20 largest (by volume) milk processors controlled more than 25% of the worldwide milk production market.[3]

[1] https://www.oecd-ilibrary.org/docserver/7ccc11c6-en.pdf?expires=1610443887&id=id&accname=guest&checksum=0E00D34B2FEEF87C2F4D707827631B72

[2] http://www.fao.org/dairy-production-products/production/production-systems/en/

[3] https://link.springer.com/article/10.1007/s13280-019-01177-y

[4] https://www.thelancet.com/journals/langas/article/PIIS2468-1253(17)30154-1/fulltext

## Key Impacts

### Land-use change, GHG emissions and biodiversity loss

Land-use impacts and greenhouse gas emissions vary considerably depending on the livestock production system.

Large-scale dairy herds rely on grain-based concentrated feedstocks. The expansion of feed crops, such as soy, has driven rapid deforestation and land-use change in regions including the Amazon and Cerrado. This severely affects wildlife and biodiversity.

The risk of continued land-use change remains high unless there are significant shifts in diets and advances towards more sustainable livestock production systems, for example pasture-based systems for cattle in combination with approaches such as silvopasture.

### Chemical inputs & pollution

These vary by livestock production system. Grain or soy-based feeds rely heavily on agrochemicals, such as pesticides and synthetic fertilisers, which are often used inefficiently. The high usage of agrochemicals has reduced soil quality and increased pollution of water courses in regions that produce feed crops. The severity of the impacts varies by farm and by region.

### Animal welfare issues

The welfare standards under which livestock are raised varies globally depending on the production system. Furthermore, animal welfare is an important concern for many consumers. Traceability is, therefore, important to ensure that acceptable welfare conditions are met.

### Allergen

Globally, 68% of the world's adult population suffers from lactose malabsorption – the inability to comfortably digest dairy foods that contain lactose. This tends to be more prevalent in developing countries and less prevalent in Western markets like Europe and North America.[4]

# BUTTER AND GHEE

## SIGNALS OF CHANGE

Cargill Brazil has launched a new fat that can reduce the saturated fat content in ice cream, creams and dairy drinks by up to 30%.

Source:
https://www.ofimagazine.com/news/cargill-launches-new-fat-for-ice-cream-and-dairy-products

The Sustainable Dairy Partnership (SDP) hosted by SAI Platform is working to scale up the sustainable production of dairy around the world using a step-by-step programme for companies. Rather than imposing a single sustainability standard, the SDP recognises national and company programmes.

Source:
https://saiplatform.org/sdp/

The Business Benchmark for Animal Welfare is a leading benchmark of 150 food companies with combined revenues of more than $3 trillion. The benchmark assesses the extent to which companies are actively managing the business risks and opportunities associated with farm animal welfare and the improvement of welfare practices.

Source:
https://www.chronossustainability.com/news/bbfaw-2020-investors-progress-continues-despite-pandemic-but-companies-must-close-gap-on-process-and-impact

In 2021 research groups began scaling up for the commercial launch of a cattle feed additive - red seaweed - which has been shown to almost completely stop methane production. Within the digestive tract, the additive prevents hydrogen from binding to carbon atoms, so that extremely little methane is burped out by cows into the air.

Source :
https://www.allaboutfeed.net/all-about/new-proteins/red-seaweed-stops-methane-production/

# OLIVE OIL

Valued for its nutritional profile containing healthy fatty acids and antioxidants. Olive oil ranges from a mild and fruity flavour to robust and peppery. Mainly used as a cooking oil rather than in processed foods.

## Stats & figures

**Annual production**:
3.12 million metric tons (2020)[1]

**Fatty acids (g/100g):**

**Typical yield**: 0.31 tonnes oil per hectare

**Greenhouse gas emissions**: 5.4kg CO2 equivalent per litre (largely stemming from agrochemicals and processing)

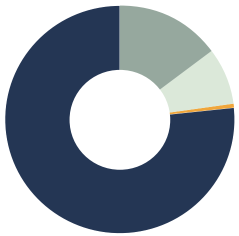
**Water use**: 2142 litres per litre. Very high from a combination of irrigation and water-intensive processing

**Land use**: 26.3 m2 / year per litre

**Agrochemical use**: High levels of nitrogen fertiliser [2]

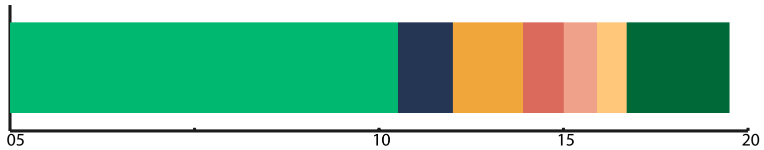
**Production climate:** Produced mainly in the Mediterranean

## Fatty acids (g/ 100g)



- **SFA:** 14.3
- **PUFA (Linoleic acid/omega 6):** 7.5
- **PUFA (Alpha-linolenic acid/omega 3):** 0.7
- **MUFA (Oleic acid / omega 9):** 73

## Global production - olives (million metric tonnes)




- **European Union:** 10.5
- **Turkey:** 1.5
- **Morocco:** 1.9
- **Egypt:** 1.1
- **Tunisia:** 0.9
- **Syrian Arab Republic:** 0.8
- **Other:** 2.8

[1] https://www.statista.com/statistics/613466/olive-oil-production-volume-worldwide/

[2] "The fertilizer requirements are 200 to 250 kg/ha N, 55 to 70 kg/ha P and 160 to 210 kg/ha K" http://www.fao.org/land-water/databases-and-software/crop-information/olive/en/

GHGs, water use, land use figures: Poore & Nemecek, 2018, Science
Oil yields calculated by Our World in Data based on data from the UN Food and Agriculture Organization (FAO)
https://ourworldindata.org/grapher/oil-yield-by-crop?tab=chart&country=~Other%20oilcrops

# OLIVE OIL

## Uses

Some 87% of land used to grow olives is for olive oil, the rest is for table olives.

## Production method

Around 20% of olives are cultivated on marginal land using traditional methods, with a low tree density of roughly 200 trees per hectare. 50% is grown on land cultivated traditionally but on flatter territory that offers the ability to mechanise. 29% is grown intensively with higher planting density – modern cultivation has a density of 250 to 400 trees per hectare and super- intensive cultivation between 600 and 1,600 trees per hectare. 1% is grown as hedgerows.

Farmers face pressure to fell old trees in favour of intensive production with new trees so that they can compete on price.

Olive is a perennial crop. The industry is subject to high levels of regulation by the International Olive Oil Council.

[3] https://www.foodnavigator.com/Article/2020/08/19/Europe-adopts-new-measures-against-notorious-olive-blight-Xylella-fastidiosa

## Key Impacts

### Vulnerability to climate change

Warmer temperatures and droughts in the Mediterranean and California are severely impacting olive oil production and quality.

### Soil health

Erosion is a growing risk in olive oil production due to its homogenous and intensive cultivation. Soil degradation and erosion result from high tree density, minimal cover crops and heavy traffic during harvesting.

### Water depletion

New plantations are irrigated, causing challenges in areas of the Mediterranean already at risk of desertification. This has increased salinisation, which is often associated with contamination of water bodies due to pollution from runoff. However, olives are less prone to agrochemicals leakage than other crops due to the use of drip irrigation methods.

### Chemical inputs & pollution

Semi-intensive and intensive farms use a variety of agrochemical products. These include nitrogen and phosphate fertilisers and copper for disease control. Nitrogen, in particular, is often over-applied, with few farms measuring actual nutrient requirements. This results in negative effects on the tree, crop quality and the environment.

### Pests and diseases

Olive growers in Europe are facing the spread of one of the world's most dangerous plant bacteria, Xyella Fastidiosa. The blight could cause production losses of up to €5.5 billion per year. The European Commission is adopting measures to minimise the spread, however, in areas of Spain, Italy and Corsica, eradication is deemed impossible. [3]

# OLIVE OIL

## SIGNAL OF CHANGE

A Spanish organic olive oil cooperative, funded by the EU, has developed an innovative composting technique. This method turns a polluting by-product (olive cake) into green fertiliser, reducing nitrate pollution in aquifers.

Source:
https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/rural-development/country

Part 3.

# NOVEL FATS AND OILS IN DEVELOPMENT

# AN ALTERNATIVE FUTURE FOR EDIBLE FATS AND OILS?

## NOVEL FATS AND OILS IN DEVELOPMENT

Written in February 2021, in collaboration with Prof. Christopher Chuck from the University of Bath and the International Platform of Insects for Food and Feed (IPIFF).

A number of novel fats and oils have begun development in recent years, as researchers endeavour to overcome some of the sustainability impacts associated with mainstream animal and crop-derived fats and oils. The prize for many innovators is to stake a claim on the burgeoning demand for oils like palm oil, while recognising the need to expand production sustainably and mitigate the negative impacts of oil production.

However, producing oils in this way comes with significant limitations, making the prospect of a commercially viable alternative to palm or rapeseed oil extremely remote in the short to medium term.

Here, we turn our attention to four novel sources of edible oil that have been the focus of recent research efforts:

### Algal oils

Several companies are commercialising algae-based oils, mostly produced via a fermentation process using $CO_2$ and sugar-based feedstocks.

### Yeast oils

Similar to algae, a fermentation process produces oils using oxygen and sugar-based feedstocks.

### Insect oils

Insects can convert organic waste into oil and protein products with high efficiency. The fatty lipids can be used as an alternative to vegetable oils and animal fats.

### Coffee oils

A number of companies are extracting oils from coffee waste, which they say are of comparable quality to commercial alternatives, such as palm oil.

# COFFEE OILS

Coffee is big business these days, and many companies are starting to capitalise on its popularity by extracting oil from used coffee grounds collected from instant coffee producers, coffee shops and even households.

The oil is simple to extract using solvents and contains a relatively high proportion of oil, at around 15% to 20%.

The oil itself is low in monounsaturated fats and high in saturated fats, making it a fairly unattractive option from a nutritional perspective. Furthermore, it contains some biomolecules that need to be removed before it can be used as an edible oil.

## Could coffee oils replace vegetable oils and animal fats?

While coffee grounds are physically easy to collect, the logistics of gathering a sufficient quantity without generating excess greenhouse gas emissions is more of a challenge. Collection from a major food service provider could be feasible, but households and coffee shops would require multiple pick-ups.

Given that it's extracted from waste, the primary uses of oil from waste coffee wouldn't be for food. Instead, it's more likely to be used in cosmetics and other limited applications.

The primary constraint, however, is supply. Annual coffee consumption is now estimated at around 10 million tonnes 1 which sounds a lot but, in terms of the global oil market, even if oil was extracted from every gram of waste, it would still be a tiny drop in an enormous ocean.

**Revive Eco is an example of a start-up making products from used coffee grounds.**

[1] Jackie Massaya, André Prates Pereira, Ben Mills-Lamptey, Jack Benjamin, Christopher J. Chuck, Food and Bioproducts Processing 118 (2019) 149–166

PART 3. NOVEL FATS AND OILS IN DEVELOPMENT

# INSECT OILS

Insects are highly efficient converters of agricultural food co-products and by-products into oil and protein ingredients. With greater attention now being paid to the many benefits of insects, the industry is thriving.

Insect lipids, commonly referred to as 'insect oil', can be used to complement or replace vegetable oils and animal fats in myriad applications. They're also compatible with a diverse variety of food products, including salty snacks, sweets and meat analogues.

Trials of insect-enhanced products are highly popular right now. Recent research, for example, evaluated the use of insect oils as complement to butter in waffles [1] or as a butter analogue, referred to as 'insect margarine'.[2]

These oils can also satisfy some of the nutritional requirements of farmed animals – such as fish, poultry or pigs – because they contain the necessary, balanced proportion of monounsaturated and polyunsaturated fatty acids.

In terms of their texture, flavour and fatty acid profile insect oils perform similarly to vegetable oils.[4]

[1] Delicato et al., 2019
[2] Smetana et al., 2020
[3] Tzompa Sosa and Fogliano, 2017
[4] D.A. Tzompa-Sosa et al, 2021

## Could insect oils replace vegetable oils and animal fats?

According to EU legislation, insects are classified as farmed animals. As such, the feed used in insect farming can't include products not authorised by the EU. The legislation rules out food waste, but most insect producers in the EU rely on agri-food by- or co-products, such as wheat bran or fruit and vegetable peels, or former foodstuffs originally intended for human consumption.

Insect meals and oils have been successfully trialled on aquaculture, poultry and swine, and in the EU, these ingredients are now authorised for such use, as well as for pet food. Indeed, products containing insect oils are already on the market in some member states.

While insect oils have the potential to complement or indeed replace many vegetable oils and animal fats in food and feed products, production forecasts suggest that insect oil won't outpace current palm oil production.

There is, of course, a major barrier to insect-derived oils reaching more mainstream appeal in the food industry – consumer acceptance. Taking account of that obstacle, it's likely that insect oils will play a far greater role in the animal feed industry.

**Several companies such as Ynsect, Hermetia Baruth GmbH, Innovafeed and others are active in the production of insect oils. Protix was involved in the development of an insect margarine.**

# SINGLE-CELL ALGAL OILS AND YEAST OILS

Biotech companies and research institutions have pumped billions of dollars into exploring the oil potential of algae and yeast over the last 50 years. Much of that research has investigated whether algal and yeast oils could eventually substitute edible oils, such as palm and rapeseed.

Single-cell oils are held up as a promising direct alternative to palm oil because their lipid profiles can be 'tuned' to provide comparable nutritional and functional benefits.

Despite this mammoth research effort, no company has yet demonstrated that oil could be produced at the scale of palm or rapeseed oil, let alone for anything like the equivalent cost. In fact, it hasn't even been possible to model the production of algal oil at a cost that competes with today's palm or rapeseed oil prices.

As a result, large-scale development is at somewhat of a dead end – biotech companies are no longer exploring algal or yeast alternatives to palm oil, despite substantial financial backing.

# PHOTOTROPHIC ALGAL OILS

## Production method

Microalgae is grown using CO2 and light in either large, open ponds, or closed photobioreactors. Algae produced this way is known as phototrophic algae.

Producing algal oil this way is prohibitively expensive. The eye-watering capital costs, including for the creation of a fully sterile environment, make it substantially cheaper to buy land and create a palm oil plantation instead. On top of the initial outlay, the running costs of providing constant light and carbon dioxide are also extreme. None of this is financially worth the effort for the relatively low yields.

Added to this, the greenhouse gas emissions associated with algal oils is currently unknown, so can't be compared with other production methods.

Because of these factors, some companies have transferred their research efforts to yeast or heterotrophic algae fed on sugars. On a positive note, recent work in this field suggests it may be possible to use food waste or agricultural residues as a sugar source. However, the infrastructure required means this is currently more expensive than using conventional sugar.

# HETEROTROPHIC ALGAL OILS AND YEAST OILS

## Production method

Yeast or algae is fed on sugar and given a source of oxygen to grow (heterotrophically) in large bioreactors.[1]

Yeast is generally thought to be more viable than microalgae as a way to produce oil. This is because it can grow at one hundred times the density of phototrophic algae, making it far more productive and therefore potentially cheaper to produce.

However, it still requires large bioreactors and other processing equipment, meaning that the capital costs of production are very high.

It is possible to make an edible oil substitute from yeast with the same biochemical profile as rapeseed or palm oil. This oil would potentially be able to be used for food, fuels, chemicals or for care products.

## Feed sources for yeast oils

The current cheapest source of sugar to feed yeast is cane sugar or molasses produced in Brazil which has a large bioethanol industry. This demand for sugar would come, of course, with significant social and environmental impacts related to its production.

## Production costs

Modelling work by academic groups estimates that the cost of a yeast oil would be between $2,000 and $5,000 per tonne – four to 10 times higher than palm oil.

Even using the theoretical price estimate[2] puts the cost of production at approximately twice the price of palm oil.

## Nutraceutical uses

One area of growth, however, is the nutraceutical market, where heterotrophically produced algal oil is considered a high value commodity.

Algal oil can be tailored to contain levels of polyunsaturated fatty acids that are equivalent to the fatty acid profile of fish oils – a crucial source of omega 3 for humans and livestock – but produced with a much lower environmental footprint.

[1] Heterotrophic algae can also be grown using the exact same process, and produces an identical output to yeast. Hence they are grouped together in this section for the sake of simplicity.

[2] Modelled for a production facility working at the theoretical maximum on a biological organism producing lipid at the biological maximum

# HETEROTROPHIC ALGAL OILS AND YEAST OILS

## Could insect oils replace vegetable oils and animal fats?

Further modelling of yeast oil production suggests two scenarios in which the price could potentially be reduced to be more in line with palm oil.

One possibility involves finding a way to extrude oil from the cell continuously, so that the cell doesn't need to be broken open to extract the oil. At present, however, this process is purely theoretical.

The second option is to explore whether the whole organism can provide both protein and oil to make a complete food or care product. While this wouldn't compete with palm oil per se, it would replace a product that contains palm oil with an entirely yeast or algae-based product. Using both the protein and the oil in the same product could make it economically viable, in a similar way that oil refineries are subsidised by producing both oil and plastics.

Single-cell oils could become more economically viable if they benefited from policy and financial incentives and if the environmental and social costs of oil crop production were factored into market prices.

**New York-based start-up, C16 Biosciences, is attempting to develop a synthetic alternative to palm oil, as are researchers at the University of Bath and another start-up, California-based Kiverdi.**

# NOVEL FATS OILS IN DEVELOPMENT : CONCLUSION

1. Our current food system is set up to produce food cheaply. Vegetable oils are part of that system. Unless we can factor in externalities, such as carbon emissions or health impacts, it's currently impossible to produce a novel oil that provides the same properties as palm or rapeseed oil at a similar cost.

2. We are a long way off the economies of scale required for yeast or heterotrophic algae oil to compete on price. Both require extremely high capital investment.

3. While insect-derived oils have the potential to be scaled, consumer acceptability poses a stiff challenge.

4. For algal and yeast oils, rather than producing a 'like for like' edible oil, a more economically viable option could be to use the microorganism's protein and oil content to produce a complete food product that replaces a vegetable oil-based product.

5. Novel oils and fats have great potential to play a role in uses other than human food, such as cosmetics, where regulatory barriers are lower and profit margins higher. An example of this in practice is pet food, where insects are already beginning to be used.

Part 4.

# CONCLUSION AND CALL TO ACTION

PART 4. CONCLUSION AND CALL TO ACTION

# CONCLUSION

## OUR RESEARCH HAS HIGHLIGHTED SEVEN KEY TAKEAWAYS

### 1. Meeting climate ambitions requires system-wide transformation.

Unless we consider oils and fats as a part of a single system where changes to one part impact the whole, our world won't keep its commitment to limit global warming to 1.5˚C since pre-industrial levels. Yet, to date, most action focuses on single commodities, such as palm oil. Sustainability in fat and oil production requires much wider collaboration – across geographic and supply chain boundaries. For many companies, that means developing a holistic oils and fats policy rather than tackling single ingredients in isolation.

### 2. Don't go it alone.

As the above suggests, no one organisation can crack this challenge on its own. From growers and buyers to product technologists and investors, the whole industry must collaborate and act together. In fact, the risks related to fats and oils, including deforestation, human rights abuses and biodiversity loss are common to many agricultural commodities, and there are opportunities to learn from and create best practice across all systems.

### 3. Research before you substitute, and watch out for unintended consequences.

The implications of choosing one oil over another are complex. Each has different nutritional properties, physical characteristics, environmental impacts and labour conditions which need to be carefully examined.

Reactionary media stories, campaigns and corporate actions in recent years have skewed the picture. Notably, palm oil has been labelled a 'bad' oil whereas coconut oil is perceived as 'good'. This has created pressure on businesses to replace palm oil.

But no oil crop is nearly as productive as palm. If many companies choose to switch, they could exacerbate and displace to other locations issues like deforestation and biodiversity loss.

With evidence pointing to the harmful health impacts of saturated and trans fats, it's vital to balance nutrition with functionality when considering oils for product formulation. How can our industry inspire consumers to eat a healthier, more plant-forward diet with a lighter environmental and social footprint?

### 4. Look for impact hotspots to inform decision-making.

To change the fats and oils system in the most impactful way, it's crucial to understand the whole food system. That starts with putting data into context. For example, globally, soy is responsible for more deforestation than palm oil.(1) And some oils have much greater water and carbon emissions than others.

How fats and oils are used also matters. It's important to note that by far the largest proportion of the world's soy goes into animal feed, for instance. Similarly, given that oils and fats are critical to the human diet and that palm is the dominant cooking oil in Asia and Africa, it makes sense to prioritise palm oil substitution in other areas, such as in cosmetics.

[1] https://ec.europa.eu/environment/forests/pdf/1.%20Report%20analysis%20of%20impact.pdf

# CONCLUSION

## 5. Sustainable production is the goal.

The food sector needs to feed a growing population in a way that's nutritious, equitable and within planetary boundaries. Global demand for fats and oils is only going to increase unless we also address sustainable consumption.

Meeting this growing nutritional demand means maximising land-use efficiency and adopting regenerative agricultural practices, as well as encouraging food choices that carry a lower environmental burden. In recognition of this, Barry Callebaut and USAID have set up the Coconut and Coconut Oil Roundtable [1] to forge a more sustainable industry in the face of rising demand.

Production must be genuinely sustainable across all edible oils and fats. Otherwise, the threat of boycotting a single product could even create a disincentive for producers to take up sustainable certification. While far from perfect, the work of bodies like the RSPO needs to be supported. Palm oil is not going away overnight and neither will any other major oil, such as sunflower or rapeseed. Every sourcing decision needs to consider the full range of social and environmental issues.

## 6. Prepare for climate disruption.

Climate change is going to increase the physical, financial and transitional risks of edible fats and oils production. For most oil crops, physical impacts will adversely impact yields and nutritional quality. For example, increased aridity is predicted to reduce the oil concentration and seed yield of rapeseed crops.[2]

For animal fats like butter, dairy cows have difficulty coping with extreme heat, and increased temperatures often lead to lower milk yields, higher susceptibility to diseases and other physical problems. The full value chain, investors included, must act differently. At the moment, for example, climate risks are generally not part of financing for tropical soft commodities, such as palm oil and soy, [3] nor for meat and dairy products.

## 7. Tell the complicated truth, not a simple story.

There's no such thing as a good or a bad oil. Brands, retailers, campaigners and the media need to educate consumers about the complexity of these issues. The narrative about palm oil, for instance, is so negative that even companies who use certified sustainable palm oil won't talk about it. Conversely, companies using coconut oil sometimes overstate its benefits. Overly simplified messaging leads consumers to call for overly simplified solutions, which pressurises businesses to respond accordingly.

[1] https://www.sustainablecoconutcharter.com/

[2] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6218090/

[3] Although it is worth noting that soy is grown in both topical and temperate regions. https://orbitas.finance/2020/12/07/climate-transition-risk-survey-capital-providers-for-tropical-soft-commodities/?mc_cid=71adc1af50&mc_eid=9b0924c1b0

# YOUR ROLE IN TRANSFORMING THE EDIBLE FATS AND OILS SYSTEM

## QUESTIONS TO CONSIDER

A holistic transformation of the edible fats and oil system is essential to meet our global climate ambitions. With too much focus on single commodities, organisations risk losing sight of the real facts about fats.

Below, we've compiled a checklist of questions that helps any organisation sourcing, purchasing and using edible fats and oils to better understand how to minimise their impact.

- ○ Does your organisation have an edible fats and oils policy which helps decision-makers understand all the environmental and social risks and provide options for addressing them?
- ○ If your organisation does have such a policy, does it provide for the following sustainability considerations?
    - Strong environmental and social standards, regardless of geographic location, oil crop or end-use
    - Efficient production and closing yield gaps to save space
    - Land-use regulation to avoid unsustainable expansion
    - Partial future replacement by alternatives that require less land, such as single cell oils.
- ○ With no such thing as good or bad oil, substituting one for another isn't straightforward. What research and analysis do you conduct before switching oils?
- ○ Do you track impact hotspots to inform your choice of edible fats and oils? How?
- ○ How do you track the various risks of fats and oils production?
- ○ Are you planning for climate disruption to your supply chain?
- ○ What proportion of the edible fats and oils your company uses is sustainably produced?
- ○ Are you working with suppliers, customers and other organisations to understand and mitigate the system's complex web of risks ?
- ○ How does the sustainability of the fats and oils you use relate to your overall product portfolio? Does it support or undermine your work elsewhere?
- ○ How do you communicate the truth about edible fats and oils to your consumers? It's not a simple story, and as corporate citizens you have a responsibility to tell the truth, however complicated.

If you find it difficult to answer the questions in our checklist above, you're not alone.

What's important is to understand the system and find solutions to make it as environmentally and socially sustainable as possible.

We're looking for leaders to continue pushing for change in the edible fats and oils system. If you'd like to be involved, get in touch with us at v.toledo@forumforthefuture.org

PART 4. CONCLUSION AND CALL TO ACTION

# NEXT STEPS

To help companies work together and accelerate change in this space, we formed the Edible Fats and Oils Collaboration.

We are looking for more ambitious and pioneering collaborators to help us make the fats and oils sector more sustainable.

Help us navigate the way forward

Demonstrate leadership and innovation while influencing the shifting dialogue on fats and oils. Joining the Edible Fats and Oils collaboration gives you the opportunity to build relationships with others who are working on this issue, and will help you foster greater collaboration with your value chain.

**For more information, visit:**
**www.forumforthefuture.org/edible-fats-and-oils-collaboration**

**To get in touch with us, please contact**
**v.toledo@forumforthefuture.org**

# EDIBLE FATS AND OILS STEERING GROUP

The Edible Fats and Oils collaboration is founded by the following organisations, who commissioned and shaped this report:

This report was written by the following Forum for the Future team members: Ivana Gazibara, Karen Sim, Maria Powazka Samuel Smith, Sarah Tulej, Sophie Robins, Vicky Gerrard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# APPENDIX

# METHODOLOGY

The data and insights contained in this report are the result of desk-based research and interviews with experts who work across the global fats and oils industry.

Our interviewees, contacted between 2019 and 2021, include academics and scientists, nutrition experts, policy experts, NGO representatives and consultants involved in sustainable palm and soy initiatives, palm oil traders, and representatives of food companies involved in manufacturing, retail and food service.

Below is an overview of how we gathered and used data for this report:

## Nutritional information

To ensure the information in the nutrition section was balanced and widely accepted by the scientific community, we consulted with nutritionists.

Figures provided on fatty acid profiles are drawn from McCance & Widdowson's Composition of Foods Integrated Dataset (CoF IDS) the United States Department of Agriculture (USDA).

## Functionality information

To understand the variety of ways that fats and oils can be used in food production, we consulted with our project steering group members, supplementing their responses with desk-based research where needed.

## Environmental impacts data

There is a dearth of free, publicly available data on the environmental life-cycle impacts or production and consumption of fats and oils. This lack of access to comparable information is one factor hindering balanced decision-making on edible fats and oils sourcing.

It is our hope that, by publishing the information we've gathered through this project, others will highlight new sources of information or make existing data openly available, helping paint a more vivid picture of edible fats' and oils' sustainability.

We've only included figures on environmental impacts where directly comparable data is available.

We were able to find comparable LCA data via Poore et al., Science (2018) for five of the nine oils and fats we profile: soybean, palm, sunflower, rapeseed, and olive.

# METHODOLOGY

Poore et al derived data from a comprehensive meta-analysis that identified 1,530 studies for potential inclusion, supplemented by additional data from 139 authors.

Their study calculated impacts from crop production through to retail for a large range of food products, including five of the oils within our report.

We highlight three specific metrics drawn from Poore et al:

- Freshwater withdrawals (litres per litre oil)
- Land usage (m2 per litre)
- GHG emissions (kg CO2 equivalent per litre)

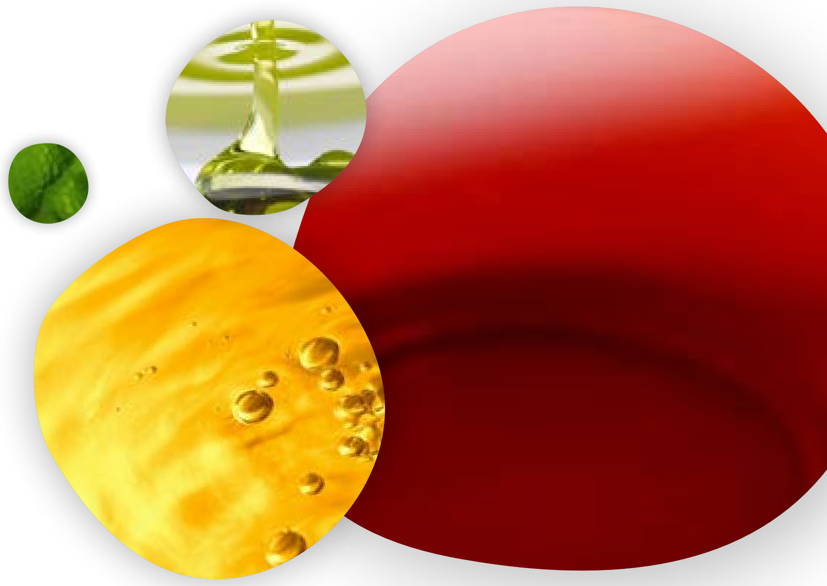
The methods used for calculating each of the above impacts is explained in the supplementary material to Poore et al, 2018.

The water usage, land usage and GHG emissions (per kg) for butter were drawn from Liao X, Gerichhausen MJW, Bengoa X, et al, Int J Life Cycle Assess 25, 1043–1058 (2020).

Their study covers the full life cycle of products with a cradle-to-grave approach that includes all necessary steps production and transportation of dairy butters.

We confirmed with one of the authors of the two studies listed above (Joseph Poore, Oxford University) that the methodologies used in both studies were similar enough for us to compare them in a meaningful way.

We were unable to find comparable data for cottonseed oil, coconut oil and groundnut oil.



# SCOPE

In the report, we present different data points on nine major vegetable oils and animal fats:

- **Palm oil**
- **Sunflower oil**
- **Groundnut oil**
- **Soybean oil**
- **Olive oil**
- **Cottonseed oil**
- **Rapeseed oil**
- **Coconut oil**
- **Butter and Ghee**

These oils plus butter and ghee were chosen because they're used extensively in industrial and domestic food production around the world. They represent the largest sources of edible fats by production volume and, therefore, depending on how they're produced, sourced and used, have the greatest potential to drive change towards or away from a more sustainable food system.

We shine a particularly bright light on palm oil. It's by far the world's most widely produced and consumed oil crop, while also being highly scrutinised for its links to environmental destruction and human rights abuses. With food companies looking to other ingredients to potentially replace palm oil, we focused on the oils most likely to be considered as its replacement.

A major reason that many of these fats and oils are so dominant in the market is because the crops they derive from provide multiple uses beyond food – for example, in biofuels, animal feed, cosmetics, chemicals, and textiles (cotton).

In some cases, these other uses have given rise to an oil's prominence in the food chain. Transforming the sector requires alignment between food and non-food players. While we recognise this, to keep the scope of the report reasonably bounded - and because the use of fats and oils in food is a critical nexus for environmental, nutritional and sociopolitical issues - we have restricted our focus to edible oils and fats only.

## Animal fats - butter and ghee

We have included butter and ghee, an animal fat, because it's an important source of fat in food production with a significant environmental footprint. As an ingredient, it's used interchangeably with many vegetable oils and animal fats. To not include butter and ghee would, we felt, give an incomplete picture of the production and consumption of edible fats and oils today.

However, the segmentation of research and data makes it difficult to compare butter and ghee against vegetable oils and other animal fats. Where possible, we've included comparable data, but this is only possible for a limited set of environmental impacts.

## Minor or speciality oils

There's an array of minor and speciality oils and fats, such as shea butter, safflower oil and flaxseed oil, that are also in use. Some of these are increasing in popularity in certain food products.

We've excluded these from this report because they're currently used in extremely small quantities and because it's almost impossible to find comparable data on their sustainability impacts.

We have, however, investigated the potential of novel oils from algae, yeast, coffee and insects due to the significant investment in research and development of potential possible alternatives to edible oils.