



## What is sustainable food?



## How sustainable is the food system?



## What solutions contribute to a sustainable food system?



## How can each party in the food chain contribute?



## What dilemmas and obstacles stand in the way of realising a sustainable food system?



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## What is sustainable food?

- How can we define sustainable food?
- Why is it difficult to measure sustainability?
- What aspects are further included in sustainability?
- What are other related concepts?
- What does the Dutch food chain look like?

## How sustainable is the food system?



Sustainability & Food

## How can each party in the food chain contribute?



## What dilemmas and obstacles stand in the way of realising a sustainable food system?



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- Hoe kunnen we duurzame voeding realiseren?
- Waarom kan het moeilijk zijn om duurzame voeding te realiseren?
- Wat voor aspecten zijn belangrijk bij duurzame voeding?
- Wat zijn andere, gekoppelde aspecten van duurzame voeding?
- Hoe ziet de Nederlandse voedselketen eruit?

## How sustainable is the food system?



## What solutions contribute to sustainable food?



## How can we realise a sustainable food system?

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### How can we define sustainable food?



A single definition of **sustainable food** does not exist. In a general sense, sustainable food fits within the definition of sustainable development from the Brundtland commission, that is to say, food that is produced and consumed in a food system that is able to feed current generations without compromising the economic, social and ecological bases necessary to feed future generations. Additionally, it is clear that when we make our food production and consumption *more sustainable*, we get closer to a sustainable food system.

WCED, 1987

A **food system** is the set of all activities linked to the production, processing, distribution, preparation and consumption of food, as well as the socio-economic and ecological outcomes of these activities. A **sustainable food system** is a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised.

FAO, 2014: p. 12

The **ecological preservability** of our food supply depends on "the impact that the global food supply has on land, natural resources and raw materials and the contribution to greenhouse gas emissions and loss of biodiversity." This preservability is measured using **indicators** such as amount and type of land use, water use, resource use, greenhouse gas emissions and biodiversity.

WRR, 2014: p. 120

In the context of food systems, it helps to differentiate within between **food chains** and **food patterns**. A **food chain** (or **production chain**, when it excludes consumers) is a sequence of two or more organizations or individuals who are directly involved in the flow of food, services and financial resources from source to consumer. A **diet** (or **food pattern**) is the total amount of food products that a person consumes, within which the amount and ratio of different nutrients and the manner of consumption is crucial.

Voedingscentrum, 2011: p. 5-7

Mentzer et al., 2001

(Voedingscentrum) and Joszi Smeets (YFM).

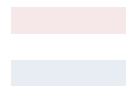
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## What is sustainable food?

- Hoe kunnen we duurzame voeding definiëren?
- Waarom kan het moeilijk zijn om duurzaamheid te meten?
- Wat voor aspecten...
- Wat zijn andere, ge...
- Hoe ziet de Nederla...

## How sustainable is th...



## What solutions contri...



### Why is it difficult to measure sustainability?



*Measuring sustainability is difficult because the line between sustainable and unsustainable is hard to define and because sustainability at the product level is different than at the system level.*

#### The line between sustainable and unsustainable

With most indicators it is hard to specify exactly where the line between sustainable and unsustainable lies. In society, diverse views exist about how serious or acceptable some effects on eutrophication or climate change are. In addition, it is often difficult to compare different indicators: a Dutch greenhouse tomato requires high-energy input, while on Spanish fields it consumes a lot of water.

[PBL, 2013: p. 15-16](#)

#### Sustainable products or systems

Sustainability of the food system as a whole is determined by an interplay of numerous product flows and processes, both within and outside the Netherlands. This makes it difficult to determine whether an individual product or process is sustainable. A Life Cycle Assessment (LCA) measures the various indicators cumulatively across all links in the food chain, in order to measure sustainability of products, processes, or at the system level.

[Heller en Keoleian, 2003: p. 1009](#)

[Jayal et al., 2010: p. 144](#)

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## What aspects are further included in sustainability?



Besides ecological preservability, the concept of sustainability can be expanded with health, animal welfare and socio-economic criteria.

### The importance of other indicators

Although sustainability is typically measured through objective criteria of ecological preservability, society often demands other criteria to be included in sustainability. For example, better animal welfare has little to do with future generations, but is high on the social agenda. Therefore, the Dutch government advocates a food policy that includes attention to public health, animal welfare and people.

Rijksoverheid, 2013: p. 2-3

### Human health

Human health includes dietary health and the health effects of food production. According to the Guidelines for Good Food by the Dutch Health Council, a **healthy diet** consists of:

- Plenty of fruit, vegetables and whole grain products every day and regular (fatty) fish;
- As few products or beverages with saturated fatty acids, trans-fatty acids, sugars and acidulants as possible;
- A varied diet, daily exercise, reduced salt intake and moderate alcohol consumption.

Gezondheidsraad, 2006: p. 14

RIVM, Volksgezondheid en Zorg

The Voedingscentrum (Nutrition Centre) has translated these guidelines into advice for consumers, of which the Food Pyramid ('Schijf van Vijf') is one. An incorrect balance between food groups can cause health problems such as obesity, diabetes and cardiovascular disease. In addition, diet composition itself strongly determines the environmental impact of food (Also see "How sustainable is Dutch food consumption?").

Voedingscentrum, 2011: p. 10

### Animal welfare

Generally, animal welfare is defined as the degree to which livestock animals are able to fulfil their behavioural or physiological needs. The Welfare Quality® system is the European industry standard and stipulates as criteria that animals:

- Do not suffer from hunger or thirst needlessly long;
- Can rest comfortably at the right temperatures;
- Have enough space to move around freely;
- Can exhibit normal, non-harmful behaviour, such as playing and foraging;
- Be handled with care, in a way that promotes positive emotions;
- Are free of injuries, illness or unnecessary pain during human handling.

De Jonge en Ooms, 2009: p. 19

Welfare Quality Network

The last point, **animal health**, is closely related to human health. Consider for example the spread of animal-human transmissible diseases such as Q fever and the use of veterinary drugs such as antibiotics, which can lead to resistant bacteria like MRSA and E-coli.

Uitvoeringsagenda Duurzame Veehouderij, 2015

### Socio-economic: Distribution, welfare and fairness

A fair distribution of food around the world and food security, as well as equal shares in profits and fair trade between producers and buyers are often included in sustainability as well. Farmers within and outside the Netherlands have little influence over the price they receive for their products, putting pressure on their income as global food chains become more efficient. Finally, the working conditions of those employed in food production are an important indicator of sustainability.

PBL, 2013: p. 44

## What are other related concepts?



*Several other concepts more or less contribute to a sustainable food system: circular economy, natural capital, resilience and biobased economy.*

**Circular Economy** – A circular economy is a resilient industrial economy where development is based on the use of resources rather than on their consumption. The circular economy is based on closing down (food) chains and (where possible infinitely) closing resource cycles. In closing food chains, waste becomes a resource, such as when food leftovers are re-used.

[OPAi & MVO Nederland, 2014: p.11](#)

[Ellen MacArthur \(2013\), Towards the Circular Economy 2, p.78](#)

For more information, see the [Knowledge map Circular Economy](#).

**Natural Capital** – Natural capital consists of all renewable and non-renewable raw materials and processes from the environment that provide goods or services for the economy, such as air, plant and animal species which are used for food production. Natural capital is also an economic metaphor for the limited stocks of natural materials, land and ecosystems that are available.

For more information, see the [Knowledge map Natural Capital](#).

**Resilience** – Resilience is the ‘stamina’ or ‘elasticity’ of a (food) system. It includes (1) the amount of shocks a (food) system can absorb whilst remaining in the same state, (2) the extent to which the (food) system can adapt to changing circumstances and (3) the (food) system’s ability to develop learning capacity.

[Pisano, 2012: p. 6](#)

**Biobased Economy** – A biobased economy (BBE) is an economy that no longer runs on fossil fuels, but rather uses biomass for raw materials and energy. In a BBE biomass (such as food waste) is used for non-food applications. At times, bio-based applications may compete with food production, such as when land is used for growing biofuels instead of food.

For more information, see the [BioBased Economy website](#).

[Novo et al., 2010: p. 769-770](#)

### What is sustainable food?

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- Waarom kan het moeilijk zijn om duurzame voedsel te produceren?
- Wat voor aspecten zijn er bij duurzame voedselproductie?
- Wat zijn andere, gerelateerde concepten?
- Hoe ziet de Nederlandse voedselproductie eruit?

### How sustainable is the food system?



### What solutions contribute to a sustainable food system?



This Knowledge Map Sustainable Food System combines the currently available knowledge on the current state of the food system, the key insights from the literature, and the available solutions. It was developed in September 2015. A Knowledge Map is not a report: it does not provide analysis or interpretation, nor does it take sides in on-going discussions. As a consequence, minor inconsistencies may arise, following from the use of multiple sources. Many experts have contributed by suggesting and weighing different sources, with the aim to come to a representative and balanced selection of key insights. These were Toine Timmermans (Wageningen UR), Hans Dagevos (LEI Wageningen UR), Josta de

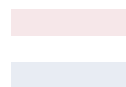
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- Wat zijn andere, gekoppelde aspecten van duurzame voeding?
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## How sustainable is the Dutch food chain?



## What solutions contribute to a sustainable food chain?



### What does the Dutch food chain look like?



*Dutch food products have usually gone through a complex food chain, both within the Netherlands itself as well as in countries abroad.*

The part of the food chain located in the Netherlands starts with the 65,000 **farmers** that produce food. The first link of this chain is formed by natural inputs such as water, energy, nutrients and animal feed. These include greenhouse growers, crop farmers and livestock farmers, but also food producers, breeders and raisers who supply feed and farm animals. 6500 **food processors** turn these outputs into semi-finished products, ingredients and consumer products. These are then sold to 1550 **transporters**, which in turn sell the products to 5 **wholesale firms**. These sell the products to 25 **retail brands**, after which they are distributed through 4850 **supermarkets**. From there, products eventually reach 7 million households, or 17 million **consumers**. Consumers also obtain food through other channels, such as farm sales or restaurants.

[PBL, 2012b: 22-23](#)

The Netherlands is an important **trading partner**. Firstly, many of the inputs to farming and processing, such as soy, are imported. Netherlands has a share of 7.5% in global agricultural export, second only to the United States'. Half of exports consist of fresh fruit, vegetables, meat and dairy products, mainly intended for neighboring European countries like Germany, Belgium, the UK and France. Besides agriculture and horticulture the Dutch processing industry also supplies a large share of the exports. Furthermore, Dutch ports like Rotterdam play an important role as transit route for products such as potatoes, soy and cocoa towards the European hinterland.

[Bosatlas van het Voedsel, 2014: p. 36-37](#)

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## What is sustainable food?



## How sustainable is the food system?

- Wherein lies the urgency of sustainability worldwide?
- How does food production impact ecological preservability?
- How sustainable is the food system according to the other indicators?
- How sustainable is the processing, transport and retail of food?
- How sustainable is Dutch food consumption?
- What trends do we see in Dutch food consumption?
- What is the influence of food waste throughout the food chain?
- What role does the government play in the Dutch food system?

## How can each party in the food chain contribute?



## What dilemmas and obstacles stand in the way of realising a sustainable food system?



## What solutions contribute to a sustainable food system?



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# Wherein lies the urgency of sustainability worldwide?



*Population growth, urbanization and rising incomes necessitate higher food production in the coming decades, which increases pressure on the environment while the restorative capacity of the earth is already exceeded. The food system puts a considerable burden on ecological preservability.*

## Demographic developments

The current world population of 7.3 billion will increase by 1.2 billion over the next 15 years, growing to 9.7 billion in 2050. This growth takes place primarily in developing countries. At the same time, a growing proportion of the world's population lives in cities, up from 50% today to 70% in 2050, coinciding with increased incomes in emerging countries.

According to FAO estimates, this larger, urbanized and wealthier population will require an increase in food availability of 70%, with a 43% higher cereal availability and 74% higher meat availability. A much lower increase in production will be required when reductions of 30-50% in worldwide food waste are achieved, or when changing diets (for example in Western countries) place lower demands on the planet (also see ["How can the food system become sustainable by consuming differently?"](#)).

A parallel development has effects on global public health. A growing proportion of the world is not consuming the right amount of nutrients, specifically too many saturated fats and not enough fibre and minerals, causing adverse effects on public health.

[UN ESA, 2015: p. 1](#)

[FAO, 2009: p. 5-8](#)

## Ecological footprint

The **ecological footprint** is an instrument that measures how much biologically productive land and water surface an individual, population or activity uses, indicated in hectares. It envelops the space necessary in order to produce raw materials and absorb the waste that is created. The current global footprint is 1.5 times larger than Earth is able to regenerate. If everyone lived as Dutch people do, 3.5 Earths would even be needed. Critics of ecological footprint as an instrument indicate that accumulating different environmental pressures in this way does not show the complicated interactions and trade-offs between indicators.

[WWF, 2014: p. 32-33, 164](#)

[PBL, 2015: p. 5](#)

## Planetary boundaries

In 2009, the Stockholm Resilience Centre formulated nine planetary boundaries within which it is expected that mankind can safely produce and consume. Exceeding any of these limits can have disastrous consequences in the form of abrupt and irreversible changes in the local and global environment. In 2015 a renewed analysis indicated that three out of nine boundaries were exceeded with certainty: genetic biodiversity, the nitrogen cycle and the phosphorus cycle. The concepts are further explained in ["How does food production impact ecological preservability?"](#).

[Rockström et al., 2009: p. 1, 24](#)

For more information and an overview of all boundaries, see the [SRC website](#)

## The impact of the global food system

Global food consumption and production is responsible for around 25% of total greenhouse gas emissions. In addition, agriculture is responsible for over 60% of the loss of terrestrial biodiversity. This is mainly due to the use of land for agriculture by replacing nature, as agricultural land has much lower biodiversity than natural land. Phosphate and nitrogen losses and pesticide emissions cause losses in biodiversity in freshwater and coastal seas. Climate change has a negative impact on biodiversity and the availability of arable land and water.

[PBL, 2013: p. 17](#)

[PBL, 2014c](#)

## How does food production impact ecological preservability? (1/2)



Global primary food production is associated with greenhouse gas emissions, land use, consumption of water and nutrients, loss of biodiversity and depletion of fisheries. These factors can reinforce each other in complex ways. [\(see definitions\)](#).

### Greenhouse gases

The total Dutch emission of greenhouse gases (GHG) has decreased by 18% since 1990. Food production accounts for 14% of total emissions. In the Netherlands, emissions from primary food production (farming) have decreased by approximately 13% since 1990, as a result of successful manure policy, greenhouse energy savings and a declining livestock. However, the abolishment of milk quotas has caused dairy livestock to grow again by 6% since 2012.

[CBS, PBL en WUR, 2011: p. 1-2](#)

[CBS, PBL en WUR, 2015: p. 1-2](#)

25% of global greenhouse gas emissions stem from food production, of which more than half is caused by the production of meat, eggs, fish and dairy. Of these, cow milk and beef production are the largest contributor, as a result of methane emissions from cows or nitrous oxide (N<sub>2</sub>O) released from manure. But feed production (e.g. for broilers and pigs) also causes CO<sub>2</sub> emissions because of deforestation for farmland and the breakdown of organic matter in peat soils.

[Blonk et al., 2007: p. 20-24](#)

### Land use

In the Netherlands, two thirds of the total land area is used for agriculture and pasture. Agricultural productivity per hectare in this country is among the highest of all OECD countries, due to fertile land and decades of agricultural innovation on a small landmass. Overall, about six million hectares are needed for Dutch consumption, 85% of which lie outside the borders. Most of this is in other Western European countries like Germany, but many also come from outside Europe, where crop yields per hectare are generally lower.

One third of the world's land area is used for agriculture (not all of the world's surface is suitable). Of this, three-quarters is used for the production of animal feed or as pasture for livestock. Beef has the

largest land use, followed by pork, and lastly poultry meat. The reason is feed conversion: cattle convert plant energy and protein is relatively inefficiently into meat. For the average daily consumption of an EU citizen, 3 kg of feed are converted into 100 gram of meat and 800 gram of milk.

One of the components of animal feed is soy, which is attractive because of its high protein content. The vast majority of soy used in Europe is intended for animal feed and originates from South America, where grasslands have often been converted to farmland. Illegal expansion of agricultural land (mainly for livestock, fodder production or oil palm plantations) is estimated to have caused between 50% and 80% of global deforestation between 1990 and 2008, which leads to the disappearance of tropical rainforests. On the other hand, maintaining grasslands for raising livestock in turn may lead to soil erosion when grazing is too intensive.

[PBL, 2012b: p. 12](#)

[PBL, 2012a: p. 26](#)

[PBL, 2011: p. 12-13, 25, 160](#)

[Brack, 2015: p. 3](#)

### Water use

Large amounts of water are needed to produce food: 1 kilogram of potatoes requires 250 litres of water, compared to 15 500 litres for a kilogram of beef. 8% of the world's water consumption is related to the production of livestock, which may lead to problems in areas with increasing water scarcity.

[Hoekstra en Föörare, 2008: p. 54](#)

[Lundqvist et al., 2008: p. 11](#)

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## How does food production impact ecological preservability? (2/2)



### Biodiversity

Food production is dependent on ecosystem services, such as carbon fixation, water purification and pollination. Declining biodiversity reduces the effectiveness of these services, and is therefore dangerous. Land use is one of the main reasons for global biodiversity loss, from inefficient use of land and the conversion of natural areas to agricultural land. Biodiversity is often expressed in **Mean Species Abundance** (MSA): the size of indigenous plant and animal populations with respect to the natural situation. Worldwide, the MSA has been measured at 70%, while in Europe this is less than 50%. In the densely populated Netherlands, MSA is only 15%. Although Europe lost much biodiversity due to increased human land use during the past centuries, biodiversity declines less quickly than elsewhere in the world, because of nature redevelopment projects.

See the Knowledge chart [Natural Capital](#) [Blonk et al., 2008: p.3](#)  
[CBS, PBL en WUR, 2013: p. 1-2](#)

### Agricultural resources

The fertility of agricultural land is to a large extent dependent on the concentration of nitrogen and phosphate since plants need these to grow. In the second half of the 20th century Dutch farmers were using more and more manure and fertilizers, thereby increasing the yield of crops. The resulting surplus of nitrogen and phosphate caused eutrophication of local ecosystems and waters. Eutrophication is the overflowing of an ecosystem with nutrients, causing algal blooms or other organic sprawl, negatively impacting local biodiversity. Acidification is the increased acidity of the soil or water surface, caused by nitrate leakage. Bacteria further convert nitrogen into toxic ammonia and nitrous oxide, a potent greenhouse gas. Partly thanks to regulation on manure disposal and emissions of nitrogen, phosphorus and ammonia, as well as the amount of pesticides that ends up in surface water, has decreased significantly since 1990. However, the Netherlands is still the country with the highest nitrogen surpluses per hectare of agricultural land in Europe.

[PBL, 2014a: p. 20-25](#)

In the rest of the world, a shortage of phosphate is developing. Phosphate in fertilizers is obtained from phosphate rock, a finite resource stock of which 70% is located in Moroccan mines. Predictions indicate that phosphate rock may already run out in the next 50-100 years. Where intensive livestock farming produces enough manure to fertilize the land in Europe, this is not the case in (developing) countries, where much of the animal feed is grown. Therefore, the phosphate cycle is not closed globally. Worldwide, we also see a trend in the capture of nitrogen from the air and its fixation in the soil.

[Cordell, Drangert and White, 2008: p. 292-293](#)

### Fishing

As the European fishery became highly regulated in the 1990s, the catch declined, and Europe became dependent on fish imports. Fish caught in the North Sea today are much younger and smaller than those caught in 1980. Furthermore, only 20% of European fish is cultivated, while in the rest of the world this is 40%. Globally, the fish population declined by a quarter after 1950, and 80% of all commercial fish stocks are overfished or exhausted. ICES data shows that fishing regulation in Europe has caused fish stocks to recover steadily. Internationally, aquaculture is growing strongly, which is good news for wild fish stocks but can be a disadvantage if too much land or wild fish used for feed. This has also resulted in eutrophication and the increased use of antibiotics.

[PBL, 2011: p. 20-21](#)

[ICES, 2015](#)

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## How sustainable is the food system according to the other indicators? ✕

*In addition to pressures on ecological preservability, food production contains risks to human health from antibiotic use, compromises to animal welfare and an unsustainable distribution of wealth throughout the food chain. (See also "[What aspects are further included in sustainability?](#)").*

### Public health

In order to prevent mortality from diseased animals, up to ten years ago many antibiotics were used in animal husbandry. The risk in using antibiotics is the emergence of multi-resistant bacteria such as MRSA and ESBL. Consumption of meat with resistant germs may cause major public health problems. This is aggravated by the fact that for some time, no antibiotics have been developed that work against resistant bacteria. Effective governance has ensured that the use of antibiotics has more than halved (as set by targets) and it is no longer used for the prevention of animal disease, but *selectively* and *curatively* instead.

PBL, 2014a: p. 47

### Animal welfare

Animal welfare concerns are driven by public debate and perceptions, although in many cases these correspond with what animal scientists consider as animal suffering. Especially in pig and poultry husbandry animal suffering is widespread, as a result of for example genetic predisposition, stables with poor climate and little space to move around, interventions such as castration and beak trimming, restriction of natural behaviours and infection with animal disease.

Outside the housing system, there is also discomfort caused by stress during transportation and the slaughter of animals. A growing share of animal production is done under labels such as Better Life ('Beter

Leven') from the animal protection agency ('Dierenbescherming'), which result in an improvement in wellbeing. The Better Life certificate requires more stable space per animal, an older age of slaughter and free-range access.

Leenstra et al., 2011: p. 64-66

UDV, 2014: p. 26

### Distribution, welfare and fairness

For the continuity of the Dutch food production, farmers' income and the distribution of profits throughout the production chain are important. Research shows that incomes in primary production are on average low and unstable. Poultry farmers, pig farmers and greenhouse growers often receive only a few per cent of the retail price of their products. This is less the case for dairy farmers, because many have joined cooperations. Farmers usually have to settle for remuneration on labour without return on equity. The choice is often between quitting the business or investing in expansion, for which loans have to be taken. This decreases farmers' solvency, making them vulnerable to price fluctuations. Meanwhile, the agricultural sector is aging significantly, and farmers often have difficulty finding successors. The same mechanisms are at work in the rest of the world, but there the disparities are even greater.

PBL, 2013: p. 44,52-53

See also Baltussen et al., 2014

## What is sustainable food?



## How sustainable is the food system?

- Wherein lies the urgency?
- How does food production affect the environment?
- How sustainable is the food system?
- How sustainable is the food system for the future?
- How sustainable is the food system for the planet?
- What trends do we see?
- What is the influence of the food system on society?
- What role does the government play?

## What solutions contribute to a sustainable food system?



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## How sustainable is the processing, transport and retail of food?



*In general, the processing, transport and retail of food has relatively little direct impact on the environment. But these links in the food chain do have a large indirect impact because they decide what (un)sustainable products they buy from suppliers and offer to consumers.*

### Direct sustainability

When it comes to agricultural products such as fresh vegetables, fruit and meat, the lion share of direct environmental impact takes place during production. Even when beef is shipped from Brazil, CO<sub>2</sub> emissions from slaughtering, packing, cooling and transport are negligible compared to the methane emissions from the cows themselves. This is because economies of scale have made these intermediate food chain links very efficient. Only with fresh products that must be cooled in the supermarket (such as milk), energy consumption in the retail sector becomes significant.

The more steps of processing a product goes through, the more the total environmental impact will increase. Soda is an example in which the largest CO<sub>2</sub> emissions occur during processing and packaging, and for fresh fruit juice this occurs during transportation by truck. There is only limited research into the sustainability of complex, composite products, such as pizzas and ready-made meals, because it is difficult to go further back than a few suppliers in the food chain when tracing product flows. The same applies to the complex life cycle of product packaging. Still, there are initiatives that aim to better map the sustainability of product flows, such as the British Carbon Trust, The Sustainability Consortium and the European Product Environmental Footprint (PEF) programme.

[Marinussen et al., 2012: p. 16-18](#)

[Blonk et al., 2007: p. 19, 23](#)

[Pluimers et al., 2011: p. 37, 44](#)

[Stichting Duurzame Voedingmiddelenketen, 2008: p. 8-9, 16](#)

[See website PEF](#)

[See website Sustainability Consortium](#)

### Role of processing, transportation and retail

Although the direct impact of processing, transportation and retail sustainability is limited, these parties can play a decisive role in realising sustainability through their choice of products and suppliers, and particularly the final placement of products in shop shelves. For example, there is a growing prevalence of bargains and brands in the supermarket. Consumers indicate that they buy at least 30% of their purchased food products in sales, and 40% in the supermarket's own brand. At the same time, consumers who prefer affordability and bargains eat less fruit, vegetables and fish and more meat. These consumers are thus more susceptible to bargains made on meat, which is something supermarkets make use of.

[PBL, 2013: p. 103-104](#)

[Bartels et al., 2009: p. 14](#)

[Onwezen et al., 2011: p. 29](#)

[De Bakker en Dagevos, 2010: p. 117](#)

### Value chain initiatives

Many large supermarkets have privately set joint safety and quality standards, which they can use to have more influence on the process of production and food processing. In the Netherlands we have the Integrated Chain Management ('Integraal Ketenbeheer, IKB') certificate, which guarantees additional security checks in the production chain of beef, pork and poultry. European supermarkets together use GlobalGAP, a standard that requires manufacturers and suppliers around the world to meet food safety protocols and standards for quality and sustainability. Furthermore, the Sustainable Trade Initiative ('Initiatief Duurzame Handel') is committed to promoting fair trade practices and there are international roundtables where organisations work together to create sustainable palm oil and soy chains.

[WRR, 2014: p. 30](#)



## How sustainable is Dutch food consumption?

*The consumption of meat, fish and dairy products creates a high footprint, and because most Dutch people do not follow dietary guidelines there are health risks. This is related to important trends in consumer behaviour.*

According to Oxfam, the Netherlands ranks top in the world for countries with the most abundant, nutritious, healthy and affordable availability of food. Nevertheless, many Dutch have unhealthy diets and high carbon footprints.

### Meat, fish and dairy

Meat, fish and dairy products make up more than half of the GHG emissions of our diet, even though they only account for 15% of the daily weight of food consumed. The same goes for land use, where meat products (and fish) alone already account for 40% of the total. Average daily protein consumption is well above the recommended amount in dietary guidelines. Most Dutch people also do not consume the recommended fatty acid-rich fish twice a week (see ["fish and sustainability"](#)).

### Potatoes, vegetables and fruit

Potatoes, vegetables and fruit only have a 4% share in total land use and 20% in greenhouse gas (GHG) emissions. The difference between plant and animal products is high. Beef causes 70 times more GHG emissions than the same weight in carrots. Although the distance travelled by food (the 'food miles') are not necessarily associated with higher environmental impacts, that's certainly the case with certain products, such as the transportation of tropical fruit by air and white asparagus from Peru. Vegetables sold outside the growing season can thus have a higher environmental impact because they are for instance flown in or grown in a glasshouse. At the same time only 3-14% of the population consumes the daily recommended 200 grams of vegetables, and a quarter consumes the recommended two servings of fruit.

### Drinks and extras

Drinks and extras such as snacks, biscuits and cakes are in between the other two food groups in terms of environmental impact. But especially extras have high contents of salt, saturated fat and calories, whilst not being needed for a healthy diet.

### The wrong balance

All in all, we consume too much salt, saturated fat and calories, and too little fibre. Amongst the health consequences are cardiovascular disease, increased risk of cancer and diabetes. 5 to 10% of the Dutch burden of disease is linked to unhealthy diets. In addition, 5% of the burden of disease is caused by (morbid) obesity. Simultaneously, current dietary patterns lead to a much greater environmental impact than when we were to follow the Good Food Guidelines more closely.

[Oxfam, 2014: p.2](#)

[RIVM, Most recent publications on sustainable and healthy diets](#)

[Marinussen et al., 2012: p. 7, 14, 22](#)

[Carlsson-Kanyama en Gonzalez, 2009: p. 1707](#)

[Van Rossum et al., 2012: p. 81-83](#)

[RIVM, Volksgezondheidsinformatie.nl](#)

[PBL, 2014a: p. 47](#)

[Gezondheidsraad, 2011: p. 40-45](#)

## What is sustainable



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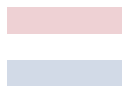
This Knowledge Map Summarises the currently available knowledge and combines the key insights from September 2015. A Knowledge Map is an interpretation, nor does it contain minor inconsistencies. The experts have contributed to the aim to come to a representative overview. Toine Timmermans (Wageningen UR), Hans Dagevos (LEI Wageningen UR), Josta de Vries (contact: Het Groene Brein, (info@hetgroenebrein.nl)).

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## What is sustainable food?



## How sustainable is the food we eat?

- Wherein lies the urgency?
- How does food production contribute to climate change?
- How sustainable is the food we eat?
- How sustainable is the food we eat?
- How sustainable is the food we eat?
- What trends do we see in Dutch food consumption?
- What is the influence of food on health?
- What role does the government play?

## What solutions contribute to sustainable food?



This Knowledge Map Sustainable Food combines the key insights from the most prominent reports and literature up to September 2015. A Knowledge Map is not a report: it does not provide analysis or interpretation, nor does it take sides in on-going discussions. As a consequence, minor inconsistencies may arise, following from the use of multiple sources. Many experts have contributed by suggesting and weighing different sources, with the aim to come to a representative and balanced selection of key insights. These were Toine Timmermans (Wageningen UR), Hans Dagevos (LEI Wageningen UR), Josta de

# What trends do we see in Dutch food consumption?



Several trends are noticeable in Dutch food consumption, such as the choice of consumers to eat meat less often and choosing sustainable products.

### Eating less meat

A growing number of consumers indicates that it is flexitarian: 43% eat meat no more than four days a week and 77% do so at most six days. These consumers regularly choose to have a vegetarian (dinner) meal, either unconsciously because of the context of meals or consciously for health and sustainability reasons. Nevertheless, real vegetarians remain amongst the few, because of a combination of factors such as the low price of meat, advertising and marketing of food, meat as a status symbol or simply the power of habit. Meat consumption fluctuated around 80 kilograms per capita between 2005 and 2010, and through to 2014 decreased with 5% to 76 kilograms per capita.

[De Bakker en Dagevos, 2010: p. 135, 182-185](#)

[Dagevos et al., 2012: p. 9-10](#)

[Verhoog et al., 2015: p. 7](#)

### Certificates and sustainable product selection

Since it started tracking the amount of sustainably certified products in the market, the Monitor Sustainable Food ('Monitor Duurzaam Voedsel') shows that market share for such products has risen to 6.1%. More and more consumers opt for environmentally and animal friendly alternatives when they go shopping. A quarter of consumers indicate that they look for labels at least sometimes, with free-range eggs, fish with a Marine Stewardship Council (MSC) label, meat with Better Life stars or organic products being the most popular options. Furthermore, four out of 10 know where their food comes from; half looks for seasonal vegetables and fruit and just over half says it reduces energy use during cooking. Although the share of certified products is increasing, a growing number of consumers thinks there are too many different labels in the market and that companies label products as sustainable too easily. Consumers prefer one label, for which the level of sustainability is guaranteed.

[LEI, 2014: p. 9](#)

[Voedingscentrum, 2015: p. 53-60](#)

(Voedingscentrum) and Joszi Smeets (YFM).

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## What is the influence of food waste throughout the food chain?



Food waste is defined as food intended for human consumption but that is not used for that purpose. Wastage may be avoidable or unavoidable. The consumer accounts for 30-50% of all food waste, followed by (often unavoidable) waste during food processing.

### What is food waste?

Roughly a third of the food produced worldwide is wasted, totaling 1.3 billion tons per year. For foods that are ultimately not eaten, the environmental impact has been for nothing. The FAO defines waste as the share of food intended for human consumption, but not being used for that purpose. Although most countries have similar total wastages, poorest countries waste the least. In rich countries more wastage takes place in supermarkets and with consumers, while in the poorest countries food waste occurs predominantly in the links from harvest to processing.

Gustavsson et al., 2011: p. 2-5

### Moerman's Ladder

Food that is threatened to be wasted can be processed in various ways. Prevention of food losses and re-use as human food (e.g. food banks) avoids food losses altogether. Moerman's Ladder indicates how much value can still be extracted from food that is lost, with the rule of thumb "the higher up the ladder, the better":

- Convertible for human food (reworking of food)
- Use in animal feed
- Raw materials for industry (biobased economy)
- Processing into fertilizer by fermentation (and renewable energy)
- Processing into fertilizer by composting
- Burning as waste (aim is destruction, with possible energy production)
- Organic waste to landfill (dumping food waste on landfills is illegal)

### The Dutch situation

Due to lack of data about where waste is created, it is difficult to assign it to specific links in the food chain, but from the way in which waste streams are processed much can be derived about their origin. It is clear that the Dutch consumer wastes most, with a share of between 30 and 50% in total food losses. This food is mainly burned as garbage, which creates very little value. Furthermore, approximately 20% of total waste is reprocessed into animal feed by the processing industry. Wastage in primary production, transport and supermarkets in the Netherlands is relatively low. In production and processing, waste is usually caused by process losses, in supermarkets by misalignment of inventory and demand.

Soethoudt en Timmermans, 2013: p. 46-48

Infographic by Wageningen UR about food waste

### Food wasted by consumers

The Dutch waste a relatively large share of their food. Of the 368 kilos of solid food that the average person buys annually, 66 kilograms are wasted. Of this, 47 kg (14%) is *avoidable*: mainly bread, fruit, vegetables and potatoes that for example have passed their expiry date, were purchased in too large quantities or of which too much was prepared during cooking. Further, 19 kg (5%) is *unavoidable*: husks and stalks, coffee and meat and fish leftovers that cannot be consumed. These numbers have remained virtually unchanged in recent years.

Van Westerhoven en Steenhuisen, 2013: p. 14

Van Dooren, 2015a: p. 3



## What role does the government play in the Dutch food system? ✕

*In recent decades, the government has focused on improving agricultural efficiency. With the emergence of EU policies and increasingly complex food chains, it can be difficult to coordinate its policy effectively or to influence consumer behaviour.*

### Agricultural policy aimed at efficient production

After World War II, the Dutch government stimulated cheap and efficient food production. Agricultural policy was aimed at protecting farmers, using measures such as minimum prices for grain and publicity campaigns for milk. Although there are still a lot of subsidies and rules, matters are increasingly left to the market, which is increasingly dominated by international trade and multinational food processors. Furthermore, environmental and agricultural policies, such as the Nitrate Directive and rules on crop diversification, are largely negotiated in the EU and laid down in the Common Agricultural Policy.

Although the Dutch government does not set more stringent sustainability standards for production on top of EU regulations, there are certain companies, production chains and alliances that have self-imposed higher requirements. For this reason, the Dutch government tries to set EU production requirements as similarly as possible, in order to create a level playing field for Dutch export.

[PBL, 2013: p. 102-104, 105-106](#)

[WRR, 2014: p. 121](#)

### Complex problems and coordination of government policies

The food system is complex and operates on many levels. Government policy therefore has to be agreed on different scales (international and national). In addition, government initiatives

are fairly dispersed, lacking a common strategy: the Ministry of Economic Affairs focuses mainly on sustainable innovation in food production, while the Ministry of Health and institutions like the Voedingscentrum and Milieu Centraal are focused on consumption education.

[WRR, 2014: p. 111-112](#)

### Influencing consumption

In its [Vision Sustainable Livestock \(2008\)](#) and [Policy for Sustainable Food Production \(2013\)](#) the government states that it wants to make consumption more sustainable, but it remains cautious in actively influencing consumer behaviour (see also "[What can I do... as government?](#)"). Nevertheless, there are successful initiatives, such as the Foodbattle, in which groups of consumers receive help and tips to combat food waste, and #SDOF (Seven Days of Feedback), in which people between 12 and 25 are stimulated towards sustainable lifestyles in a competitive context. In terms of healthy eating, there are active measures and programs, such as the required mentioning of salt and saturated fat levels on product packaging. Regarding sustainable products, the government supports mainly with knowledge and monitoring, such as the Sustainable Food Monitor.

[PBL, 2013: p. 69-70](#)

[Rijksoverheid, 2015: p. 6](#)

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## What is sustainable food?



## How sustainable is the food system?



## What solutions contribute to a sustainable food system?

- What goals are set for different parties in the Dutch food system?
- How can the food system become sustainable by producing differently?
- How can we increase sustainability by consuming differently?
- How can sharing and connecting differently increase sustainability?
- Which solutions do well on all indicators, and which only on a few?
- What solutions are there if we don't work from within the current system, but look for genuine alternatives?



## How can each party in the food chain contribute?



## What dilemmas and obstacles stand in the way of realising a sustainable food system?



This Knowledge Map Sustainability & Food aims to provide a concise overview of the currently available knowledge on sustainability in relation to food. This map combines the key insights from the most prominent reports and literature up to September 2015. A Knowledge Map is not a report: it does not provide analysis or interpretation, nor does it take sides in on-going discussions. As a consequence, minor inconsistencies may arise, following from the use of multiple sources. Many experts have contributed by suggesting and weighing different sources, with the aim to come to a representative and balanced selection of key insights. These were Toine Timmermans (Wageningen UR), Hans Dagevos (LEI Wageningen UR), Josta de

Hoog (WRR), Henk Westhoek (PBL), Gerard Kramer (Blonk Consultants), Eva Fransen (Natuur & Milieu), Liesbeth Temme (RIVM), Anne Hollander (RIVM), Corné van Dooren (Voedingscentrum) and Joszi Smeets (YFM).

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## What goals are set for different parties in the Dutch food system?

To give direction to the realization of a sustainable food system, the government and industry established several goals, such as increasing overall sustainability, reducing waste and promoting transparency.

### The government

In the Policy Letter Sustainable Food Production, the State Secretary of Economic Affairs gives an overview of the main goals of government policy:

- Restoring confidence in the food sector by guaranteeing the integrity and safety of food throughout the food chain and an early detection of risks for intervention
- Increasing sustainability of products and production processes in the context of the Top Sector Agri & Food and in collaboration with the Alliance for Food Sustainability ('Alliantie Verduurzaming Voedsel'), as well as promoting sustainable consumption and the use of alternative proteins
- Reducing food waste by periodically measuring total food waste, raising consumer awareness, facilitating businesses and promoting an international agenda
- Improving the dominant business model such that innovation becomes more attractive, and adjusting competition policies in order to enable sustainable cooperation
- Strengthening food security in an international perspective

Rijksoverheid, 2013: p. 2-13

### Industry

The Netherlands knows many coalitions working together over the entire value chain. One of these is the Alliance for Food Sustainability, a partnership between the Association of Dutch Catering Organisations (Veneca, catering), the Dutch Food Industry Federation (FNLI, processors), Food Retail Association (CBL, supermarkets), Agricultural and Horticultural Organisation Netherlands (LTO, producers) and Hospitality Netherlands (Horeca).

Their four main goals for 2013-2016 are:

- Jointly identifying and realizing higher levels of sustainability in the entire food chain;
- Realise the established higher minimum standards for poultry and pork consumed in the Netherlands ('Kip van Morgen' and 'Duurzaam Varkensvlees') by 2020 and an annual growth in turnover of 15% for certified meat;
- Measuring company waste in a common measurement system and inform consumers on how to reduce food waste during purchase or on product packaging;
- Improve transparency and communication by asking companies in the food chain to report on their progress, achievements and challenges in nine sustainability themes.

AVV, 2015: p. 3-5

### International: Sustainable Development Goals

To meet the challenges in global sustainability and to guide international development in sustainable directions, the United Nations have set the Sustainable Development Goals (SDG) in 2015, as successors to the Millennium Development Goals. These 17 targets include topics such as climate, hunger, poverty, education, health but also focus on specific themes such as agriculture and stimulating sustainable production and consumption.

See the website of the SDGs for all 17 targets

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## What is sustainable food production?



## How sustainable is the food production in the Netherlands?



## What solutions contribute to sustainable food production?

- What goals are set for the food production system?
- How can the food production system be made more sustainable?
- How can we increase the sustainability of the food production system?
- How can sharing and cooperation contribute to the sustainability of the food production system?
- Which solutions do contribute to the sustainability of the food production system?
- What solutions are most promising for the sustainability of the food production system, but look for

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# How can the food system become sustainable by producing differently? ✕

*Food production can be made more sustainable by focusing on efficient use of water, energy, raw materials and land, by utilizing residues and by protecting the local environment.*

### Producing more efficiently

In the past 50 years production efficiency has greatly increased in the Netherlands. Crop yields have risen sharply and the amount of feed needed per kilo of meat or dairy products (feed conversion) fell. The ecological footprint of the Dutch diet has therefore fallen by nearly 10 per cent, next to an increase in consumption. The reason for this is that many improvements are focused on efficient use of expensive raw materials and expensive inputs such as labour, land and animal feed. With cheap or free inputs such as groundwater, phosphorus and nitrogen, however, incentives to consume and emit less are still lacking. All in all, in the Netherlands a decrease of approximately 6% of the ecological footprint is possible until 2030, by such measures as more efficient use of fertilizers and animal feed or reducing CO<sub>2</sub> emissions. Most of the efficiency improvement (down 10 to 15% of the footprint), however, is achievable in the origin of imported foods, including cereals, soya, palm oil and coffee.

[PBL, 2013: p. 71](#)

### Utilising residuals

Besides efficiency improvements, there is much potential in the recycling of waste streams that are otherwise not used. In this way, a circular and bio-based economy can be realised, as phosphate and nitrogen cycles from waste and manure are closed, and economic value is created in providing energy and even reusing food. For this, the agricultural and greenhouse sector can collaborate with other sectors such as energy, chemicals, water and nature management.

[RLI, 2013: p. 16](#)

### Local environment and animal welfare

By not only producing efficiently, but also carefully, local environmental and natural impacts and animal welfare can be taken into account. Examples include more space for animals in the barn and free-range access, landscaping, agricultural nature management and less use of antibiotics and pesticides. Organically produced food is a prime example of this, but even the Volwaard Chicken with one Better Life star no longer requires antibiotics during its life.

[PBL, 2013: p. 71-72](#)

by explanations from several sources. These explanations are factual representations of the original source. The clickable literature list provides direct access to the original sources for further information. If you have any questions or remarks, you may contact Het Groene Brein. ([info@hetgroenebrein.nl](mailto:info@hetgroenebrein.nl)).

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# How can we increase sustainability by consuming differently?



*Consumers can eat more sustainably and healthier by choosing other products, wasting less and adjusting the composition of their dietary pattern.*

## The diet

In the adaptation of dietary patterns both health benefits and environmental benefits can be achieved. Only a small portion of the Dutch population follows the official dietary guidelines ('Richtlijnen Goede Voeding', RGV). A substantial proportion of the population over-consumes salt, saturated fat, and protein, eats too few fruits and vegetables. A less animal-based and more plant-based diet is associated with a lower risk of cardiovascular diseases, for example. If everyone would follow the RGV, 26% less land would be needed to feed men, and 15% for women. For men and women it would lead to 13% and, respectively, 3% less CO<sub>2</sub> emissions. A vegetarian diet could even lead to approximately 65% less land use and 16% less CO<sub>2</sub> emissions.

[Gezondheidsraad, 2011: p. 35](#)

[RIVM, Most recent publications on sustainable and healthy diets](#)

[Marinussen et al., 2012: p. 21-22](#)

[Marinussen, Blonk en Van Dooren, 2010: p. 18-20](#)

[See also Aschemann-Witzel \(2015\) about the relationship between health and sustainability](#)

[See also Van Dooren en Kramer \(2012\) about sustainable diets](#)

## Selecting sustainable products

The diet can also be made more sustainable if consumers choose a more sustainable version of each product. Beef has by far the highest environmental impact, followed by lamb, pork and poultry. Fruit and vegetables out of season are either imported or produced in the Dutch greenhouse using high energy input. Off-season, preserved products are generally more sustainable than fresh produce and local products have to be transported over shorter distances. Consumers expect that more awareness and availability of sustainable products will drive sales, and think that the government can help by providing information.

[Milieu Centraal: Meat, fish or vegetarian](#)

[PBL, 2014b: p. 15](#)

[Milieu Centraal: Vegetable and fruit calendar](#)

## Certification

Certificates provide guarantees that products meet certain environmental standards. The Better Life certificate is for meat with higher animal welfare standards: with one star, the animal has more space and time to grow, with two stars has free range access and the highest number of stars is 3, which is equivalent to the welfare level of organic meat. EKO and the European biological certification indicate that a product is produced according to legally fixed organic guidelines. The Marine Stewardship Council (MSC) indicates that fish is caught without overexploiting fish stocks. Finally, there are labels such as Fairtrade and Utz, aimed at improving the socio-economic conditions of producers in the developing world.

[LEI, 2014: p. 10-12](#)

[Milieu Centraal: Label and certificate monitor](#)

## Food waste

90% of consumers say they reduce food waste several times a week, but also that they need more information in order to do this effectively. The main reason for wastage is that too much was bought or cooked: only one-fifth of people weigh ingredients prior to the meal on a daily basis. Smaller portion sizes in the store, shopping lists and measuring cups or scales can provide a solution. Up to 15% of food waste is caused by expiration of the "best before" (THT) date, while the advice is to first look, smell and taste before discarding. Only after the "use by" (TGT) date it is recommended that the product should really not be eaten. Leftovers recipes or apps can also provide a solution for the reuse of ingredients and food scraps. Finally, there is much to be gained by storing products better, preferably in the packaging, frozen or refrigerated at 4° C.

[PBL, 2014b: p. 10](#)

[Van Dooren, 2015a: p. 3-4](#)

[Soethoudt et al., 2012: p. 33](#)

## How can sharing and connecting differently increase sustainability? ✕

*Sharing and connecting differently involves creating a different distribution of revenues across the supply chain, from farm to supermarket. Also, it is about increasing transparency on the sustainability of company processes and bringing consumers and farmers closer together.*

### The business model

The money that manufacturers need to make sustainable investments can in principle be earned by charging customers a higher price. But although minimum production standards have become more sustainable over time, most products are uncertified and anonymous (such as the supermarket's own brand), meaning that consumers do not pay extra for the higher standards. In the past 50 years, four major supermarket chains and wholesalers have taken over two-thirds of the market, which has concentrated bargaining power and given them more control over prices, at the expense of producers. Another issue is that a large part of Dutch produce is exported, and foreign markets do not attach the same value to sustainability. Possible solutions are jointly agreeing on higher minimum standards and introducing them gradually, the creation of international certificate schemes or cooperatives or farmers entering into long-term contracts with buyers.

Reinders et al., 2013: p. 2-3, 14-16

WRR, 2014: p. 29

### Trust and transparency

Besides the importance of investing in sustainability, confidence in the food industry and the transparency of its practices are often hotly debated. On the one hand it is expected that the food industry provide reliable information about the sustainability of products and that unhealthy diets are discouraged as much as possible. On the

other hand, food scandals such as the horsemeat affair constantly surface, and there is a constant threat of infectious disease outbreaks in animal farming. In part for this reason, the industry platform for sector-wide cooperation (the Alliance for Food Sustainability) has as its priorities stimulating demand for sustainable products, as well as increasing transparency and promoting information about them.

WRR, 2014: p. 128

Onderzoeksraad voor de Veiligheid, 2014: p. 10-12

AVV, 2013: p. 7

### Shorter food chains and local production

Today, an increasing number of entrepreneurs decide to produce in shorter, locally sourced food chains. The reason may be reducing the number of supply chain intermediaries, and/or reducing the geographical distance between producers and consumers. Major reasons for shorter chains are breaking through the anonymity of the food producer and bypassing the large food processors and supermarkets. In this way, (online) farm shops, food stalls, food halls and local markets become a way in which consumers better understand the production process, producers can obtain a larger share of the profits in the chain and fewer food miles are required.

WRR, 2014: p. 35

## What is sustainable f



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## Which solutions do well on all indicators, and which only on a few?



*Because there are many different indicators of sustainability, few solutions will score well on all aspects of sustainability. The prevention of waste is certainly a good solution, but there are contradictions between organic farming and animal welfare, as well as between health and fish consumption.*

### Solutions that score well on all indicators

There are solutions that imply an improvement on almost all sustainability indicators. The Sustainable Livestock Agenda ('Uitvoeringsagenda Duurzame Veehouderij') calls such win-win solutions as satisfying *integrated sustainability*. For example, consuming less meat and dairy and more fruits and vegetables, provides improvement in all indicators of environmental sustainability, as well as animal welfare and health. Yet there will always be parties that lose out: farmers have little to financially gain from a lower consumption, unless the value per product (and hence the profit) rises fast enough to compensate.

UDV: Integrated Sustainability

PBL, 2013: p. 63-64

### Trade-off: organic or conventional crop farming?

A commonly cited hypothesis is that although organic cultivation practices cause a decrease in local environmental pressures, crop yields per hectare are lower, thus requiring more land is to produce the same amount of crop. Several studies have shown that there were indeed on average 20% lower revenues from organic agriculture, but this difference largely depends on the specific production conditions. In case of rain-fed legumes, the difference is only 4%, while the difference is much greater when organic cultivation is more similar to conventional cultivation, such as for vegetables and wheat. The biggest added value of organic farming lies in the retention of nutrients and soil quality and lower fertilizer use. Scientists recommend finding a good combination of conventional crop yields and soil biological control.

Van Ittersum et al., 2013: p. 4-5

Seufert et al., 2012: p. 229

Tuomisto et al., 2012: p. 309

### Trade-off: animal welfare or environment?

The requirements of organic and free-range production involve pigs and broilers getting more space, living longer before slaughter and (for pigs from two Better Life stars onwards) have free-range access. For poultry, a slow-growing broiler breed is required. This allows animals to eat more feed during their lifetime, meaning more land is used to produce one kilogram of meat. Also, giving animals free-range access increases the likelihood of infectious animal diseases. On the other hand, fewer pesticides are found in organic meat and there is less manure acidification on the farm. So it seems that the transition to a higher level of animal welfare is associated with a higher footprint. Nevertheless, there are innovative farm concepts where environmental and animal welfare are not as such at odds.

Blonk et al., 2007: p. 18-24

### Trade-off: more fish or not?

While it is clear that eating less meat will lead to both health and environmental benefits, such a conclusion does not apply to all parts of the dietary guidelines. The recommendation to eat two portions of fish a week, including oily fish at least once, helps to reduce the risk of cardiovascular disease. But growing fish consumption could simply further deplete endangered fish stocks. One solution would be to opt for sustainably farmed fish.

Gezondheidsraad, 2011: p. 12-13

## What solutions are there if we don't work from within the current system, but look for genuine alternatives?



While it is important to instigate sustainability within the current system, there are also solutions based on a different view of production and consumption, such as the replacement of meat as protein source, recovering phosphorus from urine and hydroponics. For a discussion of solutions 'away from the status quo', see Dagevos et al., 2015.

[Dagevos et al., 2015](#)

### Alternative protein sources

Although eating less meat contributes significantly to environmental sustainability, there are greater potential gains when meat is entirely or partially replaced. Vegetable proteins often contain fewer amino acids than meat or in the wrong ratio, which is why our body needs more of them. Legumes such as soybeans, kidney beans or chickpeas contain enough protein, vitamin B1 and iron and have a much lower environmental impact than meat. Seaweeds and algae require very little land use, fresh water or fossil fuels to produce and contain all the necessary nutrients, but may be polluted in the wild. Insects are an oft-mentioned alternative rich in protein and vitamins, but they have an environmental impact that comes close to meat. Finally, research is being done into cultivating lab meat using animal stem cells, resulting in lower greenhouse gas emissions. The market potential of alternative proteins requires that consumers see them as genuine and attractive alternatives to meat (see also "[Consumption trends](#)").

[RIVM, 2011](#)

[Van Dooren, 2015b: p. 3-5](#)

### Recovering phosphorus

A large part of the phosphorus absorbed by plants in Dutch agriculture returns to the land in the form of manure. In addition, 3 million tonnes of phosphorus from our diets ends up in the sewers through by way of urine excretion. In order to prevent eutrophication, it is

removed from the water in sewage treatment plants, chiefly for the purpose of burning it. However, it is technically possible to recover ammonium sulphate and struvite from urine by using magnesium salts and sulfuric acid. These substances can in turn be used as raw material for fertilizers. Closing the phosphate cycle in this way must, however, be done as early on as possible in the waste stream (preferably in the household itself), in order to be economically and environmentally viable.

[Van Roekel, 2012](#)

[STOWA, 2010: p. 5](#)

### Hydroponics

Hydroponics is a form of crop farming where plants grow in water with mineral and nutrient solutions, without the need of agricultural soil. The advantage of this is that because of the stacking of production, land usage is drastically reduced, and plants are better protected against microbes, insects and extreme weather. Hydroponics can take place in densely populated areas like cities, in turn creating opportunities for locally closing phosphorus and nitrogen cycles. The emergence of spectrum-specific and highly efficient LED lamps has made hydroponics increasingly profitable and the CO<sub>2</sub> emissions from its energy consumption lower.

[Despommier, 2013: p. 388-389](#)





### What is sustainable food?



### How can each party in the chain contribute?

- What can I do... as agrarian, livestock farmer or fisherman?
- ...as food processor?
- ...as supermarket?
- ...as caterer or hospitality company?
- ...as consumer?
- ...as government?
- ...in cooperation with other food chain parties?

### How sustainable is the food system?



### What dilemmas and obstacles stand in the way of realising a sustainable food system?



### What solutions contribute to a sustainable food system?



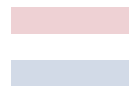
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## What can I do... as agrarian, livestock farmer or fisherman?



*As noted under the other questions, there are many opportunities for producers to become more sustainable. Producers are often expected to make great strides, in order to do that they must be able to get returns on their investment, and make sustainability measurable.*

### Measurement is key

A first step is making sustainability in the company measurable, in order to monitor progress and compare with other producers in the market. Producers can use software for business management and financial accounting to keep track of how many investments have been made in sustainability and what the results are. Next to that, Wageningen UR tracks the overall sustainability performance of the agricultural and horticultural sectors, and present an example of how a company report of financial and sustainability results might look like.

[LEI, 2013: p. 5-15](#)

[Wageningen UR: Sustainability of agriculture and horticulture](#)

[Wageningen UR: Example company report](#)

### Return on investments

For producers, investments in sustainable processes are often high and not without risk. If the investment cannot be covered by personal equity, producers will have to take out bank loans. Furthermore, there is no guarantee that the new (more expensive) product can be sold in the market. One way to deal with this is to obtain a sales guarantee set down in long-term contracts with buyers. In this way, arrangements can be made about product quality, delivery schedule, payment and even the type of animal feed. With [labels](#) or (regional)

brands, products are recognizable and distinguishable from regular products and may be charged at a higher price. Finally, producers can participate in a producer organization (such as a cooperative), giving them more leverage with buyers and creating opportunities for knowledge sharing and product marketing.

[Reinders et al., 2013: p. 39-53](#)

### Case study: integrated sustainability in Roundel eggs

A Roundel egg is produced within "a farming system designed around the natural needs and behaviours of the broiler, which at the same time uses high-tech solutions such as heat exchangers and manure drying." In the Rondeel Stable hens can find their favourite spot in the dynamic and effectively regulated stable climate, exhibit their natural behaviour and even access a covered free-range area. The use of sustainable feed, low nutrient impact (phosphorus and nitrogen) and compostable egg packaging contribute to a lower environmental impact. This has led Roundel egg to be certified with three Better Life stars and Milieukeur (an ecological preservability certificate).

[PBL, 2013: p. 85-86](#)

[Bos et al., 2004: p. 8-10](#)

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## What can I do... as food processor?



*Food processors can function as the engine of sustainability, by optimising waste streams and making sustainable innovation measurable.*

### Optimisation of waste streams

There will always be waste and by-products created throughout the food chain, many of which are inevitable. The processing industry can play an important role in extracting as much value as possible from these waste streams ([using Moerman's Ladder](#)). Key initiatives include fermenting waste to biogas, recovery of nutrients from process water and the reprocessing of organic waste to new foods or bio-based applications. An important first step is to make clear exactly where waste occurs and what happens to waste streams.

[AVV, 2015: p. 5-9](#)  
[Nowastennetwerk](#)

[Monitor Voedselverspilling](#)

### Measuring sustainability

By measuring how sustainable certain business processes or products are, processors can improve production and procurement, monitor targets, compare themselves with competitors, comply with product certification and communicate. Methods to measure the level of sustainability of raw materials, processes, products, and organizations can roughly be divided as:

- Measuring impact on certain indicators (ecological footprint, life cycle assessment, etc.)
- Measuring on established standards (certification, etc.)
- Measure for comparison between products or organizations (ranking, benchmarking, etc.)

Per method one can choose to measure only on one specific indicator, such as CO<sub>2</sub>, or combine them into a composite indicator, such as is done for many certificate schemes. Here, it is crucial to specify precisely which indicators are being measured and how. The FNLI provides an overview of tools and initiatives that seek to make sustainability measurable.

[FNLI, 2012: p. 1-7](#)

### Case study: Suiker Unie

Suiker Unie takes as a starting point not the end product (the sugar cube), but rather the raw material (sugar beet). This way it is able to get maximum value out of each sugar beet. During the process of beet processing leftover beet pulp and molasses are used for animal feed, beets spots are bio-fermented into green gas and lime fertilizer is recovered from raw juice, to be used for beet crops. This has resulted in higher crop yields, closed nutrient cycles and twenty million cubic meters of green gas produced and fed back into the power grid each year.

[KWA bedrijfsadviseurs, 2014: p. 14](#)

What is sustainable for...



How sustainable is the...



What solutions contribute...



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## What can I do... as supermarket?



*As the direct point of sale for consumers, supermarkets have the opportunity to introduce sustainability in their offering. They themselves can reduce food waste, cooperate with other actors to innovate sustainably, trace product origins and encourage sustainable consumer behaviour.*

### The supermarket as point of sale

We buy most of our food in the supermarket, which is why this party can influence the demand for sustainable products. At the same time, the supermarket is also dependent on the wishes of the consumer. Because supermarkets have become increasingly concentrated, they have growing leverage stimulate sustainability across the food chain, by setting sustainable purchasing conditions (standards that suppliers must meet to be allowed to sell to them).

[PBL, 2013: p. 103-104](#)

### Sustainability themes

A major objective for supermarkets today is realising a sustainable meat, dairy and fish assortment through the use of labelling or higher purchasing standards, such as 'Kip van Morgen'. Within the Alliance for Food Sustainability for example, supermarkets have committed themselves to an annual growth of the intermediate segment (meat with at least one Better Life star) of 15%. The supermarket can also reduce food waste, partly by matching supply and demand more closely and sending products that are nearing their expiry date to food banks or reworking plants. Furthermore, it is important to also trace the food chain across national boundaries, in order to assess sustainability indicators there.

[CBL, 2010, p. 3-10](#)

### Stimulate sustainable choices

Although the supermarket depends on the consumer for making a sale, considerable influence may be exercised on the shopping process. Bargains have a major impact on choices (see [Indirect sustainability](#), but also the layout of the store is important: the greater the share of sustainable and healthy products in the range, the more they are purchased. Products located in the middle of the

shelf or at eye level sell better. Positioning sustainable products right next to the less sustainable option is also effective, and so is making explicit how well sustainable product sales are going.

[Schuttelaar & Partners & WUR, 2012: p. 5-11](#)

[Van Kleef et al., 2012: p. 2](#)

[Duurzame supermarktiniciatieven CBL](#)

### Case study: Instock

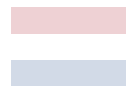
Instock is a restaurant in Amsterdam that gets 80 to 100% of its products from local Albert Heijns, where it might otherwise have been wasted. All kinds of potatoes, vegetables, fruits and breads that have remaining shelf lives that are too short to be sold, but still comply with safety requirements, can still be eaten. Other destinations for almost expired food include food banks. In this way, supermarkets can get the most value out of food that is likely to be lost otherwise.

[Website Instock](#)

### Case study: Nudging in the Plus supermarket

Nudging is a technique in which consumers' physical environment, social norms and group experience are subtly altered in order to influence behaviour. In 2011 and 2012 the effectiveness of sustainable nudging was tested in Wageningen UR's Virtual Supermarket and Plus supermarkets. Fairtrade tea placed at eye-level in the middle of the supermarket shelf was chosen more often. And placing poultry meat with 1 or 2 Better Life stars in between the regular and organic options causes the sustainable option to be bought more often. The study shows how the supermarket environment can be cleverly adjusted in order to stimulate sustainable and healthy choices.

[Schuttelaar en Partners, 2012: p. 5-6](#)



## What is sustainable for...



## How sustainable is the...



## What solutions contribute...



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# What can I do... as caterer or hospitality company?



*Caterers and hospitality companies are also directly in contact with consumers. By reducing water and energy consumption, and reducing food waste they can significantly contribute to sustainability.*

### Sustainability themes

Food that is not bought in the supermarket is often consumed in company canteens and in the hospitality sector. In addition to offering a sustainable menu (such as with organic and fair trade products), caterers and hospitality entrepreneurs can optimise their water and energy use and waste streams. The hospitality industry experiences a growing demand for honest and recognizable products and have found that energy and water consumption can be reduced by more than 30%. In catering, consumers often have limited choices and therefore (unwittingly) come into contact with sustainable food, discovering that it can be tasty as well as healthy. Therefore, caterers can accomplish much with sustainable procurement, and the (company) cook can play an important role in stimulating a sustainable offering.

[Website of Veneca](#)

[Website of KHN](#)

### Reduction of food waste in contract catering

In 2010, Venca members collectively decided to measure food waste in their canteens, a unique form of cooperation in a highly competitive market. The overall wastage was measured at five million

kilograms per year - relatively small compared to total food losses in the Netherlands: between eight and nine billion kilograms. The main way to avoid waste is to figure out in advance how many customers will visit mealtimes. Other options include a cycle menu based on local consumer preferences, gradually restocking during lunch and processing leftovers in other products such as soup.

[Soethoudt, 2012: p. 3-4](#)

### Case study: Albron sustainable recycling

At more than 500 Dutch and Belgian Albron locations, the waste management company Rotie collects food scraps and residue cooking oil. It recycles cooking oil into "second generation" biodiesel. Biodiesel imposes fewer burdens on the environment and reduces CO<sub>2</sub> emissions by more than 85% compared to the use of fossil fuels. The biogas plant ferments food waste into biogas as a fuel for gas engines. These engines power a green energy generator, supplying 20,000 homes annually in Amsterdam.

[Website Albron](#)

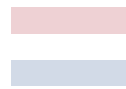
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## What is sustainable food?



### What can I do... as consumer?



*Although all parties in the food chain share a responsibility to make consumption sustainable, consumers themselves can also decide to become active in redesigning the food chain.*

#### Alternative food networks

Food cooperatives, farmers' markets and food stalls that are committed to sustainability are all channels through which consumers can become active in alternative networks. What these initiatives have in common is a greater emphasis on local and sustainable production and a connection between producer and consumer. Willem and Drees, for example, sources potatoes, vegetables and fruit from local and regional farmers. "Uit je eigen stad" is an idealistic company that produces vegetables, mushrooms, chicken and fish in the city and sells it in its own store and restaurant. The Slow Food movement (in contrast to fast food) focuses on a social consumption style. The premise is that people can enjoy food and be aware of how it is produced. Every individual in the food chain is himself a consumer and by seeking new forms of cooperation that go beyond the paradigm of economic profit, social and cultural food values that have gotten lost over time can be given new meaning.

[PBL, 2013: p. 91-94](#)

[Dagevos et al., 2015: p. 28-29](#)

#### Case study: Youth Food Movement

The Youth Food Movement (YFM) is a Dutch youth movement that, through events like eat-ins, debates, YFM Academy and the Food Film Festival, promotes young adults' awareness of the effects of food choices and the honesty and health of the food system. Regularly YFM organises large gatherings under the name of Damn Food Waste, where solutions to reduce food waste are central (damnfoodwaste.nl). While the YFM as alternative food network has not existed for very long, there is growing interest in their methods from both public and private sectors as well as from consumers who are normally not so involved in conscious food choices. In time, it is not inconceivable that it will lead culture shift.

[Website YFM](#)

## How sustainable is the food chain?



## What solutions contribute to a sustainable food chain?



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## What can I do... as government?



*The reports "De Macht van het Menu" (PBL) and "Naar een voedselbeleid" (WRR) offer the government advice on how to realise their responsibility for the food system. Moreover, the government can contribute directly to sustainability, such as through sustainable procurement.*

### **WRR: from agricultural to food policy**

The challenges that the food system faces require and the rapid changes of recent decades require a shift from agricultural to food policy, according to the Scientific Council for Government Policy (WRR).

Because diverse values and interests exist within the food system, it is important that the government pursues a clear and unambiguous strategy, coordinates effectively between government departments, dares to contradict the food industry and lobbies sustainability issues internationally. Such responsibility includes promoting a shift from animal to vegetable products, which is difficult because price measures such as a meat tax are not popular with consumers and have not proven to be effective. The complex interrelationships of production, processing, distribution and consumption, and the new balance of power within it requires governments to make sustainability measurable throughout the food chain, and focus their policies on more than just primary production. Finally, the government plays an important role in removing legal obstacles, such as the tensions between mutual agreements and competition law.

WRR, 2014: p. 139-146

De Bakker en Dagevos, 2010: p. 67

### **PBL: fulfil a responsibility for the system**

The government has a responsibility for the food system as a whole, which means that in addition to stimulating and facilitating organisations and companies it should also implement targeted interventions to accelerate the sustainable transition. They can also set a good example by establishing sustainable purchasing policies, which they have to a large extent already done. The Netherlands Environmental Assessment Agency (PBL) further presents six focus areas:

1. Aim for gradually rising and ambitious targets in the food chain and facilitate using knowledge and resources
2. Work to build trust by acting as a reliable partner with consistent policies

3. Organise public debate and involvement from citizens in food production
4. Guarantee transparency by requiring companies to measure the sustainability of their processes and communicate the results
5. Encourage changes in the supply of sustainable products and promote cooperation between companies, set standards and financial incentives where necessary
6. Promote and influence higher sustainability standards internationally, in the EU and WTO

PBL, 2013: p. 108-114

### **RIVM: promoting sustainable consumer behaviour**

Sustainability also requires a change in consumer behaviour. According to the National Institute of Public Health and Environment (RIVM) the government should take the role of 'connector', by bringing together different parties, projects and/or investors, as well as enabling a database in which initiators can post successful interventions for sustainable diets. Interventions can take place in the areas of awareness, facilitating sustainable behaviour and greening markets.

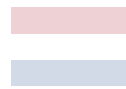
RIVM, 2015

Zwart et al., 2014: p. 24-25

### **Case Study: Meat Less Mondays**

Meat Less Mondays is a government initiative in which catering at four ministries offer less meat one day a week. By making the meat option the exception rather than the vegetarian option, the social norm around meat is influenced, allowing catering to become more sustainable. Involving the catering staff, focusing on taste and ensuring the right presentation and perception have ensured that the initiative is a success. During the three-month pilot, up to 19% less meat was eaten, which has made consumption considerably more sustainable in terms of water use, use of feed and CO<sub>2</sub> emissions, setting the right example for other sectors.

Food Cabinet, 2015: p. 5-9



## What is sustainable food?



## How sustainable is the food system?



## What solutions contribute to sustainability?



## Wat kan elke partij in de voedselketen doen?

### What can I do... in cooperation with other food chain parties?



*Sustainability often works best in partnership. Many successful sustainability initiatives are the result of a collaboration of government, business and civil society organizations. Joint visioning, selecting the right partners and building trust are critical success factors.*

#### Joint visioning

To make greater strides in sustainability, it is important for parties to agree on a common vision. An example is "al het vlees duurzaam in 2020" from the Van Doorn Commission (2011), in which thirty organizations committed themselves to more sustainable livestock farming in the Netherlands. While some NGOs prematurely dropped out due to a lack of concrete objectives, the initiative has grown to include a number of mandatory measures in the areas of antibiotic use, closing nutrient cycles and landscape integration.

De Bakker et al., 2013: p. 74-75

#### Criteria for a good partnership

When cooperating, it is important to learn from each other's knowledge and expertise, while both parties can continue to earn

enough (profit). Important steps in the initiation of cooperation are the selection of a complementary partner, carefully building trust, transparent communication, and a contract with agreements on the traceability of production processes. Together chain partners can innovate sustainably in the following steps:

- Create measurable sustainability goals and ensure compliance
- Green up the supply chain, efficiency improvement and waste reduction
- Develop sustainable products and services
- Develop business models based on the consumer's needs
- Create entirely new business practices and platforms

Omta et al., 2014: p. 47-50

Nidumolu et al., 2009: p. 3-10

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## What is sustainable food?



## How sustainable is the food system?



## What solutions contribute to a sustainable food system?



### How can each party in the food chain contribute?



### What dilemmas and obstacles stand in the way of realising a sustainable food system?

- What obstacles are there within legislation and policies?
- What are the obstacles related to behaviour and society?
- What are the obstacles related to the sharing of costs and benefits?
- What are the obstacles related to the development of knowledge?

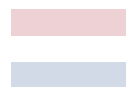
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**Literature list**

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## What is sustainable food?



## How sustainable is the food system?



## What solutions contribute to sustainability?



### What obstacles are there within legislation and policies?



*Barriers in legislation and policy concentrate on competition laws and free trade agreements.*

#### Competition laws

Competition law forbids price fixing as part of cooperation between companies, as it may disadvantage consumer and unfairly exclude other companies. But because such agreements can also deliver a societal benefit (such as sustainability), they have been partially allowed since 2013, provided that consumer benefits are big enough. In January 2015 the Authority for Consumers and Markets (ACM) denied the purchasing agreements enshrined in the 'Kip van Morgen' negotiations, because they would have unfairly limited competition. Their argument was that while consumers are willing to pay for increased animal welfare and environmental measures, the proposed improvements were not large enough to justify the higher consumer price and production costs for the producer.

[WRR, 2014: p. 124-125](#)

[Uitspraak van de ACM](#)

#### Free trade agreements

While it is possible for the government to set demands on Dutch food production, this often does not apply to products that have been imported from abroad. For example, the production of cage eggs was banned in the European Union several years ago, whilst importing them for the processing sector was still allowed. Furthermore, food safety standards established by the WHO and FAO were initially meant as a *minimum* standard beyond which governments could set stricter rules, whereas within WTO agreements it has now grown into a set of *maximum* standards that define the boundary between legitimate production standards and trade barriers.

[WRR, 2014: p. 60-64, 122](#)

[Initiatief Duurzame Handel](#)

## Contribute?

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## What are the obstacles related to behaviour and society? ✕

For most consumers, sustainable food is not a priority; they mainly prefer to choose based on taste, convenience and price. To change this, they need to be better informed and stimulated to make sustainable choices.

### Why do so few people choose to consume sustainably?

Although almost all consumers indicate that they find sustainable food values important, the actual intention to purchase sustainable products is decidedly lower. Consumers are not always rational; according to some experts 90% of the choice processes during shopping are subconscious. A small proportion of consumers considers animal welfare, environment and fairness important and act accordingly. A slightly larger group agrees, but only buys the products when they are affordable, tasty and healthy. But a large majority finds convenience, taste and price the most important factors.

Besides habit and preference the social environment is of great influence, for instance through peer pressure and role models, as well as the physical environment, such as where and in what way products are presented. Consumers indicate that their environment does stimulate them to eat healthily, but to a much lesser extent to eat sustainably.

[Backus et al., 2011: p. 25-28](#)

[Lindstrøm, 2012: p. 71](#)

[Bartels et al., 2009: p. 15](#)

### Enticing consumers to make sustainable choices

Choice processes stem from an interplay of motives, abilities and circumstances. *Motives* (values, emotions, attitudes, personal standards, awareness and problem awareness) guide consumers

in their behaviour. The consumer further requires *competences* (knowledge and skills) in order to act according to those motives. Finally, there are external *circumstances* (physical environment, technology, economic conditions and socio-cultural environment) that play an important role in guiding behaviour. Key insights include:

- The behaviour of others can be an incentive for sustainable behaviour
- Non-sustainable behaviour is often caused by the force of habit
- Attractiveness and convenience make sustainable behaviour easier
- New technologies offer opportunities to enable sustainable behaviour
- Different groups of people require different types of solutions

In addition, due to the many brands and labels in the market, as well as the many messages from government, business and NGOs, it is important that there is agreement on what exactly defines sustainability and how consumers can convert a desire to eat more sustainably into action. By making sustainable choices easy, attractive (tasty, affordable and desirable), understandable and rewarding, consumers can be encouraged to develop more sustainable habits and routines.

[RLI, 2013: p. 57-78, 21-24](#)

[Motivaction, 2015: p. 11-18](#)

[Rijksoverheid, 2015: p. 3](#)

## What is sustainable food?



## How sustainable is the food?



## What solutions contribute to sustainable food?



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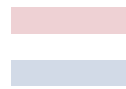
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## What is sustainable?



## How sustainable is it?



## What solutions can we use?



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# What are the obstacles related to the sharing of costs and benefits?



*Obstacles in the sharing of costs and benefits are mainly in the high price of sustainable products, the mismatch of individual and collective interests and the shadow of unsustainability.*

### Labelled foods are expensive, bulk products cheap

Products with certificate labels are relatively expensive. A kilogram of organic chicken breast is sometimes a factor of four more expensive than regular chicken, while the additional cost that the farmer has to spend is not so much higher. One major cause is that organic broilers are slaughtered and processed separately, which is logistically less efficient and more expensive. In addition, certification itself costs money. Finally the square valorisation ('vierkantsverwaarding') plays a role: with limited space on the shelf, only chicken breast is offered, because consumers prefer it. Because the drumsticks then have to be sold at a much lower price abroad, the extra cost of organic production has to be earned on the breast, which thus becomes more expensive. In contrast, non-certified products are often kept as cheap as possible, because suppliers and supermarkets compete heavily on price. This mechanism creates pressure on farmers' income, limited investment opportunities and negative impacts on the environment.

Reinders et al., 2013: p. 2, 14-15

### Individual and collective interests

Individual motives for sustainability do not always correspond with the collective interest. Not all sustainability themes are equally popular. While many companies dare to invest money in welfare improvements,

collective problems as global biodiversity, land use and nutrient cycles receive less attention. There is also the risk that companies themselves do not participate actively, but still reap the benefits of sustainability (free-riding). Enforcement from the government is thus important. Finally, it is not always clear to what extent consumers value the investments made in sustainability, or are prepared to pay a higher price, however much it is in their interest.

PBL, 2013: p. 90-91

### The real price of (un)sustainability

Environmental economists consider damage to environmental sustainability, health, animal welfare or labour conditions externalities. That is to say that the mostly negative (adverse) effects of production or consumption are not included in the price of the product. An example is CO<sub>2</sub> emissions, which without regulation could increase indefinitely, to the detriment of future generations affected by climate change. Besides government intervention, companies can also choose to include the externalities of their production in the consumer price and to take measures to mitigate or compensate them.

True Price, Deloitte, EY & PwC, 2014: p. 5-7

Also see Carolan (2013) 'The real cost of cheap food'

by explanations from several sources. These explanations are factual representations of the original source. The clickable literature list provides direct access to the original sources for further information. If you have any questions or remarks, you may contact Het Groene Brein. (info@hetgroenebrein.nl).

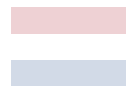
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## Literature list

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## What is sustainable food?



## How sustainable is the food?



## What solutions contribute to sustainable food?



### What are the obstacles related to the development of knowledge?



*In the development of sustainability knowledge, issues are the difficulty in measuring individual products on sustainability, and the fact that (scientific) knowledge is highly dispersed.*

#### Measuring individual products

Although dietary patterns and products are often measured at their level of sustainability, such as with the aid of Life Cycle Assessment (LCA), such analyses usually look at the average environmental pressure of ingredients, without making a distinction between different producers, processors and supermarkets. Often this information is not available in detail or companies prefer not to share it. There is thus a need for a comprehensive and simple model for comparing the sustainability of individual products.

[FNLI, 2012: p. 1-4](#)

#### Developments in knowledge sharing

Although research into nutrition and sustainability has been conducted for decennia, scientific networks are in many ways still underdeveloped. Relatively new topics such as food waste, circular economy and natural capital still do not have generally accepted definitions and measurement methods. In the case of food waste, it is nearly impossible to make comprehensive measurements of waste throughout the food chain, due to the variety of sources and sinks of waste, colliding interests of various parties and an underdeveloped knowledge network.

[PricewaterhouseCoopers, 2011: p. 2](#)

## Contribute?

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