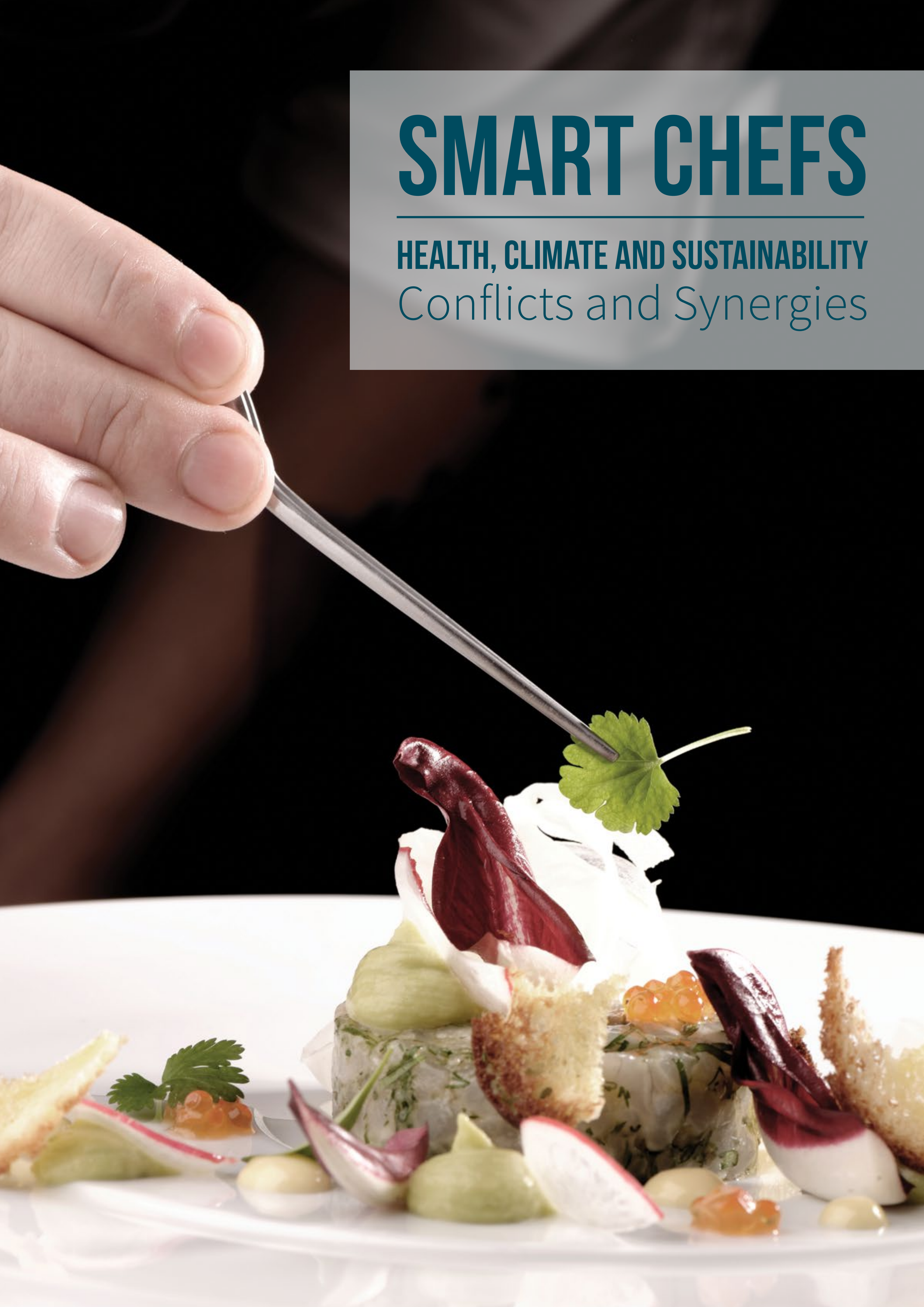
SMART CHEFS

HEALTH, CLIMATE AND SUSTAINABILITY
Conflicts and Synergies



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We thank our scientific partners, scientific advisory board, all experts and stakeholders who have contributed with their time and expertise to help in reflecting the scientific status quo.

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The information in this material was thoroughly researched and carefully selected. It does not imply to express the exact opinions of all who have contributed.

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SMART CHEFS

Our food supply chain triggers 1/3 of all of the world's greenhouse gas emissions. No advancement in transportation and no energy revolution meets the potential to slow down global warming like the awareness for smart food choices. The most impactful answers to the Paris Climate Accord are hidden in our refrigerators; and not in our garages or heating systems.

If every Swiss was to eat climate-friendly 3 times per week, the impact on greenhouse gas emissions would equal 750.000 cars less on Swiss streets. The current output of every Swiss' eating habits are around 3 Tons of CO_2 per year. The food choices of the entire Swiss population combined cause enough carbon emissions to fill the Hallenstadion in Zurich 42'000 times. If we were to build a bridge with this amount of arenas, it would span from Zurich to Chicago; every year anew.

With educated, seasonal and regional food choices we can reduce this impact by more than 50%. Food is the most efficient way to reduce greenhouse gas emissions and reach the goal of maximum global warming of 2 degrees, set by the Paris Climate Accord.

Agriculture is currently facing challenges that are deeply interwoven with climate change. Yields of important staple crops are expected to drop by 20%. Deforestation, biodiversity loss, land degradation and the use of scarce water are despite short-term gains further reducing the earth's capacity to grow enough food. Yet the demand for food is constantly on the rise. The world's population is expected to increase by 20% in the coming 30 years. With 40% of the world's land already covered by agriculture our current food supply is under distress. Each individual has the power to support a sustainable agriculture and currently the world's population does not yet meet this goal. If everyone lived like a Swiss person, we would need 3 planets to sustain us. For India it is less than one planet but for Australia it's 5.

If every Swiss was to eat climate-friendly 3 times per week, the impact on greenhouse gas emissions would equal 750.000 cars less on Swiss streets.

The good news is that the transition to a more sustainable food supply system is easy and it goes hand in hand with public health. To this day obesity, cardiovascular diseases, cancer and diabetes account for 70% of all deaths in Europe. Despite an over-supply of food we are suffering a high amount of disease. However, eating according to health recommendations will already reduce our climate impact by up to 35%.

Eaternity has developed indicators for health, land-use change, good animal treatment, seasonality and the water footprint to help the food service industry with making smart choices. In combination with Eaternity's Carbon Footprint tool we found significant conflicts and promising synergies between these indicators.

With eating-out on the rise in a modern society, the food service industry is facing a key-role, contributing to a sustainable agriculture and public health. Eaternity provides tools for smart chefs to measure, track and reduce the environmental impact of their restaurants and reduce disease risk along the way. By accessing our data solely by pushing a button, chefs are given what's needed to make smart choices. Large caterers and canteen operators have already signed on to Eaternity, taking on the challenge of reducing food related CO_2 emissions and contributing to a healthier society. The best among these food service establishments will be awarded the first ever climate-, health- and environmental Eaternity Award in 2018.

On the following pages we present the conflicts and the synergies we found between climate, health and sustainability. And we aim at explaining the science that builds the foundation for Eaternity's Climate Score, the Vita Score and the Organic Footprint.

J. Ellens
Head of Science
Eaternity

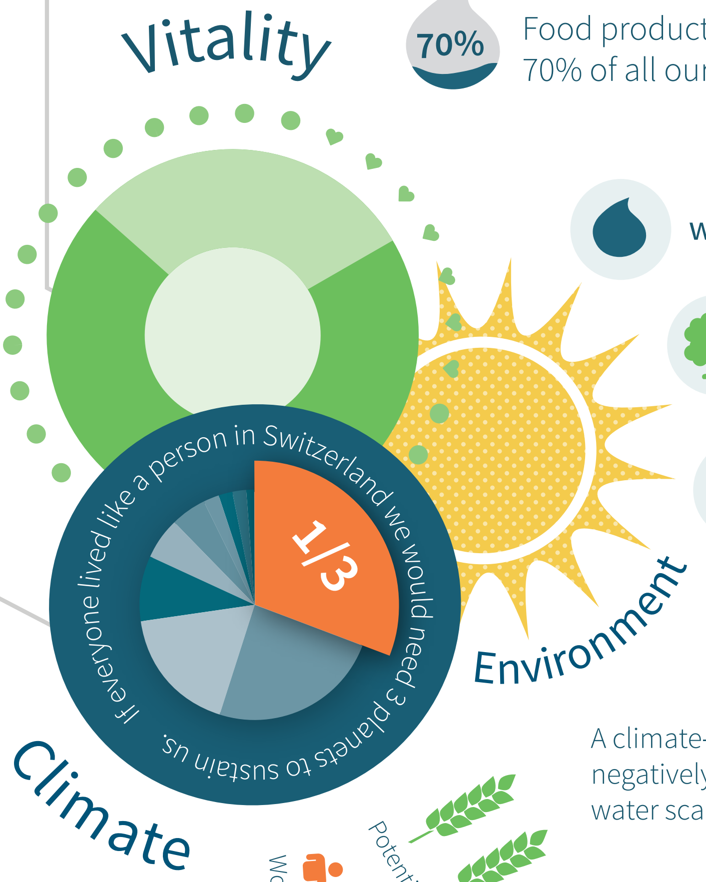
1/3

1/3 of our carbon footprint is connected to the food supply chain. This is more than all of the world's transportation.

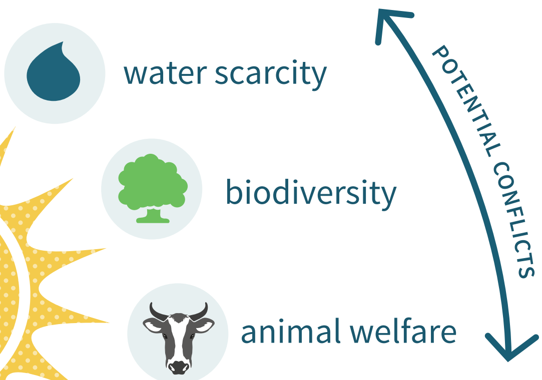
70%

In Europe obesity, cardiovascular diseases, cancer and diabetes account for 70% of all deaths.

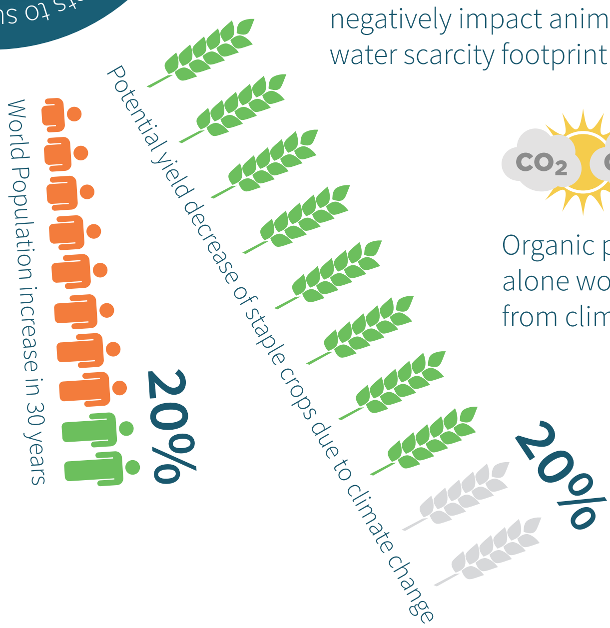
Only 10% of meals analyzed by Eaternity are mutually healthy and climate-friendly.



Food production triggers 70% of all our fresh water use.



A climate-friendly meal may still negatively impact animal welfare, the water scarcity footprint and biodiversity.



CO_2 CO_2

Organic produce alone won't safe us from climate change.

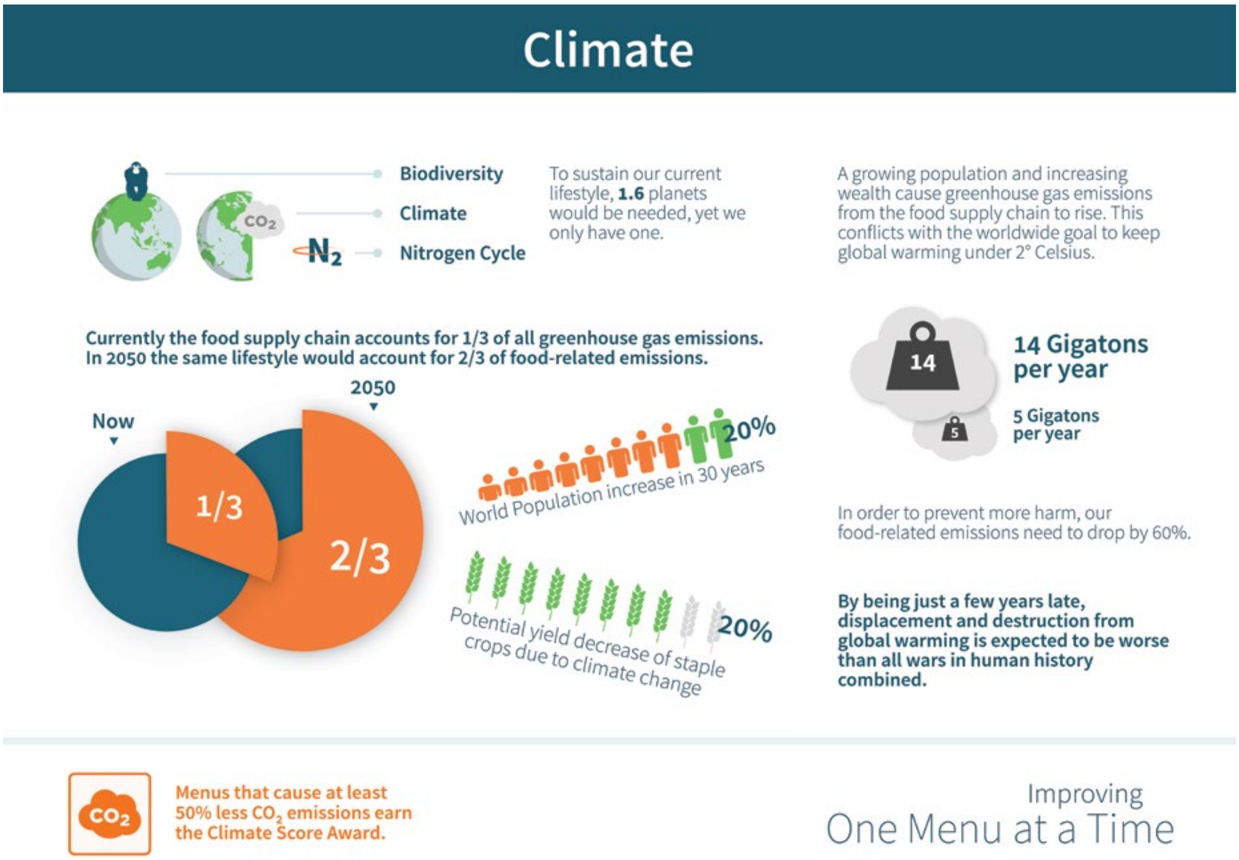
FOOD AND CLIMATE

1.1 THE RISK OF CLIMATE CHANGE

Extreme weather events like heavy rain, hurricanes, heat waves and droughts are amplified in frequency and severity by climate change, just like mudslides, melting permafrost, acidification of the oceans, the loss of plant and animal species, the spread of disease, yield drops, and increasing water scarcity[5,7,8]. Polar ice caps and alpine glaciers are melting at a rapid pace, which causes sea levels to rise. The flooding and the erosion of islands and coastal areas is the result. Climate change is not an event in the future. It's literally happening right now.

Human activities are responsible for the rise in temperature[7]. Greenhouse gases like carbon dioxide, methane and nitrous oxide are released to the air by the burning of fossil fuels and agricultural practices. Greenhouse gases trap the heat from the sun into the earth's system. Apart from the temperature going up, also the circulation and distribution of water around the earth is changing as well as many other factors impacting our lives and how we can inhabit this planet.

Global average temperature is increasing at an unprecedented rate. It has increased by 0.8 degrees since the 19th century, but most warming has occurred in the



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last three decades with roughly 0.2 degrees per decade[9]. As heat is not evenly distributed, northern regions heat up much faster than other regions. In August 2017 the first tanker crossed the Arctic without an icebreaker. And this is just the tip of the iceberg.

The higher we allow the global temperature to rise, the higher the price we pay will be. There are worldwide efforts made to keep the rising temperatures within limits. At the Paris climate conference in 2015 a global agreement was reached to keep global warming below 2 degrees. These efforts are not going to prevent us from any damage. They only aim at keeping the consequences manageable for humankind.

1.2 THE IMPACT OF FOOD PRODUCTION ON CLIMATE

1/3 of global greenhouse emissions are related to the food supply chain[10,11]. How and what we eat contributes more to global warming than the world's shipping and transportation industry[12].

Over 80% of emissions caused by our food supply incur at production[11], with the most important contributors being deforestation (38%), peat degradation (11%) and direct emissions from agriculture (50%) of which most are related to livestock, fertilizer and manure management and rice production[13]. The exact contribution of different sources of greenhouse gas emissions in agriculture are shown in figure 1.1.

In agriculture, the greenhouse gases methane and nitrous oxide play an important role (see figure 1.2). Compared to carbon dioxide, methane has a 28-fold and nitrous oxide a 265-fold stronger impact on global warming. Methane is produced by microorganisms in the stomach of cows and sheep. They support the ruminant's digestion. This process is called enteric fermentation. But methane emissions also originate in rice paddies, where waterlogged soil supports rapid bacteria growth. These bacteria produce methane. Nitrous oxide is related to synthetic and organic fertilizer use and manure management. Fertilizer that is not absorbed by plants

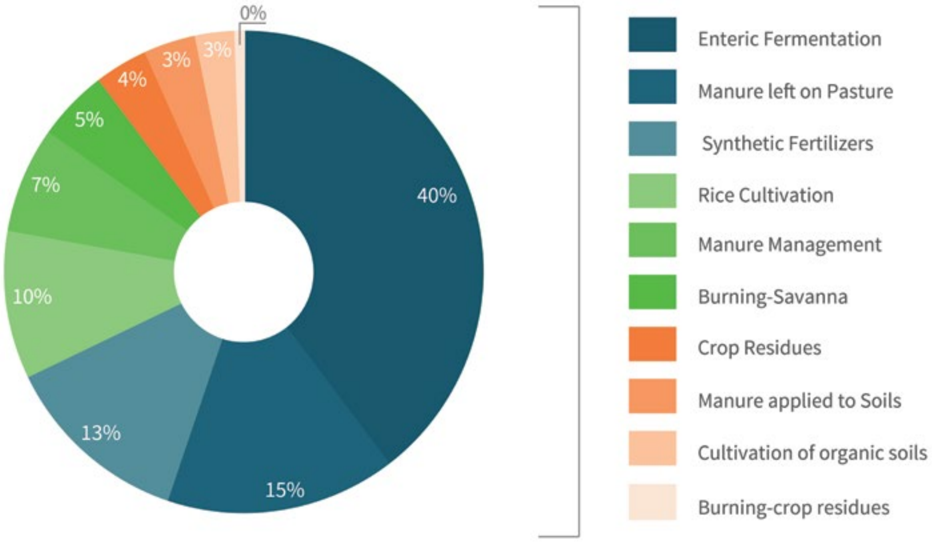


FIGURE 1.1
Contribution of different sources to worldwide emissions from agriculture[13].

is either washed out by rainfall or turned into nitrous oxide by bacteria and released into the atmosphere. CO_2 is emitted when fossile energy is used to produce synthetic fertilizers when machines work the land. Also clear-cutting forests to obtain farm land releases large amounts of CO_2.

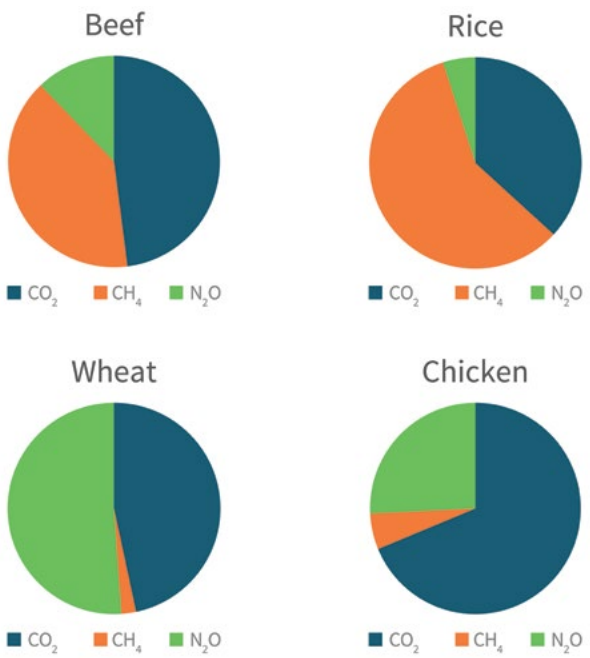


FIGURE 1.2
Food products and the relative amounts of different greenhouse gas emissions caused by their production. Methane and nitrous oxide play an important role. The impact on global warming of methane and nitrous oxide is 28-fold and 265-fold stronger than the impact of carbon dioxid[9].

1.3 MEASURING THE CARBON FOOTPRINT

The carbon footprint of a food is measured with a life cycle assessment (LCA). It is a systematic and quantitative analysis of the environmental impact of every single life stage of a product. LCAs account for transparency and comparability between the impacts of different life stages such as production, handling, transportation, storage and disposal as well as between the impacts different products. Life cycle assessments can thus support us in decision-making by showing which life stages, processes and products have a lower carbon footprint.

All greenhouse gases related to the production of food are expressed in CO_2-equivalents. This means that all greenhouse emissions are converted into the amount of carbon dioxide with a similar climate impact. In general, when we talk about CO_2-emissions we actually refer to CO_2-equivalent emissions.

An example of an LCA on pork meat is given in figure 1.3. Feed production and pig rearing account for more than 80% of the total carbon footprint[14].

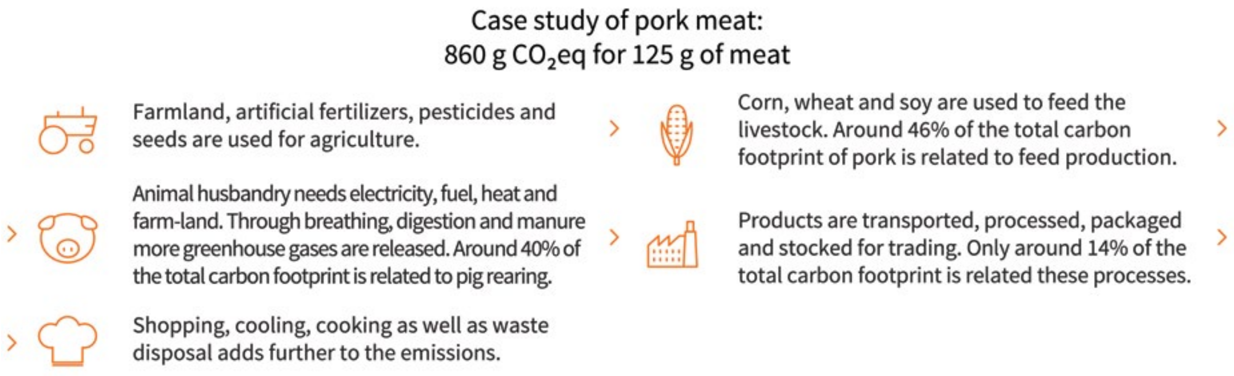


FIGURE 1.3
The carbon footprint of pork and the relative contributions of different life stages to the total footprint. Feed production and pig rearing account for more than 80% of the total carbon footprint[9].

1.4 A COMPARISON OF FOOD PRODUCTS

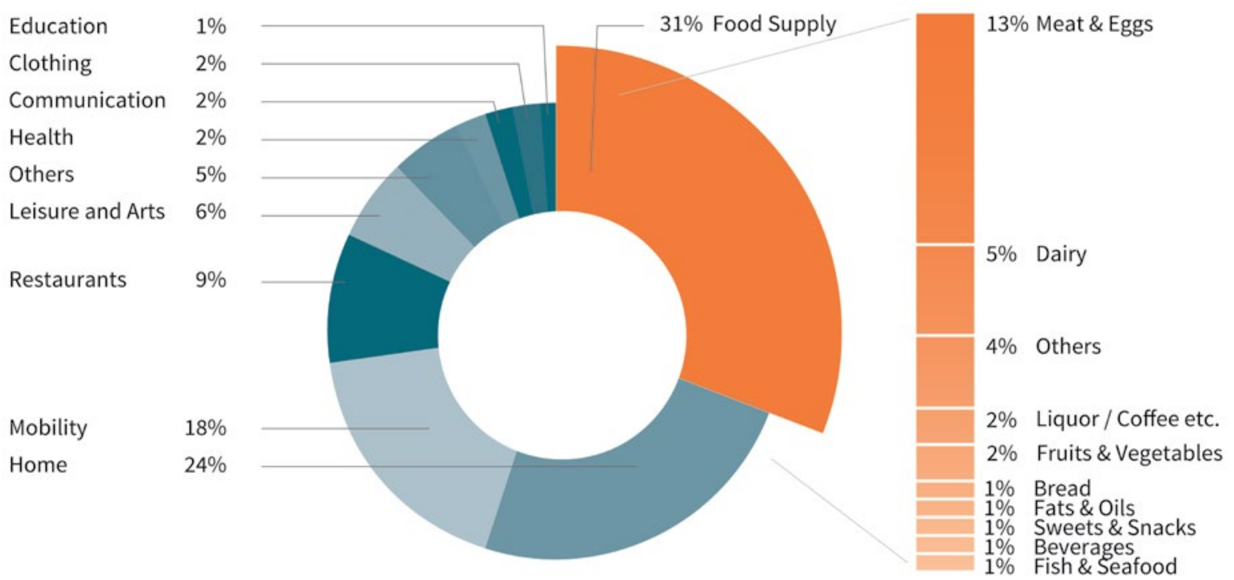


FIGURE 1.4
Emissions caused by production and consumption. More than 60% of food related emissions come from meat, fish and diary products[10].

More than 60% of all emissions related to food production and consumption come from meat and diary products[10]. In general, animal products have a high carbon footprint. To produce meat, feed needs to be produced first. The production of meat and milk products is not most efficient. On average 18 kg of plant protein is needed to raise 1 kg of animal meat protein[15]. In addition, ruminants such as cows and sheep produce large amounts of methane that has a strong impact on climate. Also most milk products have a high carbon footprint. Cream and cheese need several liters of milk to be produced and this increases the carbon footprint[16]. Plant foods such as grains and vegetables have in general a low carbon footprint as relatively little resources are needed to produce them. However, heated greenhouses and air transportation can significantly increase the carbon footprint of plant products (see figure 1.5).

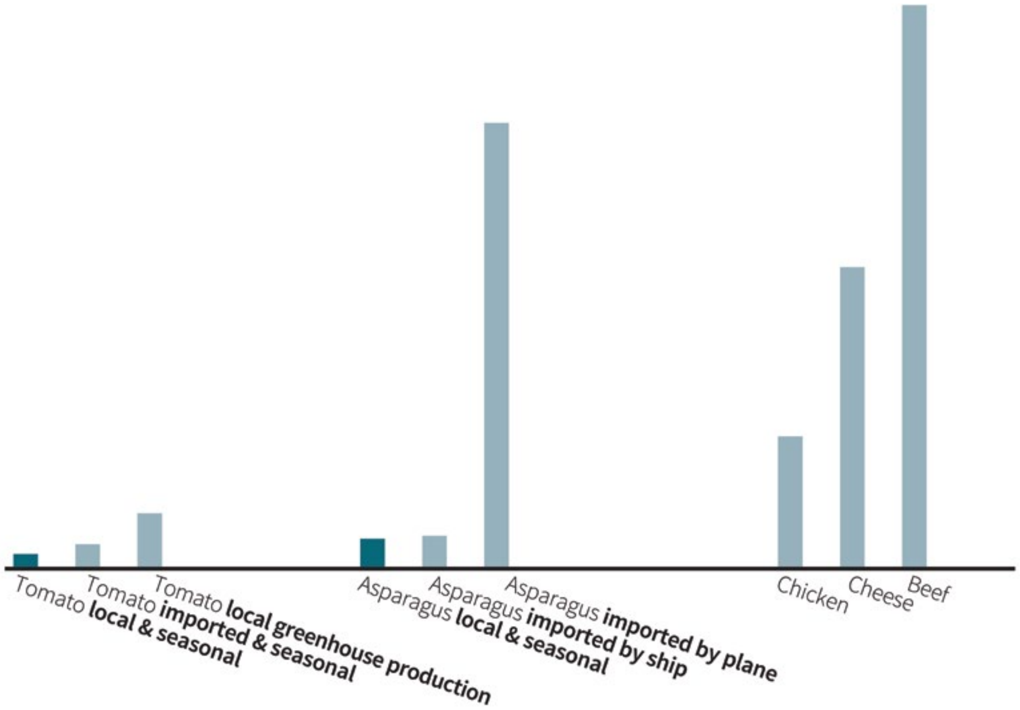


FIGURE 1.5
Comparison of the carbon footprint of different food products. Animal food products have a high carbon footprint compared to plant food products. Heated greenhouses and air transportation can however significantly increase the carbon footprint of plant foods[9].

1.5 FOOD CHOICES MATTER

Educated food choices have the potential to reduce carbon emissions of the food supply chain by at least 50%. The world's increasing population and the development of wealth combined lead to a rise in demand for food. The demand for meat and diary will

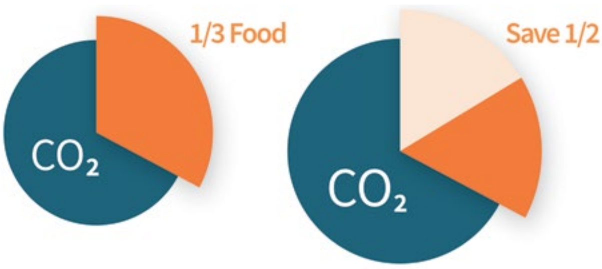


FIGURE 1.6
Smart food choices can reduce food related emissions by at least 50%[9].

increase by 75% and 65% respectively[3]. With current trends proceeding the entire carbon budget of the world will be food related by 2050[14]. Food therefore is at the core of meeting the goal of keeping global warming below 2 degrees[3,4,6].

Everyone understands that the world will not turn vegetarian entirely. There's even a case to be made for animal protein raised on steep alpine hills not suitable for vegetable farming. However, the awareness for the substantial environmental cost of animal protein is important, so everyone can make their contribution with a healthy ratio between animal protein and plant protein.

To reduce our climate impact the most important food decisions are:

Product choice:
Consider a higher ratio of plant-based products vs. animal products

Seasonality:
Choose fresh produce and avoid greenhouse vegetables

Origin:
Avoid air transportation and favor short distances

1.6 THE EATERNITY DATABASE (EDB) - A SOLID SCIENTIFIC BASIS

Since 2009 Eaternity built a solid, comprehensive and peer-reviewed CO_2-database on food items, the Eaternity Database (EDB). It forms the firm backbone of all the calculations carried out by Eaternity. With the EDB we maintain and advance the best scientific foundation for assessing the environmental impact of food.

The database is currently the largest and most comprehensive database for carrying out menu CO_2-calculations. It includes more than 550 core ingredients and additional parameters for organic or greenhouse production, origin and transportation, processing and preservation. Calculations include emissions of the complete supply chain from farm till kitchen. In addition to CO_2eq values the EDB contains nutritional values and allergen information for all the products.

Eaternity's work on life-cycle assessments is done closely with renowned scientists in the field.

Main contributors are scientists from the Zurich University of applied Science (ZHAW), Quantis – World Food Database, University of Zürich (UZH), Swiss Federal Institute of Technology in Zurich (ETHZ), Research Institute of Organic Agriculture (FiBL) as well as others.

To assure high data quality, comparability and comprehensiveness we:

- regularly update our data to latest research findings
- harmonize data from different sources (adjust assumptions and system borders)
- carry out further research and finance research
- assign yearly an acknowledged scientific review partner that reviews and optimizes our data
- collaborate with scientific institutions and share detailed data with researchers

With the EDB we want contribute to scientific research and enhance sustainable food choices. By sharing our findings and fostering exchange we can accelerate progress in research and jointly increase our impact.

1.7 EATERNITY

Eaternity has a big appetite for change: We establish climate friendly meals in society. Eaternity has developed an innovative so ware for restaurants to track, measure and improve the CO_2-footprint of all their meals and purchases automatically. Anyone can check on their personal CO_2 emissions related to food in Eaternity's public web-app.

The food service industry is an important game changer. They take on a key-role in climate change. This is the reason why we focus on developing the best solution to make environmental information accessible to chefs in all the segments of the food service industry.

Major food service businesses and restaurants have already joined in the challenge to reduce food related CO_2 emissions. They serve meals that have the Eaternity Award and with the Eaternity Reports they track and improve the impact of the monthly purchases.

EATERNITY AWARD

Meals are granted climate-friendly status if they belong to the top 20% of all meals being served (currently 76'034 in our database). A climate friendly meal has at least 50% LESS CO_2 emissions then the average meal.

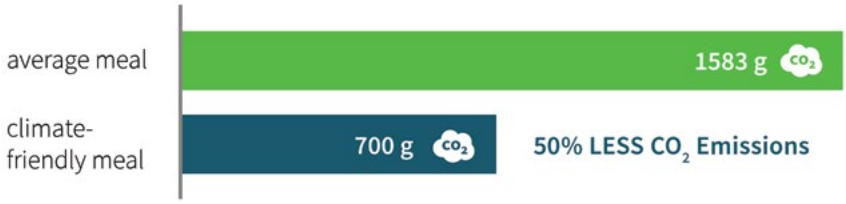


FIGURE 1.7

EATERNITY REPORTS

With a monthly report restaurants are informed on their progress and how they are doing in comparison to others. Carbon emissions are calculated dynamically in real time, including statistics of imports, transportation distances, and seasonalities.

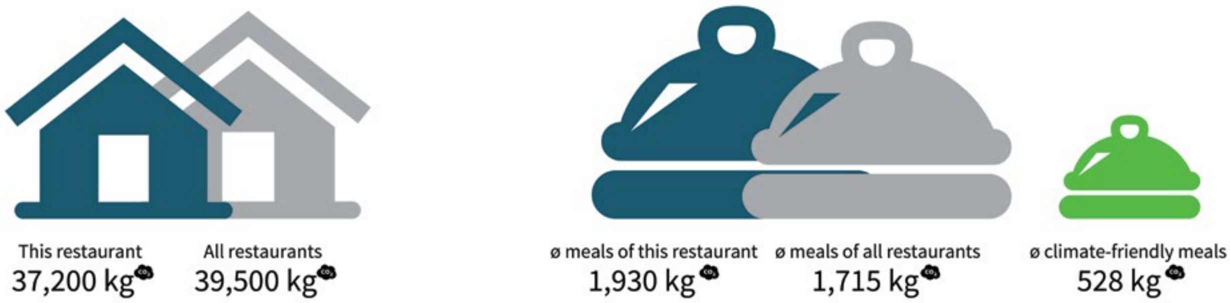


FIGURE 1.8

ORGANICS AND THE ENVIRONMENT

2.1 MAIN LEARNINGS OF THE ORGANIC FOOTPRINT PROJECT

- The most important indicators to assess the environmental impacts of our food are animal welfare, biodiversity loss, carbon footprint, land use, the oversupply of nutrients, soil fertility, toxic pollution, tropical deforestation and water use.
- Organic products improve animal welfare and avoid tropical deforestation, but can increase the carbon footprint per kg of product. This is especially true for meat products.
- We can still improve our climate impact while choosing organic products, as the most important choices to reduce emissions are eating more seasonal plant-based products.
- Basing decisions only on the carbon footprint of products may still lead to tropical deforestation and conflict with animal welfare and water scarcity.
- Food choices that reduce the carbon footprint of meals also reduce land use and the amount of nutrients brought into the environment.
- Organic production often needs more land to produce the same amount of food, but stating that it therefore has a negative impact on land use is too simple. Using more land can also have positive long-term impacts that need to be accounted for when evaluating land use.
- With the methods currently available for biodiversity, soil fertility and toxic pollution, no final conclusions can yet be drawn about which food products have the lowest environmental impacts. Biodiversity impacts though are strongly influenced by the other environmental factors we can account for.
- To make environmentally sound decisions animal welfare, tropical rainforest deforestation and water scarcity should be considered in addition to the carbon footprint. Animal welfare and tropical deforestation are well covered by organic labels.

2.2 MOTIVATION OF THE ORGANIC FOOTPRINT PROJECT

Our food system is in crisis. We are in need to find better ways to produce enough food and consumption plays a critical role in reducing the environmental impacts of agriculture.

Organic production aims to reduce the environmental impacts of agriculture. It suggests an answer and is a promising starting point to improve production practices and reduce the environmental impact of our food.

In the Organic Footprint Project we investigated and compared the environmental impacts of foods that were produced under organic and non-organic production standards. We further investigated the overlap and conflicts between different environmental indicators caused by certain food choices. The aim of the project was to come with an easy, but complete set of recommendations to improve the environmental footprint of our food.

Main questions that guided us through the project were:
- Is organic production better for the climate?
- Which measurable advantages does organic production have over non-organic production?
- Does a reduction in climate impact also reduce the impact of other important environmental indicators?

The results of the Organic Footprint Project reflect the current scientific status quo on what we currently can measure. The scientific advisory board of the project as well as leading experts provided us with many valuable contributions.

As a consequence of the project, Eaternity included additional indicators for water scarcity, tropical deforestation and animal welfare into the Eaternity App.

2.3 WHAT EXPERTS WANT US TO LOOK AT

The multiple negative impacts of our food production system call for action. Due to system complexity it is impossible for one person to oversee all the consequences of his or her choices. This asks for proper tools that create transparency and simplify decision-making by focussing on the most important environmental indicators.

Our negative impacts on climate, biodiversity and the nitrogen cycle already exceeded the safe limits of our planet[1]. This means we are irreversibly changing our environment. All three are strongly related to agriculture.

During an expert and stakeholder workshop organized by Eaternity in November 2016 in total 9 indicators listed in table 2.1 got the highest approval as being the most important indicators for measuring the impacts of agriculture: carbon footprint, water use, land use, aquatic eutrophication, toxic pollution (ecotoxicity), soil fertility, biodiversity, conservation of tropical rainforest and animal welfare. It strengthened us in the view that climate impact is one of the most important indicators, but that the other impacts cannot be ignored either.

In the scientific community there is no final agreement yet on how to measure biodiversity, ecotoxicity and soil fertility (see also below). Quantifiable methods are still under discussion and high quality data is missing. We therefore chose not to focus on these indicators in this study, but urge for further research on these indicators and the improvement of data. For the same reason we did not analyze the overlap between climate impact, biodiversity, ecotoxicity and soil fertility.

Several studies that have analyzed biodiversity could however show that an increase in the environmental impact of the most important indicators lead to biodiversity loss as well. We are therefore confident

Table 2.1. The most important indicators to evaluate the environmental impact of meals. For every indicator we assessed if in general methods to calculate the impact exist, are sufficiently developed and if enough data is available to compare the impacts of organic and conventional agriculture.

Most important indicators	Carbon footprint	Water use	Land use	Aquatic Eutrophication[a] (nutrients oversupply)	Ecotoxicity[b] (toxic pollution)	Soil fertility	Biodiversity	Conservation of tropical rainforest	Animal welfare
Can impacts be calculated?	Yes	Yes	Yes	Yes	Yes	No	(No)[f]	(Yes)[g]	(Yes)[g]
Comparison organic/ conventional possible?	Yes	No[c]	Yes	(Yes)[d]	(No)[e]	No	No	(Yes)[g]	(Yes)[g]

a The oversupply of nutrients reduces the water quality of lakes and rivers. It disturbs the fine natural balance of plants and animals living in the water and can lead to habitat loss of certain animals.

b Toxic chemicals harm animals and plants. The chemicals either kill organism or disturb their mobility or reproduction.

c Not enough data available.

d There are uncertainties, but they are not expected to change conclusions obtained in this project.

e Calculations possible except for heavy metals. The cycling of heavy metals in organic agriculture is difficult to model due to lack of data (content of heavy metal in manure is not known and may differ from conventional manure).

f Methods are still being developed.

g Only qualitative judgements possible.

that at least for biodiversity, the improvement of other environmental indicators also automatically reduces the impact on biodiversity.

For a comparison between the water use of organic and non-organic production sufficient data is currently lacking. We did however run a first analysis on the potential overlap and conflict between climate impact and water scarcity in general.

Based on the estimation of experts and the current data availability we focused in this study on the comparison, overlap and conflicts between climate impact, water use, land use, eutrophication, animal welfare and tropical deforestation.

BIODIVERSITY

Biodiversity refers to the variability of life on earth. Many services provided to us by nature depend on this variety of species. The loss of species makes ecosystems less healthy and the ability of nature to provide us with different services is lost. Services that nature provides us are for example clean drinking water, pollination, food, soil formation and protection, pollution breakdown and absorption and climate stability. Agriculture reduces biodiversity through land use changes, overexploitation and pollution.

Today we lose species at an alarming rate. It is estimated to be about 1000 times higher than would occur when humans were not around[17]. On average, the number of mammals, birds, reptiles, amphibians and fish are estimated to have dropped by half within the last 40 years[18]. Calculating and approximating biodiversity loss with a general methodology is difficult. There are many stressors that act simultaneously and they all need to be understood and accounted for. Methods have been suggested to quantify separately the impacts of land use, nutrient oversupply and water scarcity on biodiversity[19,20], but no generally accepted method exist yet to combine the stressors or to compare organic and conventional agriculture. As a consequence, we cannot sufficiently compare the impact of organic and conventional agriculture on biodiversity yet. One meta-analysis showed that organic farming can have benefits for biodiversity, but the impacts also depend on other factors than the farming systems itself. For example, field margins, hedges, natural pastures and ponds on the farm and in the surrounding landscape form important refugee habitats for many species[21].

SOIL FERTILITY

Fertile soils are the fundament to grow food and are a non-renewable resource[22]. Once fertile soil is lost it takes many years, longer than a humans lifespan, to recover. One-third of the world arable land is severely degraded because of unsuitable farming practices[23]. Fertile soils have enough nutrients, no pollutants, have a good soil structure and show high biological activity. Good farming practices such as avoiding bare soils or reduced tilling help to maintain soil fertility. Research is still ongoing on how to best maintain soil fertility and how to measure it. A longterm study in Switzerland showed benefits of organic agriculture on microbial activity, while other soil parameters were similar like in the conventional farming[24].

ECOTOXICITY

Toxic chemicals harm animals and plants. They disturb their mobility, their reproduction and increase their mortality. Both natural or synthetic chemicals can be toxic[25]. Farmers have to protect their crops against fungi, insects, and weeds, and one method is to use chemicals. However, those pesticides are also toxic for other organisms that we want to protect. Scientific methods are quite good to judge the effects of synthetic chemicals on the environment. In contrast, the toxic impacts of heavy metals are still more difficult to judge.

Organic agriculture is very restrictive in using chemicals for protecting the crops. It is expected that organic farming causes lower ecotoxicity when looking only at pesticides, even though organic agriculture uses also low amounts of copper against fungi. In addition, organic farming relies mainly on manure instead of synthetic fertilizers to fertilize the fields. Manure contains heavy metals. Data is lacking on if the heavy metal content differs between organic and conventional manure. Data on this is lacking. Therefore, it is still difficult to measure and compare the total impact of organic and conventional farming on ecotoxicity.

2.4 LABELS AND REGULATIONS OF ORGANIC PRODUCTION

Specific regulations in organic standards are key in influencing the carbon footprint.

Organic agriculture aims to reduce our environmental footprint in agriculture. It provides a real alternative to the conventional agricultural system. Conventional agriculture tries to maximize yield at the lowest possible costs. It follows the minimum environmental regulations that are given by national governments. Nothing more, nothing less. In Switzerland national environmental regulations for agriculture are more strict than those in other countries. The standard agricultural production type in Switzerland is „integrated production". It addresses similar concerns like organic agriculture but actions are less strict[26].

However, also organic systems need to operate economically. In contrast to conventional agriculture they try at the same time to minimize the environmental impact and to operate as naturally as possible. Organic production has environmental regulations that come on top of the national regulations. Most common regulations in organic production are listed in table 2.2 and mainly have to do with the use of artificial substances, soil management and raising animals.

There are different organic certifications systems and labels. Although all share the same vision they can be different in their exact regulations and be less or more strict on certain measures. Bio Suisse requires for example that at least 90% of the feed for cattle consists of roughage, while in EU Organic only 60% are required. We analyzed and compared the regulations of 5 different and wide-spread organic certification systems (BioSuisse (Switzerland), EU Organic, UK soil association, USDA oranic (US), Produto Organico Brasil (BR))[27].

In general, it can be said that most certifications have no regulations that specifically target the reduction of greenhouse gas emissions yet, even though there are also exceptions. For example, BioSuisse prohibits transport by plane or restricts the heating in greenhouses. Most certifications have regulations that mainly serve other purposes but also reduce carbon emissions (e.g. prohibiting tropical rainforest deforestation). In the next chapters we quantify and compare the environmental impacts of organic production with non-organic production. One of our main learnings is that the organic certification system under scope does matter and that specific regulations are key in influencing the carbon footprint.

Table 2.2. Most common regulations in organic labels. Labels differ in the amount and strictness of their regulations.

Limiting the use of	Soil management	Other regulations
Synthetic pesticides	Crop rotation	Animal welfare (see table below)
Synthetic fertilizers	Closed nutrient cycles at farm level, organic fertilisers	Protection of high conservation value areas (e.g. no tropical rainforest deforestation)
Antibiotics	Reduced tillage	
Hormones	Cover crops to avoid bare soil	
GMO		

2.5 ORGANIC ANIMAL PRODUCTS AND THEIR CLIMATE IMPACT

Organic meat can be worse for climate, but is better for animal welfare.

In our meta-analysis we reviewed existing publications that compared organic with conventional production[28]. The results showed that differences in the carbon footprint of organic and non-organic meat were potentially huge. Large variations could occur depending on specific assumptions, regulations considered, methodology, country and data-set. To get to the bottom of this we carried out life cycle assessments for beef, chicken and pork and compared organic with non-organic standard production specific for Switzerland, Germany and the UK. This is what we learnt: Organic meat can be worse for climate, but it is better for animal welfare.

2.5.1 BEEF

How cattle is raised and fed determines the CO_2-footprint of beef most.

Switzerland

Organic beef from Switzerland has an at least 50% higher carbon footprint than beef from the predominant non-organic standard production system. How cattle is raised influences the carbon footprint of the meat most[29-32].

Organic beef comes 50% from grazing and 50% from grazing suckler cow production systems, while non-organic beef is mostly produced in the more efficient standard production system, even though all productions systems can be found. As meat from grazing production systems have a higher footprint, organic meat in Switzerland has a higher footprint compared to the non-organic standard production. Exactly those measures that increase animal welfare also increase the carbon-footprint. There are three main ways to raise cattle:

1. Standard production, where animals are fed a higher share of concentrated feed and the calf is separated for fattening from the dairy mother cows. In Switzerland, the meat from this production system has the lowest carbon footprint. Standard production in Switzerland is special, as of 2016 practically all (99%) imported soy for feed was certified responsible. This means that emissions related to deforestation contribute only very little to the carbon footprint of Swiss meat.
2. Grazing production, where the animals spend most of the time on grasslands. Their feed consists mainly of natural feed and only very low amounts of concentrated feed. The calves are usually separated from the dairy mother cows. Measures that are good for animal welfare such as a high amount of natural feed instead of concentrated feed and more free space to move around makes the animal mature and fatten slower and therefore it takes longer before it reaches slaughter weight. This results in a higher carbon footprint as the animal emits more of the greenhouse gas methane during his longer lifetime. The carbon footprint is 50% higher than in the standard production system.

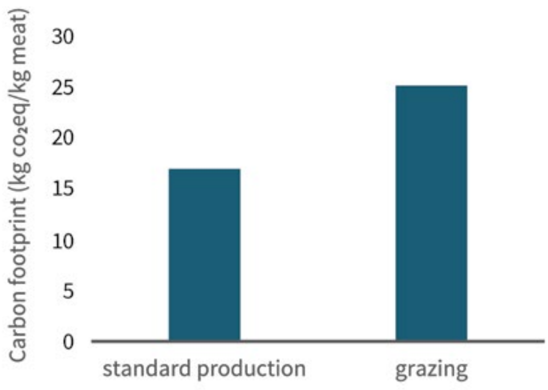


FIGURE 2.1

The carbon footprints of beef meat in Switzerland. In Switzerland, beef from grazing production has an at least 50% higher carbon footprint than beef from non-organic standard production, but animal welfare is higher in organic grazing production[30].

3. Grazing suckler cow production, where the calf stays with the mother and the milk of the mother is not used for human consumption. Like in the grazing system the animals also spend much time on grasslands and receive low amounts of concentrated feed. Beef from this production system has the highest carbon footprint. The main reason is that all production related emissions are fully allocated to the end-product meat and not partially attributed to milk.

Germany and UK

The trade-offs between animal welfare and climate impact observed for Switzerland does not necessarily translate to other countries.

In Germany organic beef from grazing production has a 12% lower carbon footprint when compared to beef from non-organic standard production. The main reason is that the feed production is very intensive and the related carbon emissions increase the carbon footprint of the non-organic standard production. For example, feeding large amounts of uncertified soy lead to carbon emissions from deforestation and increase the carbon footprint. In contrast, non-organic standard production in Switzerland uses soy that is certified responsible.

Organic beef in Germany stems 50% from grazing and 50% from suckler cow production. As explained above, beef from suckler cow production has always the highest carbon footprint compared to other productions systems. Beef from suckler cow production in Germany has a carbon footprint that is twice as high when compared to the non-organic standard production system.

Most organic beef in the UK is from suckler cow production and therefore has in general a higher carbon footprint than UK beef from non-organic standard production. Also in the UK carbon emissions related to deforestation are part of the carbon footprint of beef of non-organic standard production. Yet beef from grazing suckler cow production still has the highest carbon footprint and the highest animal welfare.

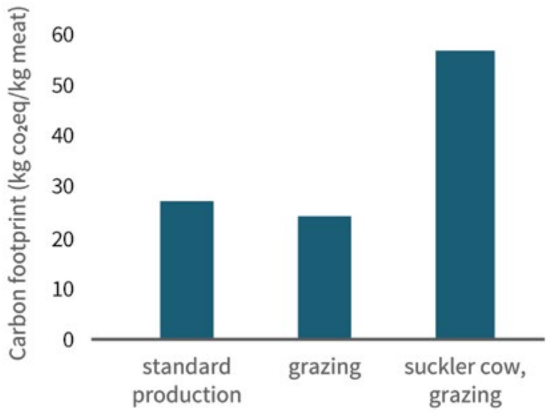


FIGURE 2.2
Carbon footprint of beef meat in Germany. Grazing suckler cow production has the highest animal welfare but also the highest carbon footprint[33, 35].

2.5.2 CHICKEN AND PORK

Switzerland

Chicken meat from organic production in Switzerland has a 45% higher carbon footprint than chicken meat from non-organic standard production in barns[32]. Organic chickens grow slower, live longer and therefore use more feed than standard chicken. This is caused as chicken breeds with unnaturally high growth hormone production are avoided and regulations that give chicken more space to run around cause them to burn more energy. However, these measures improve animal welfare. The carbon footprint of free-range chicken lies in between organic and standard production: they live longer than in standard production but less long than in organic. For this reason the carbon footprint is higher than in standard production and lower than in organic production. Again we find that there is a conflict between reducing the CO_2-impact of meat and improving the living conditions of the animal.

For organic pork, there is no conflict between animal welfare and climate impact[29]. The carbon footprint of organically and conventionally produced pig meat is similar. The reason is that similar breeds are used and slaughter age and feed intake are similar in conventional and organic production. However, animal welfare is higher under organic standards than under governmental minimum requirements. Typical measures that increase animal welfare do not influence the carbon footprint (e.g. provide a rooting box and space on the concrete area outside).

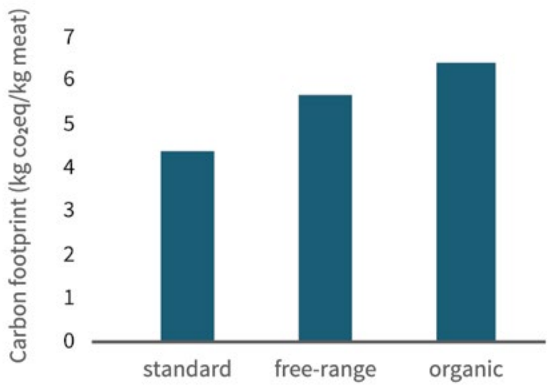


FIGURE 2.3
Carbon footprint of chicken meat in Switzerland. Chicken raised with higher animal welfare standards have a higher carbon footprint[32].

Germany

In contrast to the findings for Switzerland, the carbon footprint of organic chicken in Germany is 28% lower when compared to non-organic standard production. The main reason is that non-organic standard production[34,35] uses mostly uncertified soy. This leads to an increase in the carbon footprint caused by deforestation. In Switzerland, practically all soy used for feed is certified responsible. As in Switzerland the life time and therefore feed intake of free-range chicken in Germany lies between standard production and organic production. The free-range chicken has the highest carbon footprint because it lives longer and eats more soy than in standard production. The organic chicken live longest but eats only certified soy which reduces the carbon footprint tremendously.

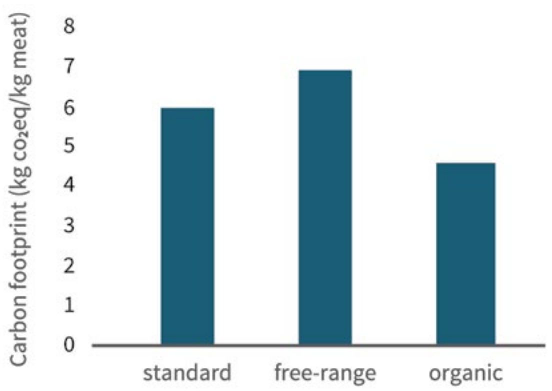


FIGURE 2.4
Carbon footprint of chicken meat in Germany. The carbon footprint and animal welfare are not always in line. Organic chicken raised with high animal welfare standards have the lowest carbon footprint[35]. However, free-range chicken have the highest carbon footprint as there are no environmental regulations on feed and more feed is needed than in non-organic standard production.

For pork we find similar results as for Switzerland. The carbon footprint of organic and non-organic pork is similar[34,35]. Pig production in the organic system have more regulations to improve animal welfare.

2.5.3 MILK

Organic milk is just as good for the climate and better for the animals.

Milk from organic and non-organic standard production has a very similar climate impact[16]. However, animal welfare under organic production standards is higher than under non-organic production standards.

The main reason for finding only slight differences in the carbon footprint of organic and non-organic milk is that the higher emissions related to the use of concentrated feed in non-organic production are reversed by a higher milk yield per cow. It is the other way around for the organic milk. The lower emissions related to the use of more roughage as feed are reversed by the lower milk yield per cow. This finding was specifically shown for Switzerland, but also our meta-analysis on peer-reviewed publications revealed that on average the differences between organic and non-organic milk are small[28]. Other measures that increase animal welfare do not influence the carbon footprint.

2.5.4 EGGS

Organic eggs are better or just as good for the climate and better for the animals.

Eggs from organic production in Germany have the lowest carbon footprint when compared to free-range and non-organic standard production[34,35]. The main reason is that emissions from deforestation are avoided in organic production as only feed from sustainable sources is used. If the emissions from deforestation are ignored, all production systems had a similar carbon footprint. The reason is that in all production systems the chickens had similar egg laying rates and similar life expectancy.

In Switzerland, practically all imported soy for feed comes from sustainable sources. Therefore, we expect that the carbon footprint of all Swiss eggs are similar. On the other hand, animal welfare is lowest in standard production and highest in organic production. In short, there is no conflict between animal welfare and carbon footprint for eggs: either the carbon footprint is similar, or the system with higher animal welfare has also a lower carbon footprint.

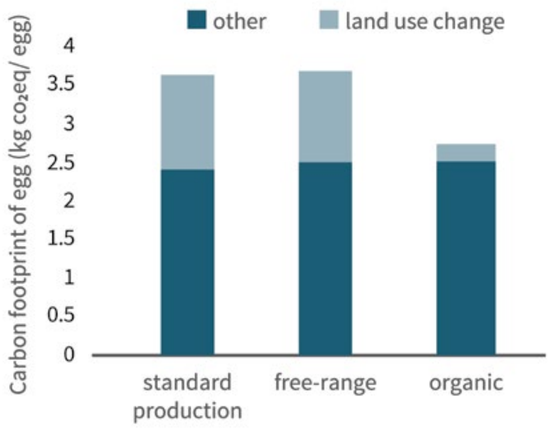


FIGURE 2.5
Carbon footprint of chicken eggs in Germany. Eggs from organic production have a lower carbon footprint and are better for animal welfare. The lower carbon footprint for eggs from organic production is explained by the absence of emissions related to deforestation caused by soy feed production. As in Switzerland practically all soy comes from sustainable sources differences in the carbon footprint between eggs from Swiss organic and Swiss conventional production are expected to be low[35].

2.5.5 ANIMAL WELFARE

Organic labels have regulations that improve animal welfare

Increasing the efficiency of meat production can improve the carbon footprint of meat, but might come at a cost for the animals, because living conditions and general treatment are less adjusted to their needs and habits. In the case of pork and milk we did not find this conflict, but in the case of beef, chicken and eggs this trade-off makes it more difficult to decide what to do.

Animal welfare in itself is a difficult topic. From a scientific perspective, it is a challenge how to exactly measure it. How do we know if the animals that we raise for their meat, milk and eggs are actually more happy and comfortable with certain living conditions? We do not know everything yet. Therefore, regulations on animal welfare are partly based on behavioural studies as well as on expert judgement.

All organic labels include regulations that aim to improve the living conditions and treatment of animals. Apart from organic labels there are also a few certifications that focus on animal welfare only. Certifications have additional regulations on top of the national minimum regulations for animal husbandry. Certain national governments set in addition financial incentives for voluntary measures that improve animal welfare[36].

Several measures are related to improve the wellbeing of animals[37]. For example, most labels have requirements on the amount of space an animal should have. Further, for swines most labels require an area where they can dig and for chickens that they can pick for grains (foraging). Also a minimum share of roughage in the feed of cows and pigs is often considered to improve animal welfare. Actions can also be taken to reduce stress situations for the animals during transport or in the slaughter house,

Table 2.3. Labels increase animal welfare with different actions. The choice and strictness of actions differ between labels.

Natural behaviour	Housing	Feed	Other actions
Activity possibilities (digging, picking)	More Space	Natural feed	breeds that improve animal welfare
Space and time to go outside	Stables with daylight	No GMO	Transportation
No tail docking, debeaking, dehorning	No fixing of animals		Slaughtering
Suckler cow raising (no seperation of the calf from the mother)			

but these are less frequently required by certifications. In general, certifications differ in their choice and strictness of animal welfare measures.

Making statements on which labels improve animal welfare most is tricky. How can we objectively judge and compare the impact of different measures on animal welfare? How do we, for example, know if it is more important for the animal to have more space or to eat more natural feed? Currently, judgements are either based on expert opinion or on a simple summation of the amount of different measures that a certain certification implements.

An objective and quantified scientific comparison of the impact of different measures on animal welfare is currently lacking. As a consumer, we do have the power to promote certain measures that we deem are more important. This requires however a transparent basis for decision-making. With the implementation of animal welfare into the Eaternity App we deliver this transparent basis for decision-making.

SWISS GOVERNMENTAL VOLUNTARY PROGRAMS

In Switzerland there are two voluntary programs that improve animal welfare called RAUS (more time outdoor) and BTS (better stables) that compensate farmers financially if they participate. The RAUS program defines standards for how often animals should have access to an outdoor free-range area and the BTS program defines certain criteria for stables. In the BTS program it is required that animals are not chained and that there is day light. Further, animals should have enough space to move around freely, rest, occupy and express themselves as closely as possible to their natural habits. In 2016 80% of the cattle farms, 50% of the pig farms and 7% of the poultry farms were part of the RAUS program and 53% of the cattle farms, 66% of the pig farms and 91% of the poultry farms were part of the BTS program[38].

2.6 ORGANIC VEGETABLES, FRUITS, GRAINS AND THEIR CLIMATE IMPACT

If organic or conventional production has the better carbon footprint cannot be generalized

Grains, vegetables and fruits produced outdoor

On the whole, there is no conflict between eating organically produced plants and reducing the climate impact of our diet. In general, vegetables, grains and fruits have a low carbon footprint in comparison to animal products.

The carbon footprint of one kilogram of crops produced under organic standards can be better, worse, or similar compared to conventional production[28,39].

Several factors explain the diverse and contrasting results in the carbon footprint of crop products. The balance if organic production or conventional production has the lower carbon footprint can be easily tipped. First, measures that potentially reduce the carbon footprint can lead to other measures or circumstance that increase it. For example, not using synthetic pesticides saves energy, but might lead to the increased use of machines on the field. Further, minimizing pesticide and fertilizer use as much as possible can lead to lower yields per area and reverse the positive effect on the carbon footprint of using less inputs. In addition, other factors such as location make factors like machine use more or less necessary and again tip the balance.

Currently, potential contributions of agriculture to reduce global greenhouse emissions through the increased storage of carbon into the soil are not properly accounted for in the carbon footprint of a product. The storage of carbon into the soil is called soil sequestration and depending on production practices this can be increased or decreased. Methods to measure and calculate soil sequestration are still being developed. Once the impact of soil sequestration can be included into the comparison of the carbon footprint of organic and conventional products, this might flip the balance in favor of one of the production systems[40].

Vegetables produced in greenhouses

An organic tomato in Switzerland has a 45% lower carbon footprint than an organic tomato in the UK

The carbon footprint of vegetables produced in greenhouses changes throughout the year: off-season vegetables grown in heated greenhouses have a much higher carbon footprint. A tomato harvested in February has a 16 times higher carbon footprint than a tomato grown in June.

The certification Bio Suisse (CH) strongly restricts the use of peat and the amount of heating for production. Peat is dense organic matter that can be found in the soil of wetlands. Peatlands are normally water clogged. If they

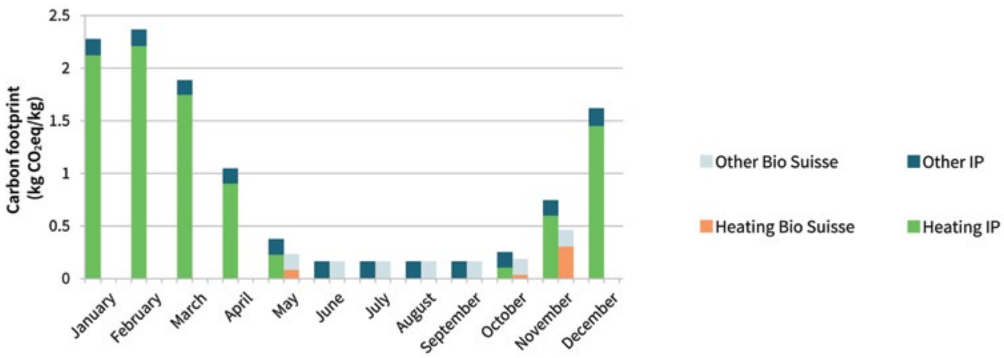


FIGURE 2.6
The carbon footprint of a tomato grown in Switzerland changes over the year. Heating the greenhouse used for production during the colder months strongly increases the carbon footprint. In Switzerland the organic label Bio Suisse restricts the heating of greenhouses. Therefore, organic tomatoes produced in Switzerland are available during a shorter season. If they are available, they have a low carbon footprint[33].

are drained, the peat reacts with oxygen and the carbon is released to the air. Reducing the amount of peat therefore reduces the carbon footprint[41]. Further, due to the heating restrictions Swiss organic greenhouse vegetables are available during a shorter period of a year only[33]. But if they are available, they come with a low carbon footprint. In the early spring, organic tomatoes from Spain are available. In those months, Spanish tomatoes come with a lower carbon footprint than Swiss tomatoes because the carbon emissions of the transport by track are substantially lower than heating greenhouses.

The organic labels of other countries that we investigated have less strict regulations on the use of heating and peat. An average organic tomato in the UK has therefore a 45% higher footprint than an organic tomato produced in Switzerland[27].

In the winter months, seasonal vegetables will have the lowest carbon footprint of all vegetables in general. If typical greenhouse vegetables need to be served the use of imported, conserved and frozen vegetables are the smarter choice from a climate perspective.

Vegetables imported from abroad

The transport of food by airplane increases the carbon footprint tremendously. For example, green asparagus that are imported from Mexico by plane come with a carbon footprint of 11 kg CO_2eq /kg, while asparagus from Spain have only 2 kg CO_2eq/kg. The transport by truck emits much less CO_2 than the transport by airplane. Local asparagus have the lowest carbon footprint (0.8 kg CO_2eq/kg) because long distance transport is avoided[14].

Bio Suisse prohibits the transport by plane and there significantly reduces the carbon footprint of organic products available in Switzerland.

2.7 ORGANIC PRODUCTS: THE MEAL PERSPECTIVE

Substantial reductions in carbon footprint can be achieved also with organic meals

The meal perspective brings in a whole new dynamic to evaluate the climate impact of food. Every meal consists of a unique mix of ingredients that have lower and higher carbon footprints. The exact amounts of ingredient used and the carbon footprint of each ingredients together determine whether the meal has a high or low carbon footprint. Therefore, meals with a relatively low carbon footprint can still contain ingredients with a higher carbon footprint. As long as amounts are balanced and amounts of CO_2-intensive ingredients are not too high, a meal can save CO_2 compared to an average meal.

To analyze the climate impact and CO_2 reduction potential of organic meals we calculated and compared the carbon footprint of more than 1300 recipes[42]. The recipes represent a standard food offer of restaurants in the food service industry. We first calculated the carbon footprint of all meals with ingredients from conventional production and then changed to ingredients from organic production.

The carbon footprint of the total food offer and of the average meal increased by 10% when all ingredients were substituted by the same ingredients from organic production. Meals with organic veal had in general a lower carbon footprint than meals with veal from non-organic standard production, but this was not enough to compensate the increase in carbon emissions caused by meals with organic beef and chicken. All other meal categories showed no significant differences in climate impact.

Despite the general increase in climate impact nothing significantly changed for the meals that got the Eaternity Award for climate-friendliness. The same amount of meals with conventional and organic ingredients were awarded and have at least 50% less CO_2 than an average meal.

In general, meat dishes with beef and veal had the highest carbon footprint and vegetarian and vegan dishes had the lowest carbon footprints. However, within each meal category the range of possible CO_2-values is large. For meals containing meat the carbon footprint depends mainly on the amount of meat and on the piece of meat.

Nose-to-tail pieces have a lower carbon footprint. For vegetarian dishes the carbon footprint depends mainly on the amount and kind of milk products used. Further, single ingredients could influence the carbon footprint significantly if they were transported by plane. As the range in CO_2-values within each meal category is large it is important to exactly calculate the impact of a meal to assure its CO_2-reduction potential.

The main learning from the findings described above is that although differences in the climate impact of organic meat and non-organic meat can be significant, the difference in carbon footprint between a climate-friendly meal and an average meal is much larger. Therefore, to reduce climate impact it is much more important to select ingredients with a low carbon footprint in general than if it was produced organically or not.

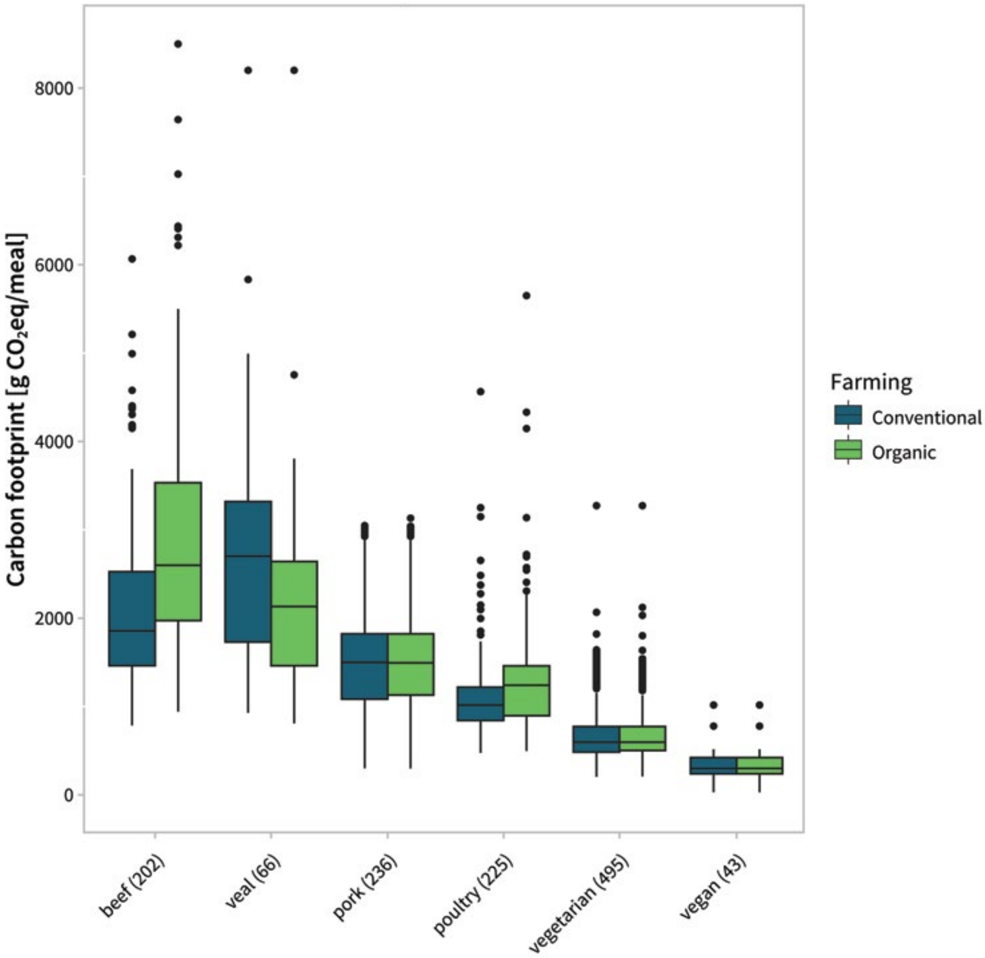


FIGURE 2.7
Comparison of the carbon footprint of more than 1300 meals once calculated with conventional and once calculated with organic ingredients. The carbon footprint of meals mainly depends on the type and amount of meat and whether ingredients were imported by plane. It was assumed that all meals were prepared in July[42].

2.8 TROPICAL DEFORESTATION

Choices based on the carbon footprint alone might not avoid tropical deforestation

Tropical forests store massive amounts of carbon and house an incredible amount of plants and wildlife. They store about 25% of all terrestrial carbon and hold 2/3 of all land-based species even though they only cover 5% of the Earth's land area. They provide us with fresh water and they affect local and global climate and weather patterns[43].

Agriculture is the main cause of tropical deforestation and is directly linked to biodiversity loss and the release of carbon emissions by land-use change. Tropical forests used to occupy 12% of the Earth's land area, but today make up less than 5 percent. Tropical forest loss will increase temperature and reduce rainfall, both locally and regionally, and in many cases, globally. Preserving what is left is crucial to prevent species extinction, the release of massive amounts of carbon and negative impacts on weather and climate.

Especially the production of palm oil and soy lead to tropical deforestation. Indonesia and Malaysia produce more than 85% of global palm oil. Around 80% of soy is produced in the US, Brazil and Argentina[44].

The carbon footprint of a product includes the emissions related to deforestation and land-use. Even so, basing your food choices on the carbon footprint only still can be related to deforestation. For example, a margarine spread has a lower carbon footprint than butter, but margarine often contains palm oil. As large amounts of palm oil can be produced on a relatively small area its carbon footprint on the product level is relatively low even when deforestation occurs[45].

There is still uncertainty in how to exactly account for deforestation in carbon footprint calculations. Prevailing methods are being under discussion for underestimating the climate impact related to deforestation. Depending on what the scientific community will agree upon in future the conflict between making decisions based on the carbon footprint of products only and tropical deforestation might become less strong.

2.8.1 CERTIFICATIONS AND OTHER ALTERNATIVES

Choosing foods from organic production typically ensures that no valuable nature areas or tropical forest was lost. There are also other certified labels, like Max Havelaar and the Rainforest Alliance, that specialize to protect those valuable areas.

There are two large global stakeholder initiatives that drive the availability of certified palm oil and soy; the Round Table for Sustainable Palm Oil (RSPO)[46] and the Round Table on Responsible Soy (RTRS)[47]. These certifications guarantee that no tropical forest was cleared for production. Further, they have minimum requirements to protect soil and water and social criteria like minimum wages. Organic certifications are part of the RSPO and RTRS certifications, but include additional measures to increase the sustainability of production.

Currently, only 21% of global palm oil production is certified by the Round Table for Sustainable Palm Oil (RSPO)[46]. For soy, only Brazil produces currently significant amounts of certified non-GMO soy. In Switzerland, we have the special case that in 2016 already 99% of imported soy used for feed was responsible[48].

In addition to buying certified produce we can reduce our negative impact on tropical forests by reducing our need for palm oil and soy itself. We can achieve this by including more fresh products into our diet instead of processed products such as frozen pizza which often contain palm oil. Further, as currently 75% of all soy is fed to animals we can reduce the amounts of milk and meat that we eat in favour of more vegetables, pulses and grains. In addition we can purchase soy from European production.

In contrast, substituting all palm oil with other oils is in the long-run not automatically more sustainable.

As the yield of palm oil per area is 5 - 9 times higher than for other oils, substituting palm oil with other oils does require more agricultural land and would need additional regulations to ensure sustainability[49].

2.9 WATER SCARCITY

Reducing climate impact can conflict with water scarcity - the location on the globe matters

Globally, we have enough fresh water resources, but water is not evenly distributed around the planet. Agriculture uses 70% of our fresh water supply, mainly for irrigation[50]. For regions where sufficient water is available, high water use is less problematic than in regions where water is scarce. In our analysis, we therefore focus on the water scarcity footprint of products.

The water scarcity footprint of a product depends on the amount of fresh water (surface- and groundwater) that is used and on the relative water scarcity in the particular region of production[51]. The water scarcity footprint differs from other prevailing water footprint methodologies in that it explicitly includes the water stress of a region as a weighing factor for the amount of water used. Water stress depends on the amount of water used in that region compared to the amount of water that is naturally provided by rainfall and other precipitation. Other approaches do not look at local water scarcity and measure in addition to the blue water (surface- and groundwater) also the use of green water (rain water) and grey water (amount of water needed to dilute pollutants to a safe level). However, green water is also a part of land use, because the water can only be used by plants occupying that land and there are no trade-offs with other water consumers[53]. The methodology for grey water use is less developed, and the meaning overlaps with eutrophication and ecotoxicity. We address land use, eutrophication and ecotoxicity in below.

Enough data to compare the water footprint of products from organic and conventional agriculture is currently lacking. A comparison of the water scarcity footprint with the climate impact however is possible.

Food choices that reduce climate impact can still increase water stress. For example, olives or nuts that have a relatively low carbon footprint are often produced in areas where water is rather scarce.

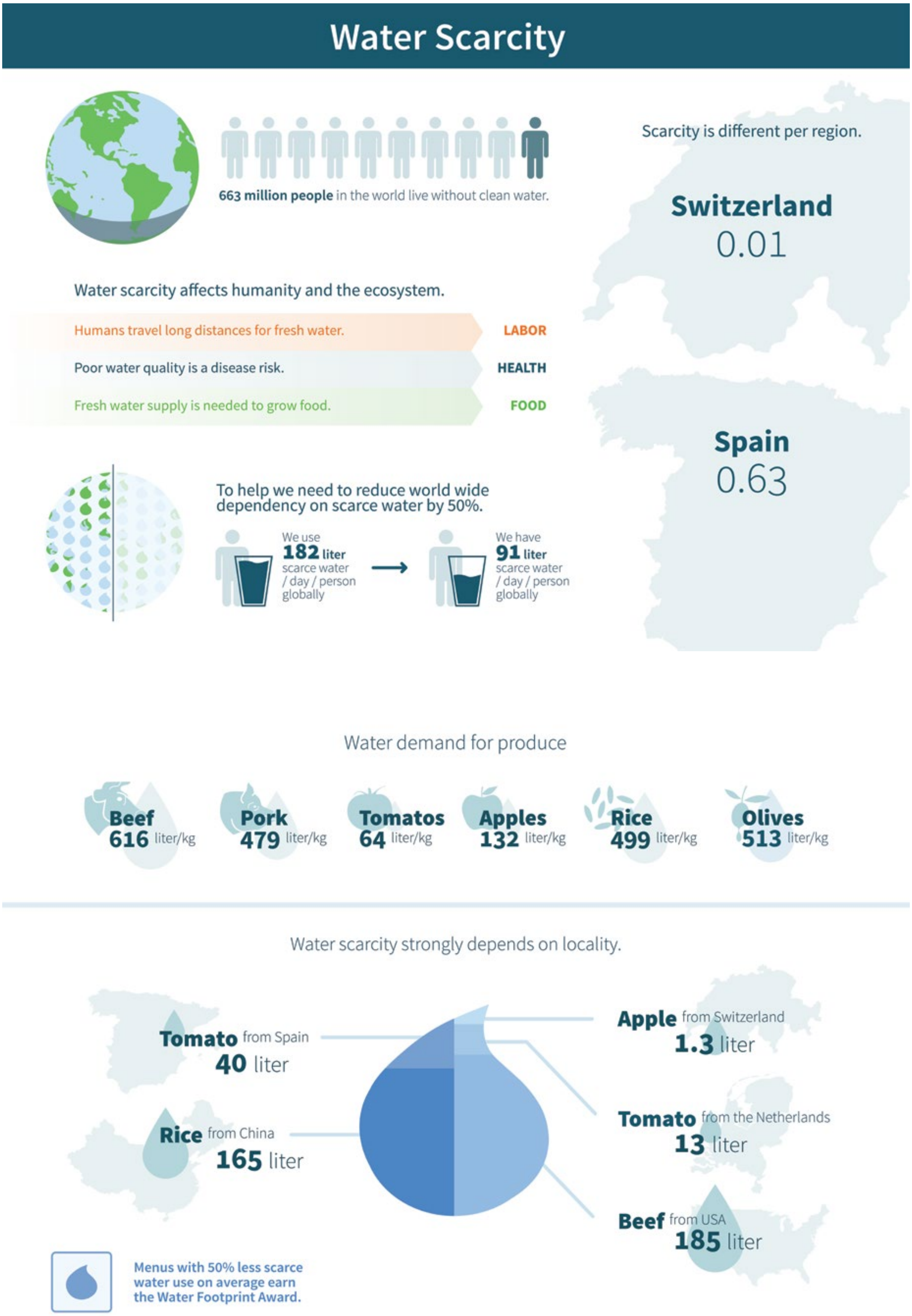
The water scarcity footprint of a product strongly depends on the region where it was produced. For example, a tomato that is produced in Spain requires 44 times more irrigation water than in Switzerland. In addition, water is more scarce in Spain than in Switzerland. Therefore, the water scarcity footprint of an average Spanish tomato is 2400 times higher than an average Swiss tomato (raw data from [20]).

In Switzerland water is not scarce and all foods produced in Switzerland have a low water scarcity footprint. This is even true for animal products that usually need larger amounts of water for their production. The water scarcity footprint of Swiss beef is especially low because a substantial part of the feed is from non-irrigated grasslands.

Depending on what food is consumed and where the food comes from, every country has a unique list of food products that are typically problematic and contribute most to the national water scarcity footprint. In Switzerland, the consumption of olives, nuts, chocolate, coffee, milk products, rice and beef contribute most to the Swiss national water scarcity footprint. This list gives us a first coarse guideline at what to look when planning meals with a low water scarcity footprint[20]. It does not mean that we should avoid these products altogether, but that we should be more careful in their use and that it matters where these foods were produced.

2.9.1 WATER SCARCITY IN THE FOODSERVICE INDUSTRY

To figure out how big the problem of water scarcity is and how often it conflicts with a reduction in carbon footprint, we made a first case study with a set of 631 meals[36]. Water scarcity footprint calculations are based on the data of Scherer and Pfister (2016). If specific



Based on data from: 20, 85

country data was lacking for a certain product, we used the global median water scarcity footprint. Future work will refine the modeling.

To bring global water consumption to a sustainable level, we need to reduce our water scarcity footprint by 50%. We defined that all meals that substantially contribute to reducing the average water scarcity footprint by 50% receive the Water Footprint Award.

With this approach to award meals, 80% of all meals had a low water scarcity footprint. Those meals that had a high water scarcity footprint were mostly vegetarian meals. The reason for this result was that products such as lentils, olive oils and nuts increased the water scarcity footprint substantially as they were imported from regions where water is scarce. In addition, although the production of meat is related to high water use, in Switzerland we have the special case that the water scarcity footprint of these products is low as water is not scarce. The water scarcity footprint of the vegetarian meals could often easily be improved by for example changing the origin from Turkey to Canada in the case of lentils or to use rape seed oil instead of olive oil. Some reduction is also achieved by choosing e.g. hazelnuts from Italy instead of cashews from India, but nuts generally have high water footprints because they are often grown in dry areas.

In total 29% of the meals were climate-friendly. Of those meals, 72% had a low water scarcity footprint. Climate-friendly meals were mostly vegetarian. As mentioned above those meals with a high water scarcity footprint were mostly vegetarian as well.

This analysis shows us that although for most climate-friendly meals the water scarcity footprint is low, it is still an issue that needs to be regarded separately next to the carbon footprint. Around 1/5 of climate-friendly meals have a high water scarcity footprint and were mostly vegetarian.

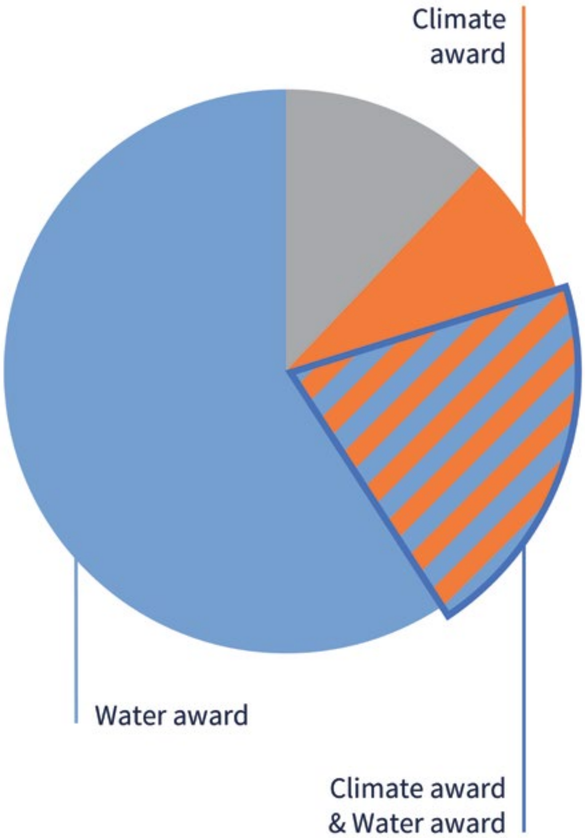


FIGURE 2.8

80% of the meals analyzed have a low water scarcity footprint. Most of the climate friendly meals are in line with reducing the water scarcity footprint. However, some climate friendly meals had high water scarcity footprint. This demonstrates the need for sustainable meal decisions to consider the water scarcity footprint in addition to the carbon footprint[36].

2.10 LAND USE AND EUTROPHICATION

Food choices that reduce the carbon footprint also reduce the impact of land use and eutrophication

Climate impact, total land use and the oversupply of nutrients (eutrophication) overlap. This means that most important food choices that reduce the carbon footprint most likely also reduce land use and the amount of nutrients brought into the environment. This is especially true for choices that favor plant products over animal products. The overlap between different plant products however is much weaker and may disappear completely[36].

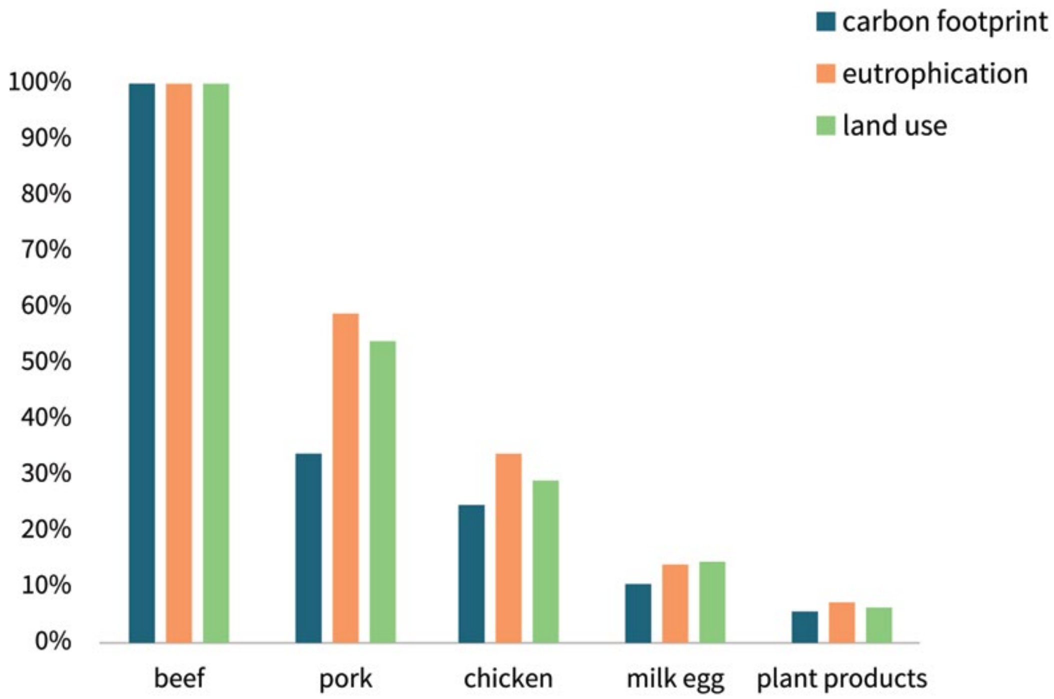


FIGURE 2.9
The average carbon footprint, aquatic eutrophication potential and total land use per kg of pork, chicken, milk, egg and plant foods relative to the impact of beef. There is a strong overlap in the severity of the climate, eutrophication and land use impact. Products with high carbon footprints have also higher eutrophication potentials and total land use. Main actions that reduce the carbon footprint of meals also reduce the negative impacts of eutrophication and land use[14].

Land use

The larger the area used for food production, the smaller the area that is available for other human activities or natural vegetation. Organic crops often need a larger area to produce the same yield than in conventional farming[54]. However, this increased land use is not necessarily a bad thing. For example if soil fertility is maintained better than in other systems, it may be worthwhile to occupy a larger area as this means that on the long run we are better off.

Next to the area of land used, also the type of land used is important. For example, grazing cattle may need more land in total, yet it offers a way to reduce land competition for human food production by using grasslands instead of crop land.

Further, also the location of the land used matters. For example, land use change in tropical rainforests is part of the most damaging land use changes in terms of biodiversity loss or carbon emissions. Organic labels usually prohibit the land use change of valuable habitats.

In general the production of meat needs more land than the production of vegetables and grains. A substantial part of this land could also be used to produce feed for humans instead. By reducing the amount of meat we eat we can make land available for less extensive human food production.

Eutrophication

Nutrients contained in the soil are taken up by plants and removed from the field when the crop is harvested. Thus the farmers need to replace those nutrients. Conventional farms use mainly synthetic fertilizers and manure and organic farms mainly manure. However, not all nutrients of the fertilizers are taken up by the plants and the surplus is for a large part washed out to rivers and lakes.

The oversupply of nutrients in lakes and rivers is called eutrophication and it reduces their water quality. It disturbs the fine natural balance of plants and animals living in the water and can lead to habitat loss of certain animals[55].

Part of the nitrogen contained in the fertilizer is transformed in soils to the greenhouse gas nitrous oxide[56]. For this reason we observe sometimes overlaps between the amount of eutrophication and climate impact of food products. The few data available that compared the eutrophication potential of organic and conventional plant products show no systematic difference so far when comparing impacts per kg of product, but uncertainties in the scientific methods are still high.

2.11 LINKING EVERYTHING TOGETHER

To sum things up, we have gained transparency on the environmental synergies and conflicts of our food choices for 6 out of the 9 environmental indicators that experts approved to be most important. For 3 of those indicators there is no standard method established yet or not enough data available. This is the most up-to-date guide we currently have to offer, aiming at reducing our environmental impacts. Consumer behavior will play a major part in the establishment of environmentally sustainable diets. To support educated decision making, Eaternity included indicators for water scarcity, tropical deforestation and animal welfare into the Eaternity App.

Win-win situations

Synergies exist between climate impact, total land use and the oversupply of nutrients (eutrophication). Reducing the carbon footprint of our diet also reduces the impact on land use and of the oversupply of nutrients. This link is especially strong when vegetables, pulses and grains are favoured over animal products. In table 2.4 we summarize the synergies and conflicts of different meat choices in Switzerland and Europe for the most important environmental indicators.

Conflicts that we need to account for

Potential conflicts exist between climate, animal welfare, tropical deforestation and water scarcity.

Animal welfare and avoiding tropical deforestation are well covered by organic labels.

Further research needed

Biodiversity and soil fertility are important environmental indicators, but scientific methods are still being developed. Therefore, no final measurable conclusions on the impact of our food on these indicators can be drawn yet.

The same is true for ecotoxicity. Organic agriculture prohibits the use of synthetic pesticides, but does allow the restricted use of copper. The evaluation of the toxicity of heavy metals is still difficult and especially challenging because relevant data on the heavy metal content in manure is still lacking.

Impacts on soil fertility, biodiversity and ecotoxicity all are also influenced by how we use the land. Using more land may reduce the stress per area caused by fertilisers, chemicals and machines, and thus may reduce overall impacts on soil fertility and biodiversity. If this is the case needs further research.

In general, animal foods require more land than plant foods. If we eat less meat and milk products in favor of vegetables, grains and pulses we can use the land that is available for food production more extensively. This may help to protect biodiversity, soil fertility and ecotoxicity.

Table 2.4. Overview of which production system for beef, chicken and pork tends to have the lowest impact (1) and the highest impact (3) for different environmental indicators. The underlying data is based on multiple LCA studies*. German production was used to represent the EU.

	Beef						Chicken						Pork			
	CH			EU			CH			EU			CH		EU	
	Standard (IP)	Grazing	Grazing, suckler cow [a]	Intensive [b]	Grazing	Grazing, suckler cow	Standard (IP)	Free-range	Organic	Standard (barn)	Free-range	Organic	Standard (IP)	Organic	Standard (conventional)	Organic
Climate[c]	1	2	3[a]	2	1	3	1	2	3	2	3	1	1	1	1	1
Aquatic eutrophication	1	2	nc	1	1-2[f]	3	1	2	3	1	2	3	1	1	1	2
Land use total	1	2	nc	1	2	3	1	2	3	1	2	3	1	2	1	2
Crop land use	2	1	nc	nc	nc	nc	nr	nr	nr	nr	nr	nr	nr	nr	nr	nr
Scarce water	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Ecotoxicity[d]	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Biodiversity[d]	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Soil fertility[d]	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
Deforestation (qualitative)	1[g]	1[g]	1[g]	2	1[h]	1[h]	1[g]	1[g]	1[g]	2[i]	3[i]	1[i]	1[g]	1[g]	2[i]	1[i]
Animal welfare[e] (qualitative)	3	2	1	3	2	1	3	2	1	3	2	1	2	1	2	1

Impacts are considered "similar" if impact level differed by less than 5%
IP = integrierte Produktion (standard production system in Switzerland, more strict than conventional production). nc: no data or not calculated. nr: not relevant (only relevant for cattle)
*Data: Swiss beef[30-32], Swiss chicken[32], Swiss pork[29], German beef[27,35], German chicken and pork[35]

[a] Meier et al.[31] showed that the carbon footprint of suckler cow is higher than for grazing and standard beef production. Already Alig et al.[29] calculated higher carbon footprints for suckler cow production than standard beef production. Data obtained for Germany further support the conclusion.
[b] Intensive represents an intensive animal farming that could occur at any place. It does not necessarily reflect the most common conventional way to produce beef in Germany.
[c] All findings are explained in detail in the main text.
[d] no conclusions are available because methods to quantify impacts of heavy metals are still missing.
[e] animal welfare is based on expert judgements and not scientific calculation.
[f] differences are small and slightly dependent on the chosen impact assessment method
[g] Switzerland: Currently, 99% of the soy is certified ("responsible", see main text). Grazing suckler cows produced in Switzerland are not fed with soy.
[h] In the modelling it was assumed that grazing and suckler cow were produced under organic standards and thus no deforestation occurs.
[i] ranking based on the calculated carbon emissions from biomass and soil, which reflects mainly land use change.

2.12 ORGANIC PRODUCE AND HEALTH

Lower amounts of pesticide residues are measured, but the link to improved personal health is missing

Personal health is one of the main arguments why consumers buy organic foods. The exposure to pesticides is linked to different kinds of cancer, neurological problems, birth defects and neurological development disorders[57]. Whether effects occur and how severe they are, depends on the chemical itself, as well as the duration, amount and route of the exposure. Poisoning by pesticides can be a problem for workers if no sufficient and appropriate protection measures are taken.

Due to the toxic impact of pesticides the use of it is regulated by national governments. Certain pesticides are forbidden and for others maximum allowed residues in food are defined and controlled for. These maximum allowed residues are considered safe for human consumption.

Still the question remains if consumers that eat organic foods have health benefits over those that do not. A recent meta-analysis that summarizes all the results of scientifically peer-reviewed publications finds that pesticide residues are often lower in organic foods and the nutritional profile can be better. Nevertheless, there is no sufficient scientific evidence that these findings are relevant for health[58].

To improve ones personal health it may be more important to follow dietary guidelines such as to eat more fruits and vegetables than to choose organic production over conventional production.

VITALITY

3.1 MAIN LEARNINGS OF THE HEALTH FOOTPRINT PROJECT

- We found that only 10% of all meals tested were considered mutually healthy and climate-friendly. This analysis was carried out with existing peer-reviewed health indicators for meals and is representative for the food service industry.
- In modern society diet-related health issues, such as cardiovascular disorders, diabetes or cancer, are widespread, while a general lack of nutrients is on the whole less worrisome. In Europe, 70% of deaths are caused by the noncommunicable diseases mentioned above.
- A prime conflict of the modern diet with current health guidelines is the lack of vegetables and fruits. Even though not stressed in the same way as fruit and vegetables, the lack of whole grains is a major factor linked to food related disease as well. Whole grains are equally important as fruit and vegetables.
- The predominant stance of meat in the western diet is under debate. Although a small amount of protein is essential, we generally intake more than double the amount recommended.
- In order to expand the amount of meals that are mutually climate-friendly and healthy in a steep upwards curve, adjusting our diet in line with health recommendations will already bring major gains. The potential to conjointly reduce the carbon footprint of our food supply chain lies between 10% and 35%
- Eaternity developed a Vita Score for meals that aims at reducing the risk for noncommunicable diseases such as cardiovascular disorders, diabetes or cancer.
- Eaternity's Vita Score is an innovative approach and based on the Global Burden of Diseases, Injuries and Risk Factor Study – the biggest epidemiological study worldwide. It includes the relative impact of dietary choices on disease risk, as they are currently not explicitly part of diet recommendations.

3.2 MOTIVATION OF THE HEALTH FOOTPRINT PROJECT

What we eat has a tremendous impact on our health and well-being. Bad dietary habits are a leading driver of death and disability worldwide[59]. In Europe, food related diseases like obesity, cardiovascular disorders, cancer and diabetes are accounting for 70% of all deaths[61]. Despite an over-supply of food we are suffering a high amount of disease.

Current dietary habits also pose a great threat to the climate. Food is responsible for 31% of all greenhouse emissions. Both, healthier and climate-friendlier eating require changes in our dietary routine. Approximately 71% of all Swiss eat their lunches out[61]. Therefore, restaurants have an immense potential to improve our health as well as reduce carbon emissions.

In the Health Footprint project we investigated the overlaps and conflicts between healthy eating and reducing the climate impact of food. The aim of the project was to develop an easy to apply, but complete set of recommendations and tools that target healthy dietary habits and reduce the climate impact.

Main questions that guided us through the project were:

- How is healthy eating defined and what is the scientific bases?
- Is there a win-win for healthy eating and reaching climate targets?
- How can we most effectively support the increase of healthy meals in restaurants?

The results of the Health Footprint Project reflect the current scientific knowledge. The scientific advisory board of the project as well as leading experts provided us with many valuable contributions.

As a final outcome, Eaternity developed the Vita Score and included additional indicators for balanced eating into the Eaternity App.

3.3 HEALTHY NUTRITION APPLIED TODAY - THE BASICS

Healthy eating is a topic that concerns us all, as it directly influences personal well-being. Cultural and personal experiences and opinions on what is healthy are part of the constant flow of information that we get through newspapers, internet, social media and television. Despite all the “good advice” this information can be contradictory and create confusion. Although everyone has their own opinion on what is good for health, making general statements that are valid for entire populations are tricky and need to be backed up by a solid body of scientific research.

Health and nutrition organizations worldwide provide general dietary guidelines that are based on scientific evidence and expert judgement. There are in general two approaches to define what a healthy and well balanced diet is and nutritional organizations base their guidelines on both. Traditionally, the focus has been on providing the body with an appropriate amount and a well balanced ratio of nutrients. An other approach is to promote food groups which are known to reduce the risk of lifestyle diseases.

First, dietary guidelines can be based on the daily recommended amount of macro- and micronutrients, and energy needed to maintain well-body functioning. Macronutrients are proteins, fats and carbohydrates and should provide us with enough, but not too much energy during the day. Micronutrients are all the vitamins and minerals that we need for normal body functioning. In general, it can be said that guidelines based on daily recommended intake of energy and nutrients focus on preventing malnutrition. These recommendations have a long history and are very well investigated.

The daily recommendations of nutrients and calories depend on age, gender and level of physical activity. For example, a 30-year old female, whose job requires mainly sitting should eat not more than 1800kcal per day, whereas a 30-year old male who has a sitting job and does sports occasionally should eat not more than 2700kcal per day[62]. These energy values are based on a comprehensive analysis of energetic needs and expenditures.

Second, dietary guidelines can be based on known dietary risk factors that cause disease. An estimated 80% of heart diseases and diabetes type II, and 40% of cancer could be avoided if major risk factors like low intake of fruits and vegetables were eliminated[63].

The Global Burden of Disease, Injuries and Risk Factors study (GBD) is the biggest epidemiological study worldwide. It calculates, among others, the relative contribution to disease outcome of different diet and lifestyle choices[59]. More than 2000 scientists worldwide collaborate on this project. Results are based on epidemiological studies, clinical studies, disease and death statistics, as well as dietary intake statistics. Dietary risk factors that contribute to disease can be related to a food-group or nutrient. For every risk factor the number of life years lost due to ill-health, disability or death are computed. This measure is called DALY (Disability Adjusted Life Years) and it is most commonly given for 100’000 persons, for a defined population. The number of DALYs per risk factor depends on age, gender and country. In figure 3.1 the number of DALY per risk factor for an average Swiss adult are depicted. For Switzerland the most important dietary risk factors related to disease are a lack of whole grains, fruits, vegetables, nuts and seeds and a high intake of processed meat.

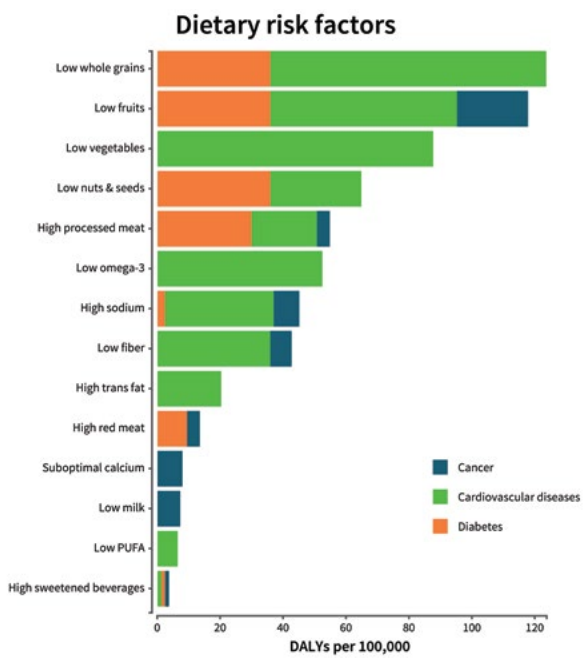


FIGURE 3.1
Dietary risk factors identified by the GBD project and their outcomes expressed in DALY (life years lost) for a Swiss population between 15 and 49 years of age[64].

In contrast to the guidelines based on daily nutrient recommendations, food guidelines based on risk factors focus less on ensuring that our diet is balanced and more on preventing diseases. No one doubts that it is important to eat healthy, balanced and provide the body with all the nutrients it needs to function properly. However, the abundance of food and changing lifestyles in modern societies have led to the fact that undernutrition is less worrisome and bad dietary habits that cause serious illnesses and death are a growing problem.

From a historical point of view, dietary guidelines have been for a long time mainly based on daily recommended intake. The perspective of basing dietary guidelines on disease risk caused by bad dietary habits is more recent. One of the reasons is, that long term and large scale data has not been available before to make well-funded connections.

3.3.1 TWO COMMON MODELS THAT PROMOTE HEALTHY EATING

Worldwide there are two common models used by national and international health organizations to explain and promote a healthy diet: the food pyramid and the plate model.

In everyday life, it is rarely feasible to perform exact nutrient calculations on what we eat. Therefore, the nutrition guidelines have been simplified and represented by two models that show which food categories in which proportions we should eat to have a good chance of getting all the nutrients we need and stay healthy. Although relatively simple, these models are not trivial, as they are based on extensive research and expert judgement. There is a general agreement that simplifications are necessary to promote healthy eating.

The food pyramid is the oldest representation. In the food pyramid, every food item belongs to a certain food group, such as vegetables, starchy products, protein rich products etc.. Foods that belong to the food group at the bottom of the pyramid should be eaten the most and foods that belong to the food group on top of the pyramid the least. The main separation of food groups is based on the main macronutrients that we need (carbohydrates, protein and fat). Fruits and vegetables are usually at the bottom of a pyramid. On the very top of a pyramid a group with sweet and salty snacks, and sugary drinks is placed. These foods are not needed to cover the nutritional needs and should be eaten in moderate amounts.

The plate model is a more recent depiction of the dietary guidelines. It attempts to make it even easier to apply them, as a plate can be directly compared to a meal one prepares. The plate shows which proportion of the surface should be covered by the different food groups, In general experts agree that the plate model is an improvement on the food pyramid and more intuitive to apply in every day life.

How the food pyramid and plate model are exactly depicted can differ slightly per country. Moreover, the exact dietary guidelines can also differ. The reason for this is partly rooted in culture. National organizations try to adjust dietary guidelines as much as possible to the current eating habits of their country. The idea behind this is that if fewer changes in diet are required people will be more inclined to follow the guidelines. For example, in the Swiss guidelines there is an exact recommendation on how much milk products we should eat daily. In the UK guidelines it is only recommended to eat „some“ milk products and no exact amount is mentioned. Also expert judgement on what works best can lead to differences in the representation of the plate and the pyramid model and if they should be able to „stand alone“ or complement each other. For example, in the US the food group of fruit and milk products are also part of the plate, but on the Swiss plate fruit is absent as it only represents lunch and not general food intake.

Expert’s debate

The exact representation of the plate and the pyramid model are part of ongoing expert debate as new information becomes available. Based on scientific data, the models have the difficult task to show a general and easy overview of what to eat to stay healthy. To bridge the gap between exact data and easy guidelines we also rely on expert judgement and interpretation. This can result in slightly different representations of the plate and the pyramid in different countries. Moreover, the pyramid or plate model themselves leave some room for interpretation. Therefore, they are often accompanied by clarifying guidelines and tips, which sometimes may be forgotten.

Most often concerns are raised regarding the representation of the protein-rich, the fat-rich and starch-rich food groups.

A general weakness is that the simplified representation of food groups lack enough differentiation. For example, in the case of starchy products whole grains should be preferred. However, this information is only given in additional materials and not directly visible from the

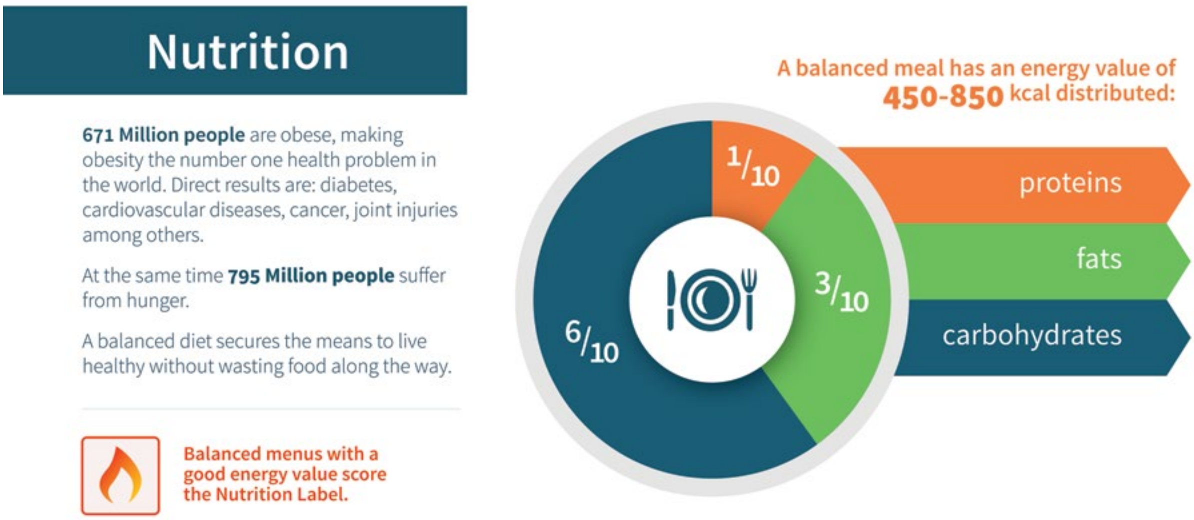


illustration. The same is true for fats. Certain fats are more healthy than others and we should know which ones should be used more often.

Another weakness is that the pyramid and plate graphical representations do not sufficiently reflect the current knowledge on dietary risk factors and related diseases. For example, too much red and processed meat are related to cardiovascular disorders or even cancer. Although complimentary written guidelines often do mention these facts, the general depiction of proteins on the plate do not explicitly encourages the healthy options.

Based on expert's debate Harvard developed a new plate where whole grains and healthy protein sources are stressed and a glass of water instead of milk is illustrated [65].

Despite an ongoing discussion the pyramid and plate model deserve much of our appreciation. They make a huge effort to provide the public with necessary and scientifically based information on healthy eating. Room for improvement means that we as humanity are learning.

3.3.2 HEALTHY EATING APPLIED IN THE RESTAURANT INDUSTRY

With the trend of eating out on the rise the food service industry plays a big role in providing us with healthy food. All chefs are trained in preparing a balanced meal. The most wide-spread rule of thumb used, provides us with the right amount of macronutrients (fat, protein and carbohydrates) and the right amount of energy. A balanced meal should derive 45-55% of it's calories from starchy products, 20-35% from fat and 10-15% from protein[66]. The recommended value of energy per day depends on age, gender and the amount of physical activity. For an average adult 2000 kcal are estimated to be appropriate[62].

In addition, a standard amount of vegetables can be served to provide us with sufficient micronutrients. The amount of grams needed of each food group per meal comes with practice and becomes a second nature.

A healthy meal in the food service industry mostly focuses on providing us with a balanced meal that has sufficient macronutrients and micronutrients. However, also here an explicit differentiation between healthy fats and less healthy fats, healthy starch and less healthy starch and proteins is missing.

Fats, proteins and climate

The CO_2-footprint of fats and proteins shows a huge variation. It matters which fat and protein you eat not only for your health, but also for climate. To assist chefs in their decision-making for healthier and climate-friendlier fats and protein we developed two score-cards. One that shows which products are high in healthy fats and have a low carbon footprint and one that shows which protein rich foods have the best carbon footprint. From the protein list red meat and processed meat are excluded as the intake of these meats is related to cardiovascular disease, diabetes and cancer.

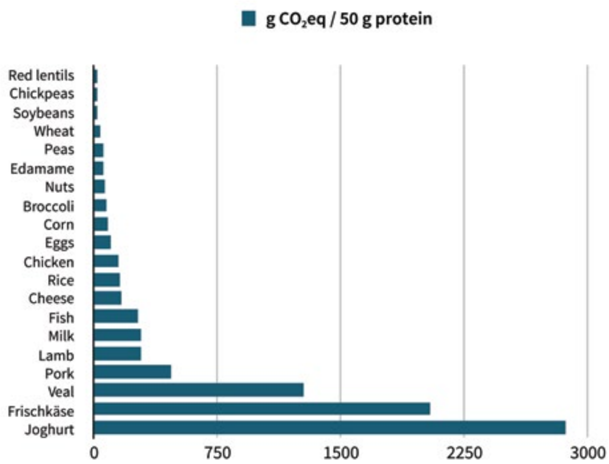


FIGURE 3.2
The carbon footprint of different protein-rich foods per daily recommended amount of 50g of protein. Pulses can provide us with the daily recommended amount of protein we need and have a low carbon footprint.

The daily dietary recommendation for proteins is 0.8 grams of protein per kg of weight and per day. This means that an average adult needs approximately 52 grams of protein per day. In general, we eat much more protein than recommended. For example, Swiss eat 85 grams of protein per day[67]. Considering the high meat consumption in Switzerland, it is most likely the primary source of protein.

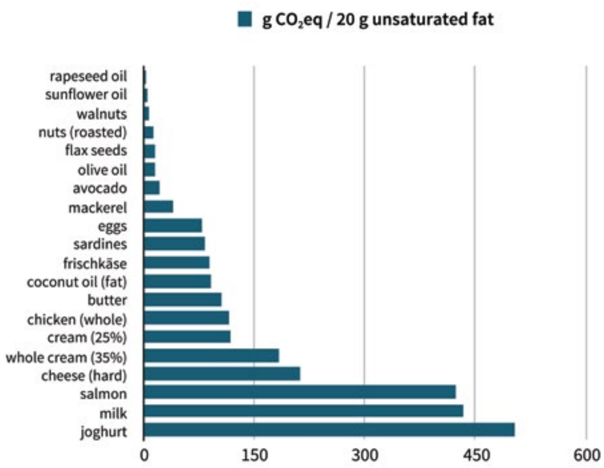


FIGURE 3.3
The carbon footprint of different fat-rich foods per daily recommended amount of 25g of unsaturated fat. Rapeseed and sunflower oil as well as nuts and seeds are a climate-friendly source of unsaturated fats. Unsaturated fats are essential healthy fats that we need for normal body functioning.

3.4 CURRENT DIET IN SWITZERLAND

If the Swiss would eat in line with Swiss national diet recommendations climate would gain as well.

Dietary statistics show that the current Swiss diet is not in line with the Swiss nutritional recommendations. Only 13% of Swiss eat the daily recommended 5 portions of vegetables and fruit. Further, the average consumption of plant oils and nuts is too low and accounts for only half of the recommended amount. Moreover, only 2 portions instead of 3 portions of milk product are eaten. On the other hand, meat consumption is more than 3 times higher than recommended. Instead of the recommended 240 grams per week, the average Swiss person eats 780 grams. Men consume almost the double amount of meat when compared to women. On top of this Swiss eat 4 times as many sweets and salty snacks as recommended and four times the amount of fats high in saturated fat such as butter, margarine, cream and fatty sauces[68].

This is a worrying condition, which is supported by the fact that almost every second person in Switzerland is currently obese. Swiss man are more than twice as often obese than Swiss women[68]. Obesity is a condition in which the body weight is to high compared to its hight, mainly because of too much fat. Obesity poses an increased risk for many diseases, such as cardiovascular disorders, diabetes, muscle and bones problems etc. It is most often the result of too high calorie intake and a lack of physical activity.

Meat has a very high carbon footprint. The amount of meat eaten by the Swiss population is therefore very controversial also from a climate perspective. If the Swiss would eat in line with the Swiss national recommendations it would mean a substantial gain for the climate. Reducing the amount of meat to healthy levels and increasing the amount of vegetables and grains instead will significantly reduce the overall carbon footprint of the Swiss diet. Although an exact analysis should be carried out to estimate the full potential, a coarse estimation gives us already a good impression on what is at stake. If we would reduce the amount of meat eaten per person by 540 grams and replace this with an equal amount of calories provided by vegetables, we calculated a potential saving of 4.5kg CO_2 per person per week. If everyone in Switzerland would do this would equal 37'800 tons of carbon which equals the carbon sequestration potential of the amount of trees that would cover Switzerland completely 7 times.

3.5 THERE IS A WIN-WIN FOR HEALTH AND CLIMATE

In Europe a healthy and sustainable diet could reduce up to 1.7t of CO_2-equivalents per person, per year[69]! That is as much as 550 million less cars on the street.

Multiple studies found similar results of a substantial reduction in greenhouse gas emissions by changing the current national diet into a healthy one[69]. The potential of healthy diets in line with national recommendations to reduce greenhouse gas emissions varies between 10% and 35%[69]. A sustainable diet that is still in line with national health recommendations has an even larger potential. The broad range of results was caused by the use of different data sources, different baseline measurements, and, what's the most important, different definition of a healthy diet.

Current diets substantially deviate from general health recommendations. Eating healthier helps to tackle climate change as there is a great overlap between improving the healthiness and reducing the carbon footprint of our diet. The top priorities for health as well as for climate is to eat more fruits and vegetables and to reduce the amount of meat in favor of plant proteins. Nevertheless, most current dietary recommendations disregard the sustainability aspects. This means that diets that are designed to maximize sustainability and in line with health recommendations have an even larger potential to reduce greenhouse gas emissions than diets that are designed to be healthy only. A plant-based (predominantly vegan) diet that is associated with reduced greenhouse gas emissions was found to be also associated with decreased mortality[70].

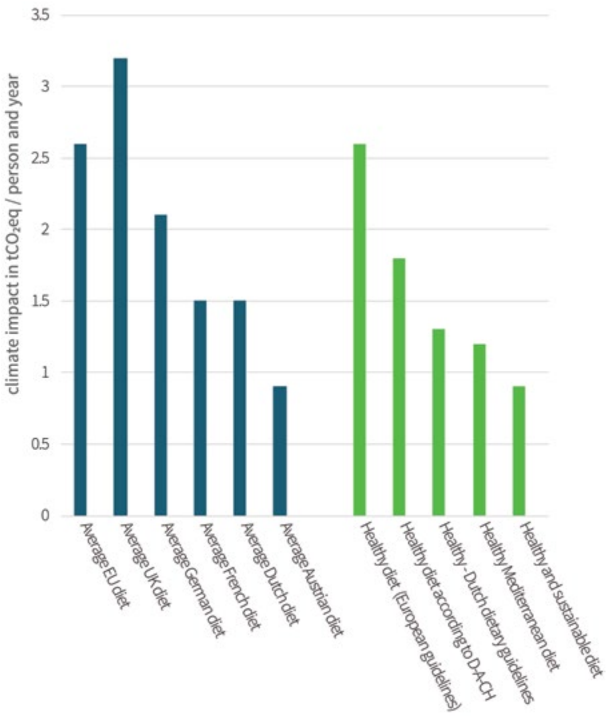


FIGURE 3.4

The climate impact of different diets. The blue bars show the climate impact of the current average diet of different countries, whereas the green bars show the climate impact of diets that are in line with health recommendations[69].

3.6 A COMPARISON OF EXISTING QUANTITIVE MEAL INDICATORS

Only 10% of all meals analyzed were healthy and climate-friendly at the same time.

To judge how much a meal contributes to a healthy diet we can calculate its nutritional content. This method is a more accurate evaluation of how much a meal contributes to a healthy diet than if we consider food-group based guidelines only. Technological advancements have given us the potential to have fast and easy access to complex information to support and simplify decision-making. We therefore, analyzed three different existing and scientifically published nutrient indicators that aim to show which meals follow the dietary guidelines closely and which do not. In general, all these meal indicators focus on providing us with the right amount of nutrients. A brief description of the different scores can be found below.

The analysis was carried out on a sample of 600 meals representative for the food service industry. Nutritional data was extracted from the Swiss nutrition database. If no Swiss data was available it was extracted from neighboring countries in the EuroFIR database. In the meal sample 49% of the meals had meat, 11% had fish and 40% were vegetarian. Only 10% of all meals analyzed were classified as healthy and climate-friendly at the same time.

Meals were classified „healthy“ when their score was within the healthy range defined by the authors or if no range was proposed, they were in the top 1/3 of the healthiest meals. Although all meals of each category could be healthy meals, fish slightly more often classified as „healthy“, whereas the vegetarian meals were slightly less healthy.

In total 29% of all meals got the Eaternity Award for having a low carbon footprint. On average 30% of those meals were also classified as healthy. This means that if we choose a climate friendly meal, we have almost a chance of 1/3 that this meal is also good for our health. Furthermore, of all the meals that were classified as healthy approximately 30% got the Eaternity Award. However, on the complete meal sample approximately only 10% of all meals were healthy and climate friendly at the same time.

There is a lot of room for improvement at low effort. Exchanging creamy, starchy side dishes for healthier ones that include more vegetables had a major impact on the amount of meals that were classified healthy and climate-friendly.

Description of the scores used

Meal scores were calculated with three different scientifically published methodologies: the nutritional footprint[71], susDISH[72] and the Sustainable Nutrient Rich Food index (SNFR)[73]. All three indicators calculate a score based on daily caloric and nutrient recommendations, and evaluate similar sets of nutrients. Decisions made on which nutrients to include, and if they would contribute negatively or positively to the overall score were based on scientific knowledge and expert judgement.

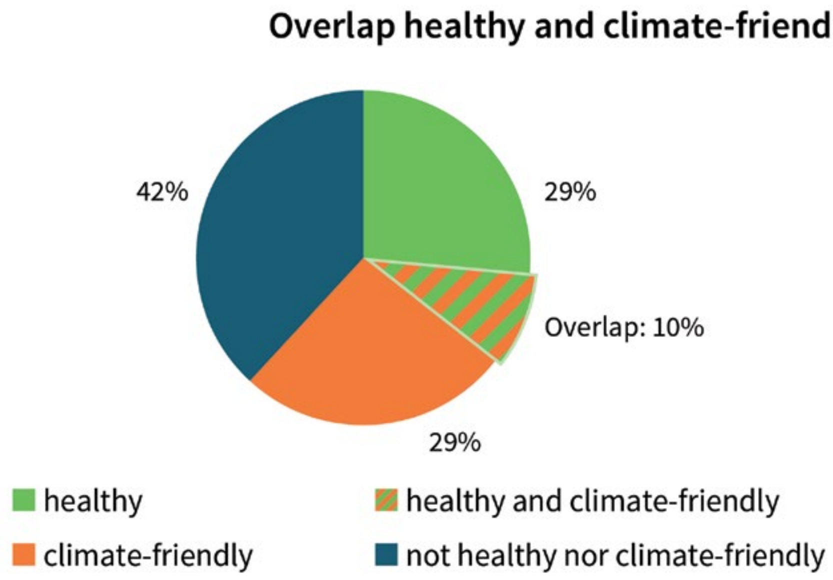
All the scores consider energy, salt and fat as something to be limited, whereas the intake of other nutrients are encouraged. The math behind the scores is relatively simple. Every nutrient in the indicator gets a score which is then summed up to a total score. In the nutritional footprint all nutrients get either one or zero points depending on if the recommended intake for a meal is fulfilled or not. In susDISH and the SNRF a nutrient gets between 0 and 1 points depending on how much of the recommended intake is fulfilled by the meal. When the recommendations are over-exceeded, the scores do not give any additional “rewards” or “punishments”. The recommended intake for nutrients and calories for meals was assumed to be 1/3 of the daily amount by the two scores (Nutritional footprint and susDISH), whereas the third score (SNFR scaled the daily recommendations to 100g of a meal. The choice of micro and macro nutrients too be included in the scores was based on current knowledge and expert judgment.

A short overview of the different meal indicators is given in the table 3.1.

Relative contributions of the different nutrients to the overall score are treated equally in all three indicators. The main reason given for the equal treatment of all macro- and micronutrients is the lack of scientific evidence that sufficiently shows that one nutrient is more important for your body than another one to maintain good health. All of them have different functions and all of them are important.

The meal scores of the different indicators had a moderate positive, but significant correlation. This shows that the general coarse direction of which meals are most healthy were the same for all indicators, but that there are also some differences between the indicators in how single meals are exactly evaluated and ranked.

The choice which nutrients are used in the different indicators substantially influenced where a single meal would end up in the ranking. From this we conclude that even though all indicators were developed and based on sound data the scientific discussion on what is exactly the best way to calculate and evaluate the health of a meal based on its nutritional content in a single score is still ongoing.



ALMOST 1/3 OF ALL CLIMATE FRIENDLY MEALS ARE ALSO HEALTHY AND VICE VERSA. IN TOTAL 29% OF ALL MEALS WERE CLIMATE FRIENDLY.

FIGURE 3.5
Only 10% of all meals analyzed are both, healthy and climate-friendly. The analysis was carried out on more than 600 meals that ae representative for the food service industry.

Table 3.1. Nutritional scores for meals used in our analysis. The colors visualize the overlap between the indexes, as they mark the same or very similar nutrients

	Nutritional Footprint (Lukas et al., 2015)	Other regulations	Sustainable Nutrient Rich Food Indicator (SNRF) (van Dooren et al., 2017)
Main nutrients (colours show the same or similar micro and macro nutrients across the indicators)	Energy (kcal) Sodium intake (g) Content of dietary fibre (g) Saturated fatty acids (g)	Energy (kcal) Proteins (g) Essential amino acids (g) Total fat (g) Carbohydrates (g) Salt (g) Fibre (g) Vitamin B1 (mg) Folic acid (ug) Vitamin B12 (ug) Vitamin C (mg) Vitamin E (mg) Calcium (mg) Magnesium (mg) Iron (mg) Cholesterol (mg)	Energy (kcal) Essential fatty acids (g) Saturated fatty acids (g) Plant protein (g) Sodium (g) Fibre (g) Added sugar (g)
Daily nutrient recommendations for a meal	1/3 of daily amount	1/3 daily amount	whole daily amount scaled to 100g of a product

3.7 THE VITA SCORE

Eaternity has developed the Vita Score for meals that aims at following a minimum risk diet to reduce the risk for noncommunicable diseases such as cardiovascular disorders, diabetes or cancer. The Vita Score complements existing dietary recommendations and guidelines and focuses on the role of bad dietary habits in the development of dietary disease. Therefore, it explicitly targets major health problems related to current diet in modern societies. These are often related to the overabundance of food, a high amount of processed foods and changing lifestyles. With the Vita Score you can develop meals that contribute to a „minimum risk diet“ and protect your health.

The decision to develop the Vita Score was based on our analysis of and review on the most prevalent dietary-related health problems in modern society, on the current health recommendations, tools and depictions to promote healthy eating available. The Vita Score fulfills the following criteria:

- The score is given for meals. It therefore supports chefs in providing us with healthy meals.
- It works also without making exact calculations of nutrients. A good Vita Score can be reached by focussing only on the relevant food groups.
- It complements existing approaches that promote balanced eating. It focuses explicitly on targeting bad dietary habits, which cause diet related diseases.
- It focuses on the most important and urgent dietary problems of a society.
- It prioritizes food decisions based on how many years of life a society loses because people get ill.

The data provided by The Global Burden of Diseases, Injuries and Risk Factor Study (GBD) quantifies the disease risk of dietary habits and is the firm foundation of the Vita Score.

The GBD project calculates, for every dietary risk factor, the number years of life lost in a given population due to disability or premature death. The outcome is called DALY (Disability Adjusted Life Years) and it is most commonly given per 100’000 persons. The number of DALYs per risk factor depend on age, gender and country. This means that the outcomes of the diet related disorders expressed in DALYs will differ depending on these factors.

In total there are 14 dietary risk factors that contribute to disease. They are listed and described in the table below together with their recommended dietary intake. A risk factor can be protective, meaning that if we eat enough of it this contributes to preventing a disease or harmful meaning that if we eat too much of it this may cause a disease.

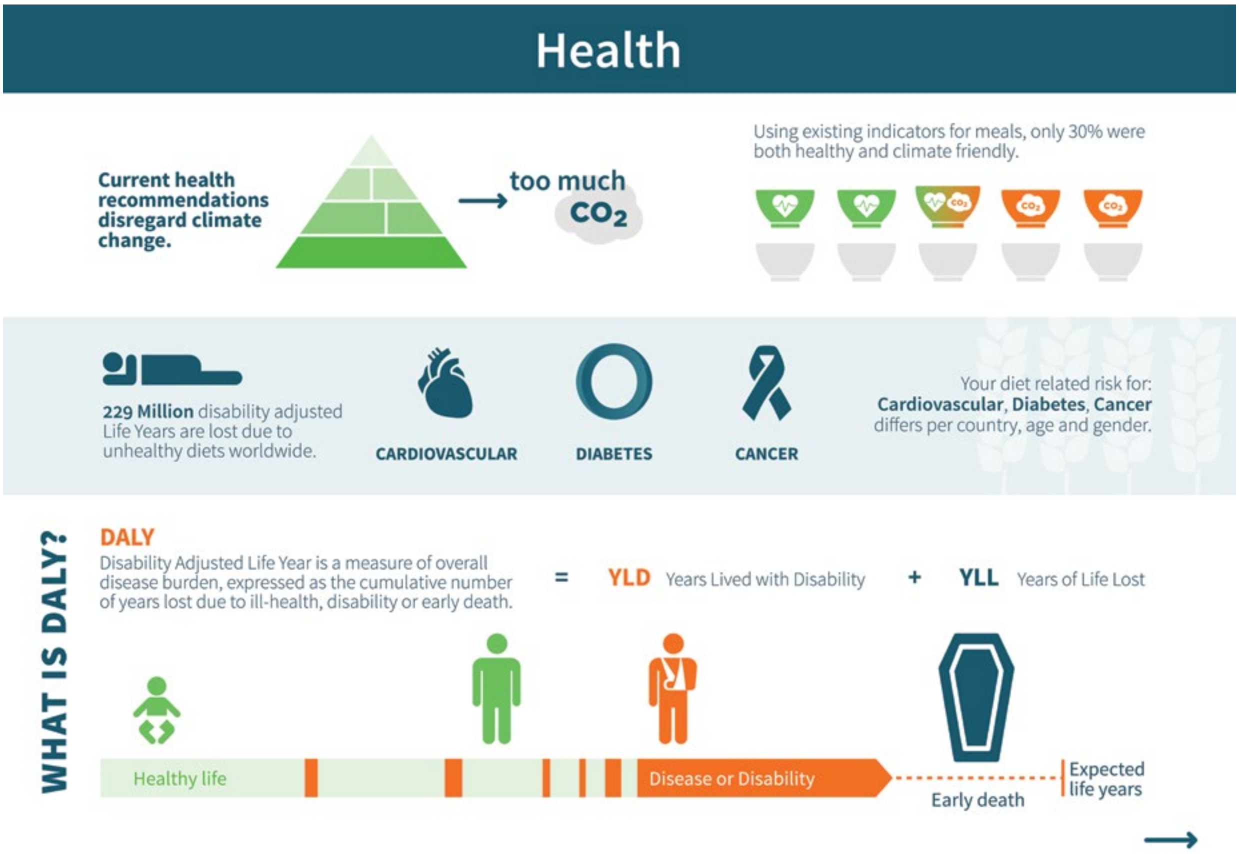


Table 3.2. Dietary risk factors defined and used in the GBD study

Dietary risk factors	Definition	Recommended intake	Effects on health	DALY per 100’000 people
Diet low in whole grains	Average daily consumption of whole grains (bran, germ, and endosperm in their natural proportion) from breakfast cereals, bread, rice, pasta, biscuits, muffins, tortillas, pancakes, and other sources	100-150 [g]	protective	124
Diet low in fruits	Average daily consumption of fruits (fresh, frozen, cooked, canned, or dried, excluding fruit juices and salted or pickled fruits)	200-300 [g]	protective	122
Diet low in vegetables	Average daily consumption of vegetables (fresh, frozen, cooked, canned or dried vegetables including legumes but excluding salted or pickled vegetables, juices, nuts and seeds, and starchy vegetables such as potatoes or corn)	340-500 [g]	protective	88

Dietary risk factors	Definition	Recommended intake	Effects on health	DALY per 100'000 people
Diet low in nuts & seeds	Average daily consumption of nut and seed foods	16-25 [g]	protective	66
Diet low in omega-3	Average daily intake of eicosapentaenoic acid and docosahexaenoic acid	200-300 [mg]	protective	53
Diet low in fiber	Average daily intake of fiber from all sources, including fruits, vegetables, grains, legumes, and pulses	19-28 [g]	protective	43
Diet low in calcium	Average daily intake of calcium from all sources, including milk, yogurt, and cheese	1-1.5 [g]	protective	9
Diet low in milk	Average daily consumption of milk, including non-fat, low- fat, and full-fat milk, excluding soy milk and other plant derivatives	350-520 [g]	procetive	8
Diet low in poly unsaturated fatty acids (PUFA)	Average daily intake of omega-6 fatty acids from all sources, mainly liquid vegetable oils, including soybean oil, corn oil, and safflower oil	9-13% of total energy	protective	8
Diet high in processed meat	Average daily consumption of meat preserved by smoking, curing, salting, or addition of chemical preservatives	0-4 [g]	harmful	55
Diet high in sodium (salt)	24 h urinary sodium measured in g per day	1-5 [g]	harmful	46
Diet high in trans fats	Average daily intake of trans fat from all sources, mainly partially hydrogenated vegetable oils and ruminant products	0-1% of total energy	harmful	21
Diet high in red meat	Average daily consumption of red meat (beef, pork, lamb, and goat but excluding poultry, fish, eggs, and all processed meats)	18-27 [g]	harmful	14
Diet high in sweetened beverages	Average daily consumption of beverages with ≥50kcal per 226·8 g serving, including carbonated beverages, sodas, energy drinks, and fruit drinks, but excluding 100% fruit and vegetable juices	0-5 [g]	harmful	3

The Vita Score uses 8 out of 14 dietary risk factors identified by the GBD Study. These are 7 food groups (whole grains, fruits, vegetables, nuts and seeds, processed meat, red meat and milk) and salt. The reason for including only these groups, is that there is some overlap between some of the food groups food groups and nutrients, which cannot be separated (as explained to us by an professor involved in the GBD project). For example the risk factor „diet low in omega 3" overlaps strongly with the risk factor „diet low in poly unsaturated fatty acids", as omega 3 is a poly unsaturated fatty acid. In addition, these two risk factors overlap with the risk factor nuts & seeds, as nuts are rich in poly unsaturated fatty acids. So increasing nuts & seeds in our diet also increases the intake of poly unsaturated fatty acids. Two risk factors a "diet high in trans fats" and a „diet high in sweetened beverages were excluded for other reasons. Trans fats were excluded, because sufficient data in nutrition databases is currently lacking. Trans fats can be mainly found in processed products. The sweetened beverages were excluded as they are not part of the meal planning from a chef's perspective.

The dietary risk factors used in the calculation of the Vita Score are not treated equally, but weighed according to the amount of DALYs given by the GBD project. This means that the Vita Score shows a relative importance of different dietary habits. For example, lack of whole grains in the Swiss population is related to 124 years of life lost per 100'000 people, whereas eating too much salt is related to 46 years of life lost. In the Vita Score it is reflected in the whole grain products being almost 3 times more important than salt.

The dietary recommendations of the Vita Score show a substantial overlap with dietary recommendations of established health organizations, but there are also differences. One of the prominent differences can be found in the exact recommendation for starchy foods. The Swiss Nutritional Society[74] recommends 3 portions or approximately 300 grams of starchy foods such as cereals, potatoes and legumes[74,75]. The Vita Score focuses on whole grains only, as these are central in reducing disease risk. This means that from a nutritional

THE VITA SCORE AND THE RELATIVE IMPORTANCE OF DIFFERENT FOODS

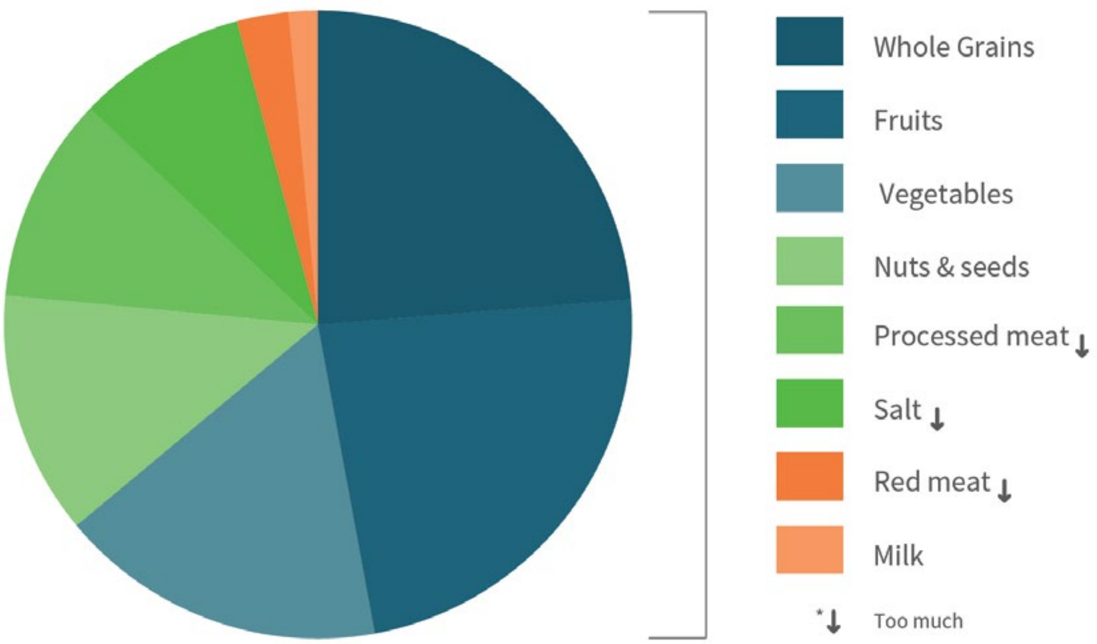
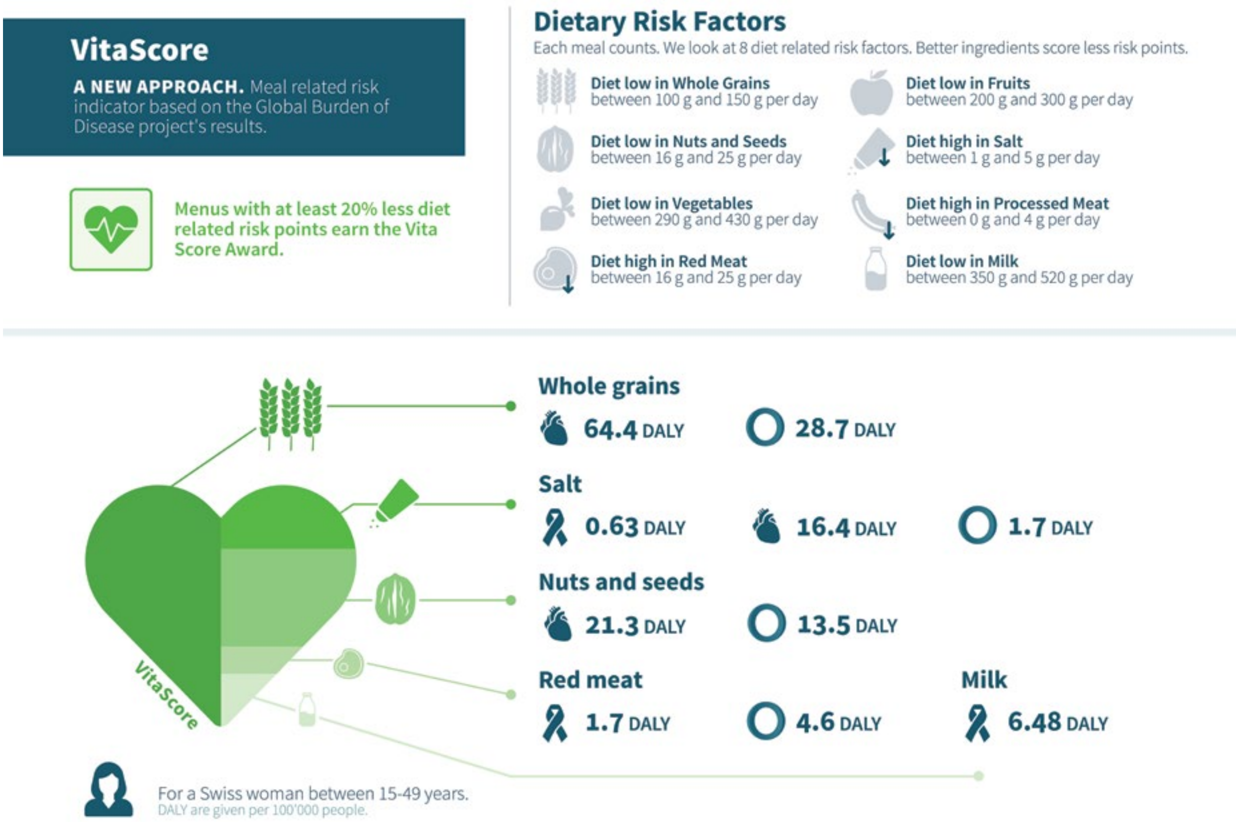


FIGURE 3.6
Food groups, food products and their relative contribution to a minimum risk diet. Processed meat, salt and red meat we should eat less. All other foods we should eat more.



perspective eating any kind of starchy food is good enough, but if these are not whole grain products the Vita Score for a meal will not be good. Another substantial difference is the recommended amount of red meat. Two portions per week are generally recommended to provide us with important nutrients. However, the Vita Score advises strongly against consumption of red meat.

As the Vita Score evaluates and aims at reducing disease risk not all nutritional components are evaluated equally important. The importance depends on how severe a burden of disease related to this dietary risk factor is. However, by basing decisions on the Vita Score there is still a high chance to get all necessary micronutrients as it promotes actively those food groups that are stuffed with them. This is at the same time also the largest and most important similarity between the Vita Score and national health recommendations as both stress the key role of fruits and vegetables in our diet.

An exact description of how the Vita Score is calculated can be found in our peer-reviewed documentation on the Vita Score. The documentation is an invitation for collaboration to scientists and experts.

3.8 THE VITA SCORE AND CLIMATE IN THE FOOD SERVICE INDUSTRY

The Vita Score calculates risk points for meals and depends on the deviation of a certain recommended intake per risk factor and the number of DALYs that this risk factor gets. The more risk points a meal gets the more it contributes to a diet related to disease burden.

Meals that belong to the best 20% of all meals receive the Vita Award. The exact value is defined yearly and depends on all the meals calculated by Eaternity which are currently over 76'000.

We investigated the behavior of the Vita Score on the same sample of meals used in chapter 3.6 which is representative for the food service industry. The Vita Score ranged between 94 and 515 risk points. In total 29% of all meals received the Climate Score Award and 20% of all meals got the Vita Award. As found in the analysis in chapter 3.6 only 10% of all meals were found to be healthy and climate friendly at the same time. However, if a meal received the Vita Award half of those meals were climate friendly.

Of those meals that received the Vita Award 62% were vegetarian, 32% contained meat and 21% fish. Vegetarian meals and those with fish had in general a better score than meat dishes.

Current healthy meal suggestions, the Vita Score and climate

Another quick test showed that meals cooked at an employee restaurant especially designed to be healthy also had a good Vita Score. However, not all meals were climate-friendly. For example, a meal with veal meat, parsley pesto, ebly and aubergines had a good Vita Score, but high carbon emissions. Other meals had a good Vita Score and were good for climate. For example, a zander fish in white wine sauce with whole grain spaghetti and leek or a gratin with vegetables, cream-sauce, cheese and a side salad have a good Vita Score and are climate-friendly.

That there is no 100% overlap between a healthy and climate-friendly meals shows that it is important to consider both factors at the same time to reach climate and health goals.

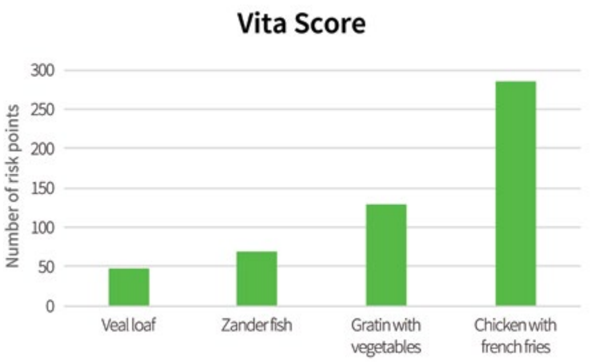


FIGURE 3.7
The Vita Score for four exemplary meals cooked at a restaurant. The meal with the best score was "veal loaf" because it has a high amount of vegetables and whole grains. The meal with the worst score is chicken with french fries mainly because it does not have any vegetables or whole grains.

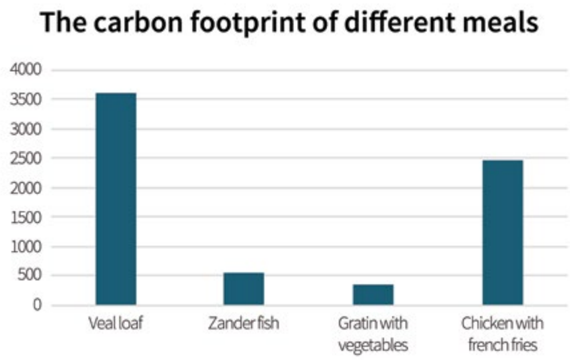


FIGURE 3.8
The carbon footprint of the same meals for which the Vita Score was calculated above. The Zanderfish and the gratin with vegetables are climate-friendly and have a good Vita Score. The veal loaf and the chicken with french fries have an above average carbon footprint, but the veal loaf has a good Vita Score. This shows that a healthy meal is not automatically climate friendly and that both factors need to be considered for choosing a sustainable meal.

THE CONNECTION BETWEEN FOOD GROUPS AND DISEASE RISK

Whole grains[76,77]
Many studies showed that eating whole grain products is associated with a reduced risk of cardiovascular diseases. The most common cardiovascular diseases are heart attack and coronary artery disease, which is narrowing of the arteries around the heart because plaques made of cholesterol and other substances. Compared to refined grains, whole grain products consist of the complete grain instead of only the inner part. Wholegrain has many valuable biologically active agents such as fibre, vitamins, minerals and other plant compounds. These substances have been shown to decrease risk of cardiovascular disorders by affecting, among others, stable blood glucose levels, improves cholesterol profile in the blood.

Vegetables and fruit[78]
Vegetables and fruit are a very heterogenous group of foods rich in variety of vitamins, minerals, dietary fibre and other phytochemicals. All these substances are needed for one's body to function properly. For instance these micronutrients influence glucose or insulin response, the feeling of satiety and repair mechanisms of the body. Many studies showed that a diet high in fruits and vegetables has a positive effect on health and is related to a reduced risk of cardiovascular disorders, diabetes and cancer.

Nuts and seeds[79,80]
Even though various nuts and seeds are rich in fats they have a very favorable fatty acids profile as they are rich in unsaturated fatty acids and low in the saturated ones. Unsaturated fat plays a role in lowering the cholesterol level in the bloodstream and therefore is associated with a reduced the risk of cardiovascular disorders. Furthermore, dietary fibre and other components in nuts may have further protective effects.

Processed meat[81]

Many studies showed that an increased consumption of processed meat is associated with an increased risk of cardiovascular disorders and diabetes. There are two main components of processed meat that most likely contribute to these findings. First, nitrates and their byproducts used for preservation are related to the hardening and narrowing of the blood vessels and vascular disfunction. They are further related to a reduced insulin secretion needed for sugar uptake and impaired glucose tolerance. Second, increased concentrations of salt are related to vascular stiffness and increased blood pressure. Furthermore, a diet high in processed meat has been associated with the increased risk of cancer. Although, the exact mechanisms is not known yet, it is assumed that nitrites and nitrates used to preserve the meat are involved.

Red meat[82]
Increased consumption of red meat has been associated with an increased risk of diabetes type II and cancer. Several potential mechanisms have been identified that might be involved. It is possible that iron deviated from red meats may have a damaging effect on the pancreas. A malfunctioning pancreas is associated with diabetes. Another potential explanation involves the inflammatory agents that are found in red meats and damage critical organs.

Salt[83]
A diet high in salt is strongly related to cardiovascular disorders, but it may also play a role in increased risk for cancer and diabetes. Even though salt is essential to our functioning, high consumption of salt increases blood pressure, which is related to adverse cardiovascular outcomes such as heart attacks. Furthermore, increased salt intake may change how cells that cover the inner service of our vessels function, which is related to kidney damage.

Milk[84]
Diets high in milk might help to reduce the development of certain types of cancer (e.g. colorectal or breast cancer). Calcium is thought to be the most important anti-carcinogenic component and milk is still in general seen as a good source of calcium.

3.9 GUIDELINES FOR HEALTHY EATING

The Vita Score complements existing dietary recommendations and guidelines and stresses the role of bad dietary habits related to disease. A good Vita Score can be reached by following the food group based diet recommendations based on the GBD project's findings. Those guidelines that influence the Vita Score the most are listed first. The relative weights of the recommendations used in the Vita score are listed in brackets and are based on the number of DALYs as calculated by the GBD project[59].

Most important dietary recommendations to reduce disease risk

1. **WHOLE GRAIN (Vita Score weight: 124)** The most important thing is to eat more whole-grain products. Replace white bread, pasta and plain rice with their whole-grain alternatives. The recommended minimum daily a mount of whole-grain products is 125g. A diet low in whole grain products accounts for almost 19% of the total burden of diet related diseases identified by the GBD study.
2. **FRUITS (Vita Score weight: 122)** Eat more fruits. An average person should eat at least 250g of fruits per day. A diet low in fruits accounts for 18.5% of the total burden of the diet related diseases identified by the GBD study.
3. **VEGETABLES (Vita Score weight: 88)** Eat more vegetables. You should eat at least 420g of vegetables per day. A diet low in vegetables accounts for 13.4% of the total burden of the diet related diseases identified by the GBD study.
4. **NUTS AND SEEDS (Vita Score weight: 66)** Eat approximately 20g of unsalted nuts and seeds per day. Diets high in nuts and seeds help reduce risk of cardiovascular diseases in diabetes. Moreover, nuts and seeds contain large amounts of the beneficial unsaturated fats. A diet low in nuts and seeds accounts for 9.9% of the total burden of the diet related diseases identified by the GBD study.
5. **PROCESSED AND RED MEAT (Vita Score weight: 55 and 14)** Minimise the consumption of processed and red meat. Processed meat (meat preserved by smoking, curing, salting, or addition of chemical preservatives, for example bacon, salami, sausages, ham, turkey, and pastrami) contains additional chemical substances (e.g. nitrates and nitrites) and large amounts of salt; therefore, it should be avoided altogether. Recommended portion of red meat is between 18-27g per day, which can be summed up to a small portion between 126 and 189g per week. A diet high in processed meat accounts for 8.4% and diet high in red meat for 2.1% of the total burden of the diet related diseases identified by the GBD study.
6. **SALT (Vita Score weight: 46)** Decrease the amount of salt. Many processed foods and finished meals have extra salt, which adds up to the amount used during cooking. Tasty alternatives to salt are herbs and spices, which make the dishes taste vibrant and delicious. An average person shouldn't eat more than 5g of salt per day - that is only ca. 1 teaspoon! A diet high in salt accounts for 6.9% of the total burden of the diet related diseases identified by the GBD study.
7. **MILK (Vita Score weight: 8)** Include enough milk. You should drink between 340 and 505ml of milk per day. This includes non-fat, low-fat and full-fat milk but excludes the plant derivatives (e.g. soy milk). A diet low in milk accounts for 1.2% of the total burden of the diet related diseases identified by the GBD study.

Supplementary dietary recommendations for balanced eating

The following guidelines target a balanced diet and complement the guidelines above. They support the score to check if you are going into the right direction when designing a healthy meal.

- A balanced meal is composed mainly of vegetables (and fruits), foods rich in carbohydrates and foods rich in protein and provide enough, but not too much energy. The recommended value of calories per day varies depending on persons age, gender and amount of physical activity. For an average adult it is approximately 2000kcal.
- A balanced meal should derive 45-55% of it's calories from starchy products, 20-35% from fat and 10-15% from proteins.

- The healthy fat and protein score cards can be used to make smart decisions on healthy fats and proteins that are also climate-friendly.
- From a plate perspective one can approximately say that vegetables should make about 40% or more of a size of a plate for a lunch or dinner meal, protein rich components 20% and starchy components around 40%.
- Avoid processed foods that are rich in trans fats. Trans fats can be mainly found in in snacks such as crisps, french fries and other deep fried foods, finished cake mixes and frostings and hardened plant fats such as margarines and other spreads.
- Reduce products with added sugars. Among others, glucose sirup, sucrose or corn sirup are often added to beverages and other processed foods. They do not provide any nutritional value except for “empty calories”, which correlate strongly with high energy intake and obesity.
- Small things matter. Choice of side dishes can greatly influence the healthiness of a meal. Choosing fresh vegetables over those covered with a heavy sauce or deep fried products is always the healthy option. Furthermore, with a smart choice of side dishes you can increase the variety of products you eat and increase changes of getting all the nutrients you need.

SOLUTIONS

Our shared responsibility for current and future generations demands actions that are not taken blindly, but fact based. And the facts indicate that the choices of each individual are the backbone of a global solution. If we, the community including everyone on this planet, continue consuming products that are not within our planetary boundaries, displacements and destruction will be worse than all wars in human history combined. Let's act today.

Eaternity's focus is the link between food and climate change. In our latest study we underscore challenges in the two most prevalent sustainability recommendations for diets: Organic and Healthy.

It's particularly difficult to address the need for change in global warming, as the arch from cause to effect spans 20-30 years. Once the damage becomes obvious it will be too late to act. It's a challenge to ask for profound changes when the need for change has not been felt entirely as of yet.

The only way is to rely on scientific predictions. Science is complex and complexity is a tough sell. But that being said, the solutions to a complex matter can sometimes be very simple. As simple as following a guideline.

With our work we aim at providing the data and the tools for joint climate action. We are inviting institutions who are recommending healthy diets and who are representing organic agriculture to join us. We encourage solutions which are both, accessible and tempting, for every consumer.

Our science tells us that key-aspects for the sustainable development of our food system are still missing. The picture is not yet whole. We are missing opportunities at targeting consumers who are willing and able to make choices that are compatible with our goal to keep global warming below 2° Celsius, as written in the Paris Climate Accord. And we can proof that economic values along the production chain can be kept up and still everyone involved can actually make a decent living.

At Eaternity we are focusing on helping the restaurant industry taking on the key-role they are facing in climate change and public health. We have crafted simple to use tools for smart chefs who decide to join us in acting now.

Our Eaternity App is a solution that provides simple indicators for healthy meals, a nutritional balance, a low water footprint, good animal treatment, minimal deforestation, seasonal production, local production, and low greenhouse gas emissions. Every single one of these scores or footprints come with an award for menus that contribute to the overall goal.

At the same time, the data for all our indicators is available for everyone for commercial and for non-commercial use outside the food service industry. Because in the end we're not a tech start-up or a money-driven corporation. What moves our growing company, and what reunites us every day as a team at Eaternity, is our huge App'etite for Change.

Manuel Klarmann
Chief Executive Officer
Eaternity

5 Health Aspects

+ GBD Risk Factors
+ Micor- & Macronutrients
+ Energy Values
+ Balanced Eating
+ Allergens

7 Life Cycle Assessment Modules

+ Product Footprint Database
+ Greenhouse Heating
+ Transportation & Origin
+ Farming procedure
+ Preservation
+ Processing
+ Waste

8 Indicators

+ Vita Score
+ Nutritional Balance
+ Climate Score
+ Water Scarcity
+ Animal Treatment
+ Deforestation
+ Regionality
+ Season

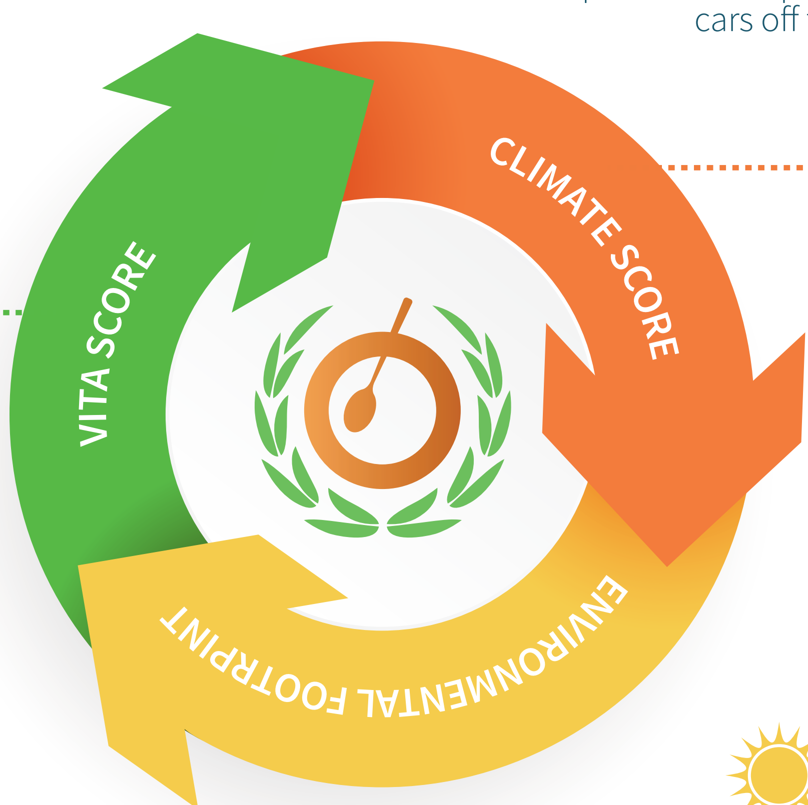
Reduce the risk of food related diseases.

80% of heart disease, stroke and diabetes type II and 40% of cancer could be avoided.

CO_2

Reduce food-related carbon emissions by 50%.

If every Swiss ate 3 climate friendly meals per week, the impact would equal 750.000 cars off the street.



Choose local, to avoid transports.

Eat seasonal produce.

Minimize land use change.

Cut down water footprint by 50%.

Promote better animal treatment.

THE EATERNITY APP

We follow the design philosophy that puts humans in the center - the easier and the more intuitive the usability of the tool, the more successful and fulfilling the work will be. The Eaternity App playfully accounts for the aspects of profitability, healthiness, sustainability and climate impact of a meal – all at once. All scores provide insights that are helpful and challenge you in reaching for the best recipe. Your produce’s specifics like origin and processing methods are automatically extracted from your data. They don’t need to be edited manually. You may get started with evaluating your scores by simply knowing what to call your menu. Effortlessly you are in charge to provide the best experience for your guests; while building trust in your skills and climbing up the ranks of a true climate hero.

Menus that cause at least 50% less CO_2 emissions earn the Climate Score Award.*

Menus with at least 20% less diet related risk points earn the Vita Score Award.*

Menus with 50% less scarce water use on average earn the Water Footprint Award.*

Balanced menus with a good energy value score the Nutrition Label.

Menus with certified or non critical products score the Rainforest Label.

Menus with good animal treatment, or no animal products, score the Animal Treatment Label.

Menus with only minor emissions from greenhouses score the Season Label

Menus with ingredients traveling on average less than 200 km score the Local Label

Menus that double the profit of an average offer score the Profit Label.

The Eaternity Award is reserved for the 20% best menus in all the categories.*

* We have calculated over 76’000 menus. These menus are our baseline for comparisons.

Brie Fondue, Apricots, Gingered Chicken

Gingered Chicken	Chicken, skin-on	2 breasts
	Rosemary	2 sprigs
	Fresh ginger root	1 cm
	Salt	½ tsp.
	Butter	1 Tbsp.
	Honey	2 Tbsp.
	Water	½ Tbsp.
Grilled Apricots	Apricot (can be frozen)	1
	Champagne vinegar	1 tsp.
	Chilly flakes	1/8 tsp.
	Honey	½ tsp.
Brie Fondue	White wine, dry	½ cup
	Brie, Swiss	120 g
	Mascarpone	80 g
	Black pepper, whole	
	Nutmeg	
	Mint	1 sprig

VALUES PER PORTION

Cost	CHF 4.32
Profit	
Nutrition	632 kcal
Vita Score	
Climate Score	
Environment	

Climate Score (rating: 2 of 5)
1572 g CO_2eq per portion
1% better than average.

Water Footprint (rating 5 of 5)
2.4 L per portion
89% better than average.

Vita Score

13% worse in comparison to an average menu.

Score	2 von 5
Risk points	375
Award	< 260

Menus with at least 20% less diet related risk points earn the Vita Score Award.

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I BIBLIOGRAPHY

1 Rockstrom, J, Steffen, W, Noone, K, Persson, A, Chapin, FS, Lambin, EF, Lenton, TM, Scheffer, M, Folke, C, Schellnhuber, HJ, Nykvist, B, de Wit, CA, Hughes, T, van der Leeuw, S, Rodhe, H, Sorlin, S, Snyder, PK, Costanza, R, Svedin, U, Falkenmark, M, Karlberg, L, Corell, RW, Fabry, VJ, Hansen, J, Walker, B, Liverman, D, Richardson, K, Crutzen, P & Foley, JA (2009). A safe operating space for humanity. Nature, 461, 472-475.

2 Global Footprint Network. 2013. Tools & Resources: Open Data Platform - Compare countries [Online]. Available: http://data.footprintnetwork.org/#/compareCountries?type=earth&cn=5001&yr=2013 [Accessed 01.09.2017].

3 Bailey, R, Froggatt, A & Wellesley, L (2014). Livestock–climate change's forgotten sector. Chatham House.

4 Bajželj, B, Richards, KS, Allwood, JM, Smith, P, Dennis, JS, Curmi, E & Gilligan, CA (2014). Importance of food-demand management for climate mitigation. Nature Climate Change, 4, 924-929.

5 Challinor, AJ, Watson, J, Lobell, DB, Howden, SM, Smith, DR & Chhetri, N (2014). A meta-analysis of crop yield under climate change and adaptation. Nature Climate Change, 4, 287-291.

6 Hedenus, F, Wirsenius, S & Johansson, DJA (2014). The importance of reduced meat and dairy consumption for meeting stringent climate change targets. Climatic Change, 124, 79-91.

7 Pachauri, RK, Allen, MR, Barros, VR, Broome, J, Cramer, W, Christ, R, Church, JA, Clarke, L, Dahe, Q & Dasgupta, P (2014). Climate change 2014: synthesis report. Contribution of Working Groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change, IPCC.

8 Folberth, C, Skalsky, R, Moltchanova, E, Balkovic, J, Azevedo, LB, Obersteiner, M & van der Velde, M (2016). Uncertainty in soil data can outweigh climate impact signals in global crop yield simulations. Nature Communications, 7, 11872.

9 Hansen, J, Sato, M, Ruedy, R, Lo, K, Lea, DW & Medina-Elizade, M (2006). Global temperature change. Proceedings of the National Academy of Sciences, 103, 14288-14293.

10 Tukker A, Huppes G, Guinée J, Heijungs R, de Koning A, van Oers L, Suh S, Geerken T, van Holderbeke M, Jansen B, Nielsen P, Eder P & Delgado L (2006). Environmental Impact of Products (EIPRO). European Communities.

11 Vermeulen, SJ, Campbell, BM & Ingram, JSI (2012). Climate change and food systems. Annual Review of Environment and Resources, 37, 195-222.

12 Steinfeld, H, Gerber, P, Wassenaar, T, Castel, V, Rosales, M & de Cees, H (2006). Livestock's long shadow: environmental issues and options, Rome, FAO.

13 Tubiello, F, Salvatore, M, Cóndor Golec, R, Ferrara, A, Rossi, S, Biancalani, R, Federici, S, Jacobs, H & Flammini, A (2014). Agriculture, forestry and other land use emissions by sources and removals by sinks Rome, Italy.

14 Eaternity. 2017. The Eaternity Database: A solid scientific basis [Online]. Available: http://www.eaternity.org/foodprint/database [Accessed 01.09.2017].

15 Wilkinson, JM (2011). Re-defining efficiency of feed use by livestock. Animal, 5, 1014-22.

16 Eymann, L, Kreuzer, S, Stucki, M & Scharfy, D (2014). Ökobilanz von Milch und Milchproduktion. ZHAW Zurich University of Applied Science, Wädenswil ZHAW Agri-food Database, www.zhaw.ch/IUNR/agri-food. LCIA also available at the Eaternity Database (EDB - www.edb.eaternity.org).

17 Pimm, SL, Jenkins, CN, Abell, R, Brooks, TM, Gittleman, JL, Joppa, LN, Raven, PH, Roberts, CM & Sexton, JO (2014). The biodiversity of species and their rates of extinction, distribution, and protection. Science, 344, 1246752-1246752.

18 WWF (2016). Living Planet Report 2016. Risk and resilience in a new era. Gland, Switzerland: WWF International.

19 Chaudhary, A, Pfister, S & Hellweg, S (2016). Spatially Explicit Analysis of Biodiversity Loss Due to Global Agriculture, Pasture and Forest Land Use from a Producer and Consumer Perspective. Environmental Science and Technology, 50, 3928-3936.

20 Scherer, L & Pfister, S (2016). Global Biodiversity Loss by Freshwater Consumption and Eutrophication from Swiss Food Consumption. Environmental Science and Technology, 50, 7019-7028.

21 Bengtsson, J, Ahnstrom, J & Weibull, A-C (2005). The effects of organic agricultureon biodiveristy and abundance: a meta-analysis. Journal of Applied Ecology, 42, 261-269.

22 Nkonya, E, Mirzabaev, A, VonBraun, J & (Eds) (2016). Economics of Land Degradation and Improvement - A Global Assessment for Sustainable Development, Springer.

23 Pimentel, D, Harvey, C, Resosudarmo, P, Sinclair, K, Kurz, D, McNair, M, Crist, S, Shpritz, L, Fitton, L, Saffouri, R & Blair, R (1995). Environmental and economic costs of soil erosion and conservation benefits. Science, 267, 1117-1123.

24 Mader, P (2002). Soil Fertility and Biodiversity in Organic Farming. Science, 296, 1694-1697.

25 Wright, D & Welbourn, P (2012). Environmental Toxicology, Cambridge, Cambridge Environmental Chemistry Series. Cambridge University Press.

26 Landwirtschaft.ch. 2017. Wissen [Online]. Available: www.landwirtschaft.ch [Accessed 23.05.2017].

27 Scharfy, D, Itten, R & Bischof, T (2016). Life cycle assessment of different organic certification schemes. Work Package A2/A3 of the Organic Footprint project. Unpublished report. ZHAW Zurich University of Applied Science, Wädenswil.

28 Hirsiger, E, O'Connor, I & Ellens, J (2016). Meta-Analysis: A review on the differences in environmental impacts of organic and conventional farming-systems. Work Package A1/A2 of the Organic Footprint project. Unpublished report. Zurich: Eaternity.

I BIBLIOGRAPHY

29 Alig, M, Grandl, F, Mieleitner, J, Nemecek, T & Gaillard, G (2012). Ökobilanz von Rind- , Schweine- und Geflügelfleisch. Zurich: Agroscope, Reckenholz.

30 Kreuzer, S, Eymann, L & Stucki, M (2014). Ökobilanzen von Kalb- und Rindfleisch. ZHAW Zurich University of Applied Science, Wädenswil ZHAW Agri-food Database, www.zhaw.ch/IUNR/agri-food. LCIA also available at the Eaternity Database (EDB - www.edb.eaternity.org).

31 Meier, M, Böhler, D, Hörtenhuber, S, Leiber, F & Oehen, B (2014). Nachhaltigkeitsbeurteilung von Schweizer Rindfleischproduktionssystemen verschiedener Intensität. Frick: FiBL, Schweiz.

32 Wolff, V, Alig, M, Nemecek, T & Gaillard, G (2016). Ökobilanz verschiedener Fleischprodukte. Geflügel-, Schweine- und Rindfleisch. Zurich: Agroscope, Reckenholz.

33 Scharfy, D, Itten, R & Bischof, T (2016). Organic LCA and allocation data for the Eaternity Database. Work Package A4 of the Organic Footprint project. Unpublished report. ZHAW Zurich University of Applied Science, Wädenswil.

34 O'Connor, I (2017). Comparison and interpretation of LCAs on livestock in Switzerland and Europe. Work Package C of the Organic Footprint project. Unpublished report. Zurich: Eaternity.

35 Thierrin, R (2017). Meat and Egg LCI. Documentation of LCI dataset for beef, chicken, pork, trout meat and egg production created for the Eaternity database. Zurich: Quantis.

36 O'Connor, I & Ellens, J (2017). Most important indicators in addition to the carbon footprint when evaluating the impact of food consumption (detailed version). Work Package C of the Organic Footprint Project. Zurich: Eaternity.

37 PUSH www.pusch.ch, WWF Schweiz www.wwf.ch, Helvetas www.helvetas.ch, SKS www.sks.ch, FRC www.frc.ch & www.acsi.ch, A (2015). Bewertung der Lebensmittel-Labels 2015. Hintergrundbericht. Zurich.

38 Bundesamt für Landwirtschaft (BLW) (2016). Marktbericht Fleisch November/Dezemer 2016: Tierwohlprogramme des Bundes. Eidgenössisches Departement für Wirtschaft Bildung und Forschung Bundesamt für Landwirtschaft, Fachbereich Marktanalysen.

39 Meier, MS, Stoessel, F, Jungbluth, N, Juraske, R, Schader, C & Stolze, M (2015). Environmental impacts of organic and conventional agricultural products - Are the differences captured by life cycle assessment? Journal of Environmental Management, 149, 193-208.

40 Aguilera, E, Guzmán, G & Alonso, A (2015). Greenhouse gas emissions from conventional and organic cropping systems in Spain. II. Fruit tree orchards. Agronomy for Sustainable Development, 35, 725-737.

41 Cleary, J, Roulet, NT & Moore, TR (2005). Greenhouse Gas Emissions from Canadian Peat Extraction, 1990–2000: A Life-cycle Analysis. AMBIO: A Journal of the Human Environment, 34, 456-461.

42 O'Connor, I & Ellens, J (2016). Menu-Analysis: Consequences for the greenhouse gas emissions when changing from conventional to organic meals. Work Package B of the Organic Footprint project. Unpublished report. Zurich: Eaternity.

43 Brandon, K (2014). Ecosystem Services from Tropical Forests: Review of Current Science. CGD Working Paper 380. Washington DC: Center for Global Development.

44 Food and Agriculture Organization of the United Nations (FAO). 2017. FAOSTAT Data Crop Production [Online]. Available: http://www.fao.org/faostat/en/#data/QC/visualize [Accessed 15.05.2017].

45 Nilsson, K, Flysjö, A, Davis, J, Sim, S, Unger, N & Bell, S (2010). Comparative life cycle assessment of margarine and butter consumed in the UK, Germany and France. International Journal of Life Cycle Assessment, 15, 916-926.

46 Round Table Sustainable Palm Oil (RSPO). 2017. RSPO Round Table Sustainable Palm Oil [Online]. Available: http://www.rspo.org/.

47 Round Table on Responsible Soy (RTRS). 2017. RTRS Round Table on Responsible Soy [Online]. Available: http://www.responsiblesoy.org [Accessed 23.05.2017].

48 Sojanetzwerk Schweiz. 2017. Sojanetzwerk Schweiz [Online]. Available: https://www.sojanetzwerk.ch/ [Accessed 09.05.2017].

49 WWF (2016). Auf der Ölspur Berechnungen zu einer palmölfreieren Welt. Berlin: WWF Deutschland.

50 Food and Agriculture Organization of the United Nations (FAO). 2014. Aquastat: Infographics on water resources and uses. [Online]. Available: http://www.fao.org/nr/Water/aquastat/catalogues/index.stm [Accessed 15.05.2017].

51 Pfister, S, Koehler, A & Hellweg, S (2009). Assessing the Environmental Impacts of Freshwater Consumption in LCA. Environmental Science & Technology, 43, 4098-4104.

52 Mekonnen, MM & Hoekstra, AY (2011). National water footprint accounts: The green, blue and grey footprint of production and consumption. Value of Water. Research Report Series No. 50. UNESCO-IHE, Delft, the Netherlands.

53 Pfister, S, Boulay, A-M, Berger, M, Hadjikakou, M, Motoshita, M, Hess, T, Ridoutt, B, Weinzettel, J, Scherer, L, Döll, P, Manzardo, A, Núñez, M, Verones, F, Humbert, S, Buxmann, K, Harding, K, Benini, L, Oki, T, Finkbeiner, M & Henderson, A (2017). Understanding the LCA and ISO water footprint: A response to Hoekstra (2016): A critique on the water-scarcity weighted water footprint in LCA. Ecological Indicators, 72, 352-359.

54 Seufert, V, Ramankutty, N & Foley, JA (2012). Comparing the yields of organic and conventional agriculture. Nature, 485, 229-232.

I BIBLIOGRAPHY

55 Conley, DJ, Paerl, HW, Howarth, RW, Boesch, DF, Seitzinger, SP, Havens, KE, Lancelot, C & Likens, GE (2009). Ecology: Controlling Eutrophication: Nitrogen and Phosphorus. Science, 323, 1014-1015.

56 Mosier, A, Kroeze, C, Nevison, C, Oenema, O, Seitzinger, S & van Cleemput, O (1998). Closing the global N2O budget: nitrous oxide emissions through the agricultural nitrogen cycle. Nutrient Cycling in Agroecosystems, 52, 225-248.

57 U.S. Environmental Protection Agency (EPA) (2013). Recognition and Management of Pesticide Poisonings: 6th edition. Section V: Chronic Effects.: United States Environmental Protection Agency. Office of Pesticide Programs.

58 Brantsæter, AL, Ydersbond, TA, Hoppin, JA, Haugen, M & Meltzer, HM (2017). Organic Food in the Diet: Exposure and Health Implications. Annual Review of Public Health, 38, 295-313.

59 GBD 2015 Risk Factors Collaborators (2016). Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. The Lancet, 388, 1659-1724.

60 World Health Organization. 2017. Noncommunicable diseases [Online]. Available: http://www.who.int/mediacentre/factsheets/fs355/en/ [Accessed 21.08.2017].

61 Bundesamt für Lebensmittelrecht und Veterinärwesen. 2017. Die Bevölkerung der Schweiz isst unausgewogen [Online]. Available: https://www.blv.admin.ch/blv/de/home/dokumentation/nsb-news-list.msg-id-66016.html [Accessed 21.08.2017].

62 Schweizerische Gesellschaft für Ernährung. 2017. DACH-Referenzwerte [Online]. Available: http://www.sge-ssn.ch/grundlagen/lebensmittel-und-naehrstoffe/naehrstoffempfehlungen/dachreferenzwerte/ [Accessed 21.08.2017].

63 European Public Health & Agriculture Consortium (EPHAC). 2011. European Public Health and Agriculture Consortium's (EPHAC) response to "The reform of the CAP towards 2020 - Impact Assessment" [Online]. Available: https://ec.europa.eu/agriculture/sites/agriculture/files/cap-post-2013/consultation/contributions/ephac-be.pdf [Accessed 21.08.2017].

64 Institute for Health Metrics and Evaluation (IHME). 2016. GBD Compare Data Visualization [Online]. Available: https://vizhub.healthdata.org/gbd-compare/ [Accessed 21.08.2017].

65 Harvard Public School of Health. 2017. Healthy Eating Plate & Healthy Eating Pyramid [Online]. Available: https://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate/ [Accessed 11.10.2017].

66 Schweizerische Gesellschaft für Ernährung. 2017. Empfehlungen BLV [Online]. Available: http://www.sge-ssn.ch/grundlagen/lebensmittel-und-naehrstoffe/naehrstoffempfehlungen/empfehlungen-blv/ [Accessed 21.08.2017].

67 Bundesamt für Lebensmittelrecht und Veterinärwesen. 2017. menuCH - Nationale Ernährungserhebung [Online]. Available: https://www.blv.admin.ch/blv/de/home/lebensmittel-und-ernaehrung/ernaehrung/menuch.html [Accessed 21.08.2017].

68 Bundesamt für Lebensmittelrecht und Veterinärwesen. 2017. Ergebnisse zum Lebensmittelkonsum [Online]. Available: https://www.blv.admin.ch/blv/de/home/lebensmittel-und-ernaehrung/ernaehrung/menuch/menu-ch-ergebnisse-ernaehrung.html [Accessed 21.08.2017].

69 Hallström, E, Carlsson-Kanyama, A & Börjesson, P (2015). Environmental impact of dietary change: a systematic review. Journal of Cleaner Production, 91, 1-11.

70 Springmann, M, Godfray, HC, Rayner, M & Scarborough, P (2016). Analysis and valuation of the health and climate change cobenefits of dietary change. Proceedings of the National Academy of Sciences, 113, 4146-51.

71 Lukas, M, Rohn, H, Lettenmeier, M, Liedtke, C & Wiesen, K (2015). The nutritional footprint – integrated methodology using environmental and health indicators to indicate potential for absolute reduction of natural resource use in the field of food and nutrition. Journal of Cleaner Production.

72 Meier, T, Gärtner, C & Christen, O (2015). Bilanzierungsmethode susDISH: Nachhaltigkeit in der Gastronomie-Gesundheits- und Umweltaspekte in der Rezepturplanung gleichermaßen berücksichtigen. DLG-Mitteilungen, 1.

73 van Dooren, C, Douma, A, Aiking, H & Vellinga, P (2017). Proposing a Novel Index Reflecting Both Climate Impact and Nutritional Impact of Food Products. Ecological Economics, 131, 389-398.

74 Schweizerische Gesellschaft für Ernährung. 2017. Schweizer Lebensmittelpyramide [Online]. Available: http://www.sge-ssn.ch/ich-und-du/essen-und-trinken/ausgewogen/schweizer-lebensmittelpyramide/ [Accessed 21.08.2017].

75 Schweizerische Gesellschaft für Ernährung. 2017. Optimaler Teller [Online]. Available: http://www.sge-ssn.ch/ich-und-du/essen-und-trinken/ausgewogen/ausgewogener-teller/ [Accessed 21.08.2017].

76 Slavin, J (2004). Whole grains and human health. Nutrition research reviews, 17, 99-110.

77 Mellen, PB, Walsh, TF & Herrington, DM (2008). Whole grain intake and cardiovascular disease: a meta-analysis. Nutrition, Metabolism and Cardiovascular Diseases, 18, 283-290.

78 Slavin, JL & Lloyd, B (2012). Health benefits of fruits and vegetables. Advances in Nutrition: An International Review Journal, 3, 506-516.

79 Kris-Etherton, PM, Zhao, G, Binkoski, AE, Coval, SM & Etherton, TD (2001). The Effects of Nuts on Coronary Heart Disease Risk. Nutrition Reviews, 59, 103-111.

80 Mukuddem-Petersen, J, Oosthuizen, W & Jerling, JC (2005). A Systematic Review of the Effects of Nuts on Blood Lipid Profiles in Humans. The Journal of Nutrition, 135, 2082-2089.

I BIBLIOGRAPHY

81 Micha, R, Wallace, SK & Mozaffarian, D (2010). Red and Processed Meat Consumption and Risk of Incident Coronary Heart Disease, Stroke, and Diabetes Mellitus. A Systematic Review and Meta-Analysis, 121, 2271-2283.

82 Pan, A, Sun, Q, Bernstein, AM, Schulze, MB, Manson, JE, Willett, WC & Hu, FB (2011). Red meat consumption and risk of type 2 diabetes: 3 cohorts of US adults and an updated meta-analysis. The American Journal of Clinical Nutrition, 94, 1088-1096.

83 Kotchen , TA, Cowley , AWJ & Frohlich , ED (2013). Salt in Health and Disease — A Delicate Balance. New England Journal of Medicine, 368, 1229-1237.

84 Ebringer, L, Ferenčík, M & Krajčovič, J (2008). Beneficial health effects of milk and fermented dairy products — Review. Folia Microbiologica, 53, 378-394.

85 Water Footprint Network. 2017. Product gallery [Online]. Available: http://waterfootprint.org/en/resources/interactive-tools/product-gallery/ [Accessed 05.09.2017]


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