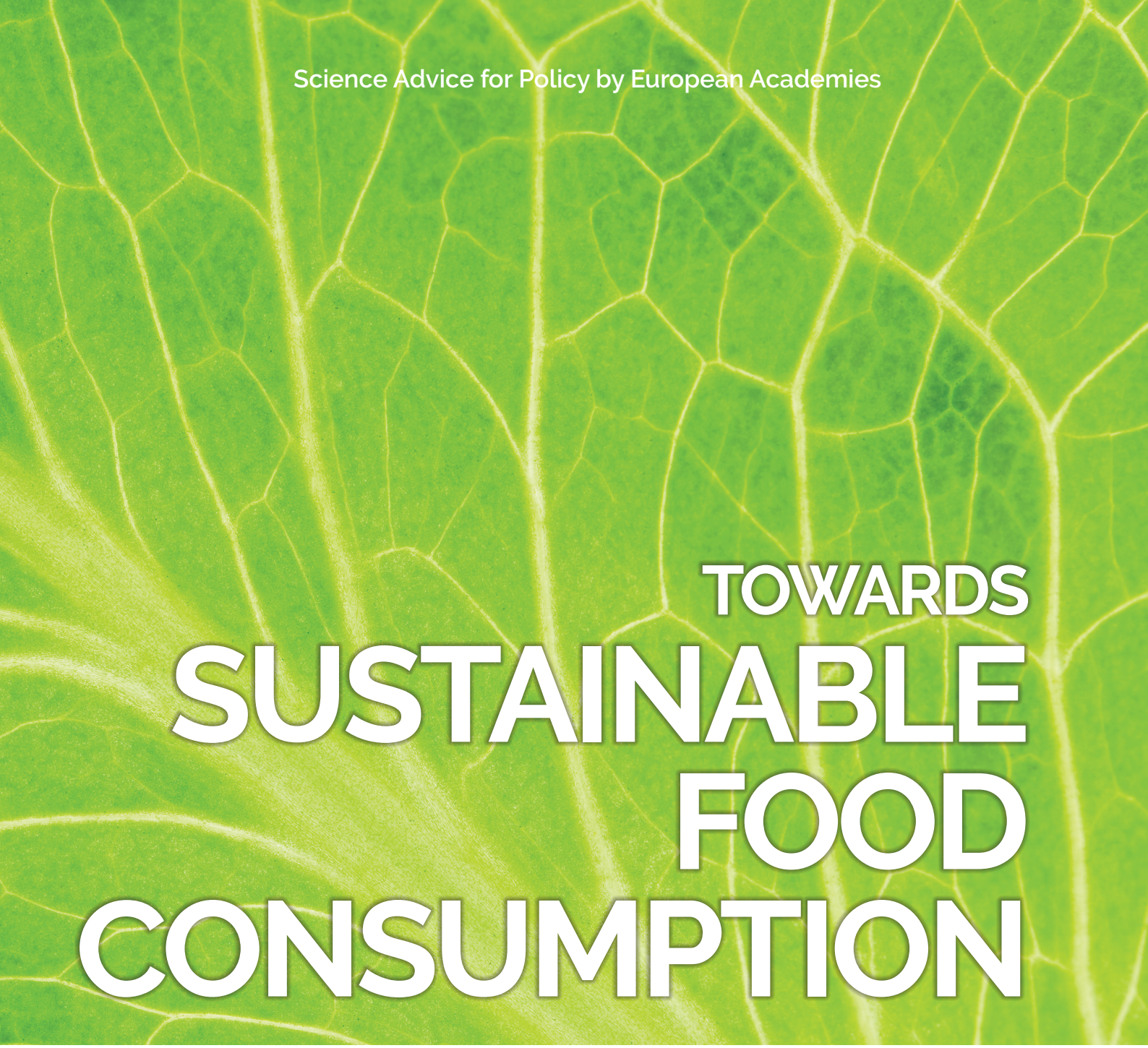

Science Advice for Policy by European Academies

TOWARDS SUSTAINABLE FOOD CONSUMPTION

SAPEA

Science Advice for Policy by European Academies

Evidence Review Report No. 12

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SAPEA

Science Advice for Policy by European Academies

Towards sustainable food consumption

Informs the Scientific Opinion
of the European Commission Group of Chief Scientific Advisors

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About SAPEA

SAPEA brings together outstanding expertise from natural, applied, and social sciences and humanities, from over 120 academies, young academies and learned societies in more than 40 countries across Europe.

SAPEA is part of the European Commission's Scientific Advice Mechanism. Together with the Group of Chief Scientific Advisors, we provide independent scientific advice to European Commissioners to support their decision-making.

We also work to strengthen connections between Europe's academies and Academy Networks, and to stimulate debate in Europe about the role of evidence in policymaking.

Europe's academies draw on the best scientific expertise to provide independent, balanced and authoritative scientific advice. This approach makes SAPEA a critical source of evidence for policymakers and the wider public.

Our Academy Networks collectively represent over a hundred academies, young academies and learned societies across Europe. SAPEA works to strengthen these academies and provides a means for close collaboration in a unique and interdisciplinary way.

For further information about SAPEA, visit www.sapea.info.

Foreword

With the approval of the EU Green Deal in 2020, the European Union embarked on a mission to respond to the climate and environmental emergencies of our time, while leaving no one behind. To achieve these objectives requires extraordinary coordination among a wide range of policy sectors.

There is now general recognition that making our food system more sustainable, healthy and fair is a key lever in this overall transition, which is why the Farm-to-Fork Strategy lies at the heart of the Green Deal. To inform the development of the Strategy, the Scientific Advice Mechanism already delivered scientific advice on *Towards a sustainable food system* in 2020.

Building on this previous advice, and to inform the 2023 revision of the Farm-to-Fork Strategy, the Commissioners for Health and Food Safety and for Innovation, Research, Culture, Education and Youth asked the Group of Chief Scientific Advisors to the European Commission to deliver science policy advice on a more specific area of the food system: food consumption and the food environment. They asked:

> What tools could be used at EU level, in addition to those mentioned in the 2020 Farm-to-Fork Strategy, to overcome the barriers preventing consumers [from adopting] sustainable and healthy diets, fostering the necessary change towards sustainability in the food environment? The Group's advice should be based on an analysis that identifies the elements refraining consumers from making healthy and sustainable choices.

To address this question, SAPEA assembled an outstanding, independent, international and interdisciplinary working group of experts in the field, nominated by academies of science and academy networks. Between October 2022 and April 2023, the working group reviewed and compiled the latest evidence on the subject to create this 12th SAPEA Evidence Review Report. This report informs the accompanying Scientific Opinion of the Group of Chief Scientific Advisors, which contains the requested policy recommendations. This project was coordinated by ALLEA, the European Federation of Academies of Sciences and Humanities, acting as the lead network on behalf of SAPEA.

We warmly thank all working group members for their voluntary contributions and dedication, and especially the chair of the SAPEA working group, Professor Erik Mathijs. We would also like to express our sincere gratitude to everyone involved in pulling this report together, as well as to the science academies across Europe.

Professor Antonio Loprieno
Chair of the SAPEA board

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- The Academy of Athens
- The Czech Academy of Sciences
- Die Junge Akademie
- The National Academy of Science and Engineering in Germany (acatech)
- The Norwegian Academy of Science and Letters
- The Royal Netherlands Academy of Arts and Sciences
- The Swiss Academies of Arts and Sciences

Executive summary

Healthy and sustainable food consumption is a key component of the EU's transition to a sustainable food system. This report unpacks the evidence to identify levers and actions that will shape food consumption for the mutual benefit of environmental sustainability and public health, including health-related inequalities. We look at current evidence and potential policies that can provide impact in this area, alongside tools to overcome the barriers that hinder sustainable and healthy consumption.

Food system impacts

The current food system is a major driver of environmental impacts, especially biodiversity loss, eutrophication, water stress, land degradation and climate change. Poor dietary quality is also linked to obesity and risks of noncommunicable diseases. To address these environmental and health issues, there is widespread agreement that diets need to shift towards more plant-based ingredients, rich in vegetables, fruits, wholegrains, pulses and fish and seafood sourced from sustainably managed stocks, with moderate amounts of low-fat dairy products and limited in red meat, processed meat, salt, added sugar and high-fat animal products.

Changing food consumption is a key lever to achieve the objectives of the EU's Green Deal and Farm-to-Fork Strategy. The food system is a dynamic and complex area, where a mix is needed of coherent evidence-based policies that consider multiple areas of impact to promote sustainable and healthy food consumption. While reducing sugar and animal product consumption are key to increasing health, reducing consumption of animal products is the key mitigation option to reduce environmental impacts. Low-input production systems like organic production can reduce chemical use and support a shift to sustainable food systems when combined with reduced animal products and decreased food waste. Prevention of and reduction in food waste can further reduce resource use and emissions. Local foods can contribute to important social aspects of the EU food system, but their climate benefits are limited.

Food environment and consumer behaviour

The food environment is the consumers' primary interface with the food system and is the focus of our attention in this report. It is the context in which food is accessed and eaten, and entails both an external domain (physical availability, the infrastructural environment, the price of food, the information environment and labelling, the social environment)

and an individual domain (affordability, accessibility, convenience and desirability) which relates to the conditions for individual daily routines and practices.

There is a huge diversity of dietary patterns in the EU, but also in the ways consumers source food, from formal markets to informal exchanges, food redistribution and more, with increasing importance of the digital environment. There are also some commonalities, with high caloric shares of processed food products in the diets of many EU countries and added sugar and salt intakes exceeding dietary recommendations. Creating a food environment that drives improvements in socioeconomic, health and environmental outcomes will have to turn trade-offs and conflicts between differing food system outcomes into a situation in which healthy and sustainable diets are the easy and the preferred choices for consumers.

The barriers to consumption changes are situated both at the individual and the contextual level. Barriers at individual level include a perceived lack of consumer motivation and capabilities, while at the contextual level there is a lack of physical, financial and social opportunities to acquire more healthy and sustainable foods. Trade-offs are exacerbated for those from disadvantaged backgrounds who may lack agency to make healthy or sustainable food choices. The obesogenic effects of the food environment will be greater for disadvantaged groups, indicating the need for disruptive measures that alter the food environment without the need for agency from consumers.

Guiding consumer behaviours or practices requires the need to understand three key socio-psychological processes. The development of effective strategies depends on the acknowledgement that consumer behaviour is driven by:

- habits, routines, and semi-automatic processes
- cognitive processes, i.e. deliberate thinking and information processing
- affective processes, i.e. emotions and impulsive reactions

Most current public policy interventions aim to increase motivation and personal capabilities by providing information or education. However, given that habits, routines, semi-autonomous and affective processes are strong determinants of food choice, policy measures need to shift food environments affecting individual behaviour significantly.

Policies and strategies

To create shifts in behaviour, disruptive measures such as taxes, bans and product reformulations should be considered, as well as softer measures that can influence and reshape social norms. These approaches help to create food environments that allow consumers to prioritise healthy and sustainable foods without the need for high agency and they also help to reduce dietary inequalities.

Five areas are considered:

- **The economic environment and fiscal food policies.** People are most likely to respond to direct incentives that make less healthy or sustainable diets more expensive. Sugar taxes in Mexico and the UK have shown their effectiveness in reducing purchases of sugary drinks and stimulating reformulation of beverages towards healthier versions. Making animal products reflect the true cost of their associated impacts is economically efficient, and may require levying carbon pricing on greenhouse gas emissions from agriculture. Consumption taxes on animal products are also effective in reducing the environmental impacts from animal products. It is important to consider the equity effects of these policies, which can be neutralised by returning the tax proceeds to citizens appropriately.
- **Physical availability.** Prominent placement of healthy and sustainable food options in the food environment can help to influence consumer behaviour, while the removal of unhealthy options from prominent places also has a positive effect. This applies to both retail and food service environments such as schools and canteens.
- **Food composition.** At a product development level, we can shape the healthiness of the food environment by reformulating food products to reduce fat, salt or sugar content. The introduction of more healthy plant-based alternatives can also widen consumer choices to replace meat products. There is a caveat here, by way of previous policies that show limited effect of reformulation when based on voluntary agreements. Comprehensive and mandatory inclusion of the food industry with clear target agreements are needed to make this policy instrument more effective.
- **The information environment.** Labelling foods for health impacts only has low to moderate impact, because consumers need to be interested and motivated to use them and because in the European context front-of-pack labelling to date remains voluntary rather than mandatory. However, some impact has been shown on food reformulation which then indirectly impacts diets and health. Warning labels, as introduced in Chile, show a comparatively better effect, while for sustainability labels the evidence is mixed.

  The effectiveness of any labelling initiative relies on developing trust. There are many new sustainability labels appearing and a coherent approach to these schemes is needed to avoid confusion.

- **The social environment.** There are many ways that choices are shaped. Peer influence has been shown to be successful in improving fruit and vegetable intake and limiting fast food consumption. There is also evidence that social influence can lead to reduced meat consumption. The digital food environment offers further possibilities, such as personalised feedback on food choices by enabling healthier and more sustainable options at check-out, but also huge risks of stimulating unhealthy and unsustainable consumption through industry marketing strategies.

Executive summary

Governments will need to introduce expanded use of policy instruments to create shifts in consumption towards healthier and more sustainable diets. A policy mix of hard and soft measures will help to overcome the barriers preventing consumers from adopting sustainable and healthy diets. The current policy focus on providing information and education is not effective enough, and must be mixed with many other policy elements. A comprehensive policy package is needed that considers addressing lobbying attempts by industry to influence policies that they might consider harmful to their own interests.

Within the policy space, there are positive examples to look towards. A meat tax framed as "animal welfare levy" is being considered in Germany, and New Zealand is implementing a price for greenhouse gas emissions from agriculture. Local initiatives across European cities indicate that public procurement of more plant-based and fewer animal products is viable and effective, and could be rolled out at the national or EU level. Experiences from Denmark and Sweden demonstrate governments can stimulate demand for targeted food categories, for example organic food, through public procurement and campaigns directed at households.

Ultimately, a legislative framework is needed for sustainable food systems that specifies the guiding principles for effective and efficient actions at multiple policy levels, in a coherent and systemic way. When approached with a dynamic, joined-up approach, these policy areas offer the prospect of positive influence over the food environment and in the end, the improved health and sustainability of our food system.

Introduction

Food consumption is an important lever to move food systems towards more healthy and sustainable outcomes. Governments — including the EU — tend to focus on informing consumers as the main policy intervention. However, the SAPEA report on food systems (SAPEA, 2020) posited that information provision by public authorities is insufficient to change consumer behaviour, due to the complexity of the food environment[1] influencing consumer behaviour on the one hand, and the habit-based nature of consumer behaviour on the other. Based on this evidence, the Scientific Opinion of the Group of Chief Scientific Advisors to the European Commission recommended to ensure a combination of "regulatory, financial, behavioural, information, communication, and education measures" to reshape the food environment. In this context, "information-based initiatives should be a part of the policy mix despite the fact that on their own they would be insufficient to change behaviour" (GCSA, 2020, pp. 41–42).

Building on this previous advice, the Commissioner for Innovation, Research, Culture, Education and Youth Mariya Gabriel and the Commissioner for Health and Food Safety Stella Kyriakides have asked the Advisors to deliver advice in the form of a scientific opinion on the topic of sustainable food consumption by the second quarter of 2023, as it will feed into the revision of the Farm-to-Fork strategy from the middle of 2023 onwards.

This SAPEA evidence review report gathers the relevant scientific evidence to inform the Advisors' Scientific Opinion. It addresses issues described in a scoping paper[2] which sets out the formal request for advice from the European College of Commissioners to the Advisors. The aim of this report is to analyse:

> What concrete actions could be taken at EU level, in addition to those announced in the 2020 Farm-to-Fork Strategy, to overcome the barriers preventing consumers [from adopting] sustainable and healthy diets, fostering the necessary change towards sustainability in the food environment?

The current policy mix

The current policy mix related to sustainable and healthy food consumption is highly fragmented, rooted in the General Food Law established in 2002 on the one hand, and in many pieces of legislation that influence the sustainability of the food system, either directly or indirectly, on the other.

1 As it is central in this report, the concept of the food environment is introduced and defined at length in chapter 1.

2 https://research-and-innovation.ec.europa.eu/system/files/2022-07/scoping-paper_sustainable-food-consumption.pdf

Introduction

The 2002 General Food Law[3] is rooted in EU food safety policy that falls under the EU Treaty's articles on public health (article 168) and consumer protection (article 169). The Law lays down the general principles governing food safety, establishing the European Food Safety Authority (EFSA) as the main governing body. Issues addressed include the regulation of food additives (vitamins, minerals, food supplements); health and nutrition claims made on foods; food intended for infants, young children and special medical purposes; and the impact of foods on food allergies.[4]

In its White Paper on *A strategy for Europe on nutrition, overweight and obesity-related health issues*, the European Commission stresses that:

> any public action, including those possibly undertaken at Community level, in this field should take into account three factors. Firstly, the individual is ultimately responsible for his lifestyle, and that of his children, while recognising the importance and the influence of the environment on his behaviour. Secondly, only a well-informed consumer is able to make rational decisions. Finally, an optimal response in this field will be achieved by promoting both the complementarity and integration of the different relevant policy areas (horizontal approach), and of the different levels of action (vertical approach).
>
> *(European Commission, 2007)*

Hence, actions should result in better-informed consumers, making the healthy option available, and encouraging physical activity, with focus on priority groups and settings — particularly children living in low socioeconomic conditions.

As a result, legislation starts from the premise that a well-informed consumer is able to make rational decisions and tends to focus mainly on food labelling. Most recently, food labelling is regulated under Regulation (EU) No 1169/2011 on providing food information to consumers, merging earlier regulations on food labelling and nutritional labelling. The regulation prescribes the mandatory information that needs to be communicated to consumers, including the country of origin or place of provenance for some products.

Sustainability dimensions of the food system are regulated by various pieces of legislation, a comprehensive overview of which is difficult to realise given the complexity of food systems. EU policies aim "to protect the environment and biodiversity, minimise risks to human health, and promote the transition to a circular economy".[5] The food system relates to several environmental issues, including clean air, chemicals, industrial emissions, waste and recycling, water, soil and land, and nature and biodiversity. Particularly worth mentioning in relation to sustainable food consumption are the EU initiatives to make sustainable products the norm in the EU and substantiate green claims

3 Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety.

4 https://www.efsa.europa.eu/en/applications/nutrition/regulationsandguidance

5 https://environment.ec.europa.eu/index_en

on products. These initiatives are intended to replace current Regulation (EC) No 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel.

The regulation of climate change mitigation differentiates between energy-intensive sectors of the economy that are covered by the EU's Emissions Trading System (ETS1) and other sectors, including domestic transport (excluding aviation), buildings, agriculture, small industry and waste. For the latter, the Effort-Sharing Regulation has been in place since 2018, stipulating that these sectors must reduce emissions by 30% by 2030 compared to 2005. In 2023, the Regulation was amended, increasing the reduction target to 40%.[6]

The European Commission also plans to revise the Regulation on land use, land use change and forestry "to provide more powerful incentives for member states to grow and improve their natural carbon sinks in line with the European Climate Law, and to reduce the complexity of the current rules".[6] Particularly promising is the CSR Directive that entered into force in January 2023, requiring all large companies to list information on risks and opportunities arising from social and environmental issues.[7]

Another important instrument is public procurement. Directive 2014/24/EU on public procurement currently prescribes that public contracts must be based on the most economically advantageous tender. This method of assessment "allows for considering price, or cost, and other criteria that relate, among other factors, to quality, social, environmental and innovative aspects as well as delivery conditions such as delivery date, delivery process and delivery period. In practice, this method rewards the bids which are compliant with specific criteria".[8]

Last but not least, the Common Agricultural Policy (CAP) significantly impacts the sustainability of agricultural production. The CAP remains the major EU policy directed at the food sector. As an agricultural policy, farm interests have been at the centre of policymaking. However, demands from outside the farming community that the CAP should respond to sustainability issues have resulted in policy evolution in which provision of public goods, in the form of compliance with specified environmental measures, has been added to the direct farm income support payments as an eligibility criterion. Sustainability in the CAP domain has been defined entirely from an environmental perspective; it has done very little to address public health (De Schutter et al., 2020). While most CAP support is not coupled to production, a considerable

6 https://climate.ec.europa.eu/eu-action/effort-sharing-member-states-emission-targets/effort-sharing-2021-2030-targets-and-flexibilities_en

7 Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting

8 https://op.europa.eu/en/publication-detail/-/publication/b1b7d65b-5334-11e8-be1d-01aa75ed71a1/language-en

amount of subsidies coupled to livestock production still exist. The most recent reform has added the instrument of eco-schemes to the existing set of instruments including the conditionality of obtaining income support on a set of food safety, environmental and animal welfare standards in the first pillar of the CAP and the rural development measures of the second pillar of the CAP addressing issues related to nature, the environment and climate change. Important to mention are also the Regulation and the Resolution regarding the aid scheme for the supply of fruit and vegetable and the EU's quality policy. The EU protects and promotes certain foods that are linked to their geographical origin and to traditional know-how. Geographical indications include Protected Designation of Origin, Protected Geographical Indication, and Geographical Indications for spirits.

The Farm-to-Fork Strategy

To address major environmental and climate change challenges across all policy fields, the Commission published the European Green Deal in December 2019 and the Farm-to-Fork Strategy in May 2020.[9] The strategy aims to accelerate the European Union's transition to a sustainable food system, addressing the food environment in two ways.

First, to facilitate the shift towards healthy and sustainable diets, the strategy proposed the following actions:

- proposal for a harmonised mandatory front-of-pack nutrition labelling to enable consumers to make health-conscious food choices
- proposal to require origin indication for certain products
- determine the best modalities for setting minimum mandatory criteria for sustainable food procurement to promote healthy and sustainable diets, including organic products, in schools and public institutions
- proposal for a sustainable food labelling framework to empower consumers to make sustainable food choices
- review of the EU promotion programme for agricultural and food products with a view to enhancing its contribution to sustainable production and consumption
- review of the EU school scheme legal framework with a view to refocus the scheme on healthy and sustainable food

Second, the strategy also proposes a set of actions to stimulate food processors, retailers, hospitality and food services companies to become more sustainable:

- initiative to improve the corporate governance framework, including a requirement for the food industry to integrate sustainability into corporate strategies

9 https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_en

- develop an EU code and monitoring framework for responsible business and marketing conduct in the food supply chain
- launch initiatives to stimulate reformulation of processed food, including the setting of maximum levels for certain nutrients
- set nutrient profiles to restrict promotion of food high in salt, sugars or fat
- proposal for a revision of EU legislation on food contact materials to improve food safety, ensure citizens' health and reduce the environmental footprint of the sector
- proposal for a revision of EU marketing standards for agricultural, fishery and aquaculture products to ensure the uptake and supply of sustainable products
- enhance coordination to enforce single market rules and tackle food fraud, including by considering a reinforced use of OLAF's investigative capacities[10]

Most (but not all) of the proposed actions focus on information and marketing, and are thus in line with the aforementioned legislator's main focus on well-informed and rational consumers as the starting point of policies supporting the shift towards healthy and sustainable diets.

Approach in this report

Given the complexity and breadth of the food system, choices have been made concerning the evidence that the working group looked into to compile this report. To frame the report, we would like to make explicit three important considerations that widen the scope of this review to non-conventional aspects of the food system on the one hand, but narrow down its scope on the other.

First, it needs to be recognised that hegemonic approaches to alternatives to the conventional food system and its transformation along sustainability lines are derived from research in Western European contexts and are based on ethical consumerism, food commodification, certification and marketisation. These alternative approaches are largely reminiscent of the "ABC policy model in which attitudes (A) drive the kinds of behaviour (the B) that individuals choose (the C) to adopt" (Shove, 2010, p. 1274). The dominance of the ABC model in these narratives of transformation can be criticised on the grounds that these approaches are "incapable of conceptualising transformation in the fabric of daily life on the scale and at the rate required" (Shove, 2010, p. 1238). Clearly, there is a strong need to widen the scope of what is considered a sustainable food system. In this respect, the already existing and largely sustainable — environmentally and socially — informal food practices make a compelling case.

10 OLAF is the European Anti-Fraud Office: https://anti-fraud.ec.europa.eu/index_en

Second, the food system is a highly complex system with a range of interacting social, cultural, technological, economic and ecological components. Its complexity is key, but also threatens its resilience: it guarantees diversified resources and supply chains, but compromises sustainability if not guided appropriately on a global scale. Food consumption not only impacts human and planetary health, but also a range of socioeconomic factors, including working conditions for farmers and farm workers, animal welfare, power imbalances among firms, food affordability, etc. (HLPE, 2017).

However, the focus of this report is on the nutritional, health and environmental outcomes of food systems. When designing future sustainable food systems and policies to steer towards such systems, these wider food system aspects should also be considered. However, there are limitations to what can and should be controlled by food consumption interventions, and some aspects that are associated to food consumption and indirectly affected by food choice might still be more effective to address with policies directed at that issue specifically. For example, it is more effective to regulate working conditions through labour legislation than by encouraging consumers to buy food products that are produced under such conditions.

Third, the report focuses on how the food environment shapes food consumption, which means that several aspects have received less attention, such as the role of physical activity and alcohol consumption. Given the focus of most of the literature on the consumption of meat, fruit, vegetables and foods high in sugar content, certain foods also received less attention, including fish and marine products and nuts.

To respond to the scoping question, we reviewed published scientific evidence, including input from social sciences, and took a systemic approach which considers the complex architecture of the food environment. Chapter 1 conceptualises the structural dimensions of food systems and particularly the food environment that shapes food consumption. Chapter 2 defines what healthy and sustainable diets and food consumption entails. Chapter 3 identifies the various barriers to changing food consumption. Chapter 4 summarises the evidence on the impact of interventions in the various dimensions of the food environment on food consumption. Chapter 5 provides examples of successful policy mixes in selected areas that go beyond information provision. Chapter 6 concludes with a set of policy elements that could constitute a policy mix fostering healthy and sustainable diets.

Chapter 1. Food systems, food environments and their drivers

Food systems are a focal point of interaction between humans and their environment. The earlier SAPEA report *A sustainable food system for the European Union* (SAPEA, 2020) adopted a social science perspective to identify viable pathways towards a more socially just and sustainable food system. It found that promoting a transition to a more sustainable food system requires addressing several interrelated challenges, including malnutrition; population growth and urbanisation; biodiversity; globalisation; territorial imbalances and geopolitical uncertainties; and the social and environmental consequences of intensive agriculture and industrialised food production.

This new report continues to support a systemic view of actors, activities and relations, recognising the interactions between food systems at different territorial scales, allowing for both common EU and region-specific approaches.

Food and nutrition security is central in food systems thinking, as hunger and malnutrition found at a consumer level are determined by income, price, access to food, and more. An important external factor in consumption patterns is the food environment, which is the physical and social environment that affects what people eat. Therefore, this report adopts a food systems perspective to address food consumption — currently considered one of the most important drivers of both global environmental change and the state of human health — and the barriers within food environments that prevent consumers from adopting more sustainable and healthier diets.

This chapter introduces key food system concepts, the drivers of food system change, food system dynamics, and food system outcomes. Referring to the production and distribution mechanisms within the food system, we provide an overview of the different ways people access food, namely through food value chains, alternative networks, informal exchanges, and donations. We then define the food environment in terms of its key elements, the context in which food is accessed and consumed, and we address the importance of digital technology in shaping the food environment. The mix of policy instruments found later in this report (Chapters 4 and 5) target the key elements of the food environment which ultimately influence food consumer behaviour. Figure 1 summarises the contents of this chapter in the context of the following chapters.

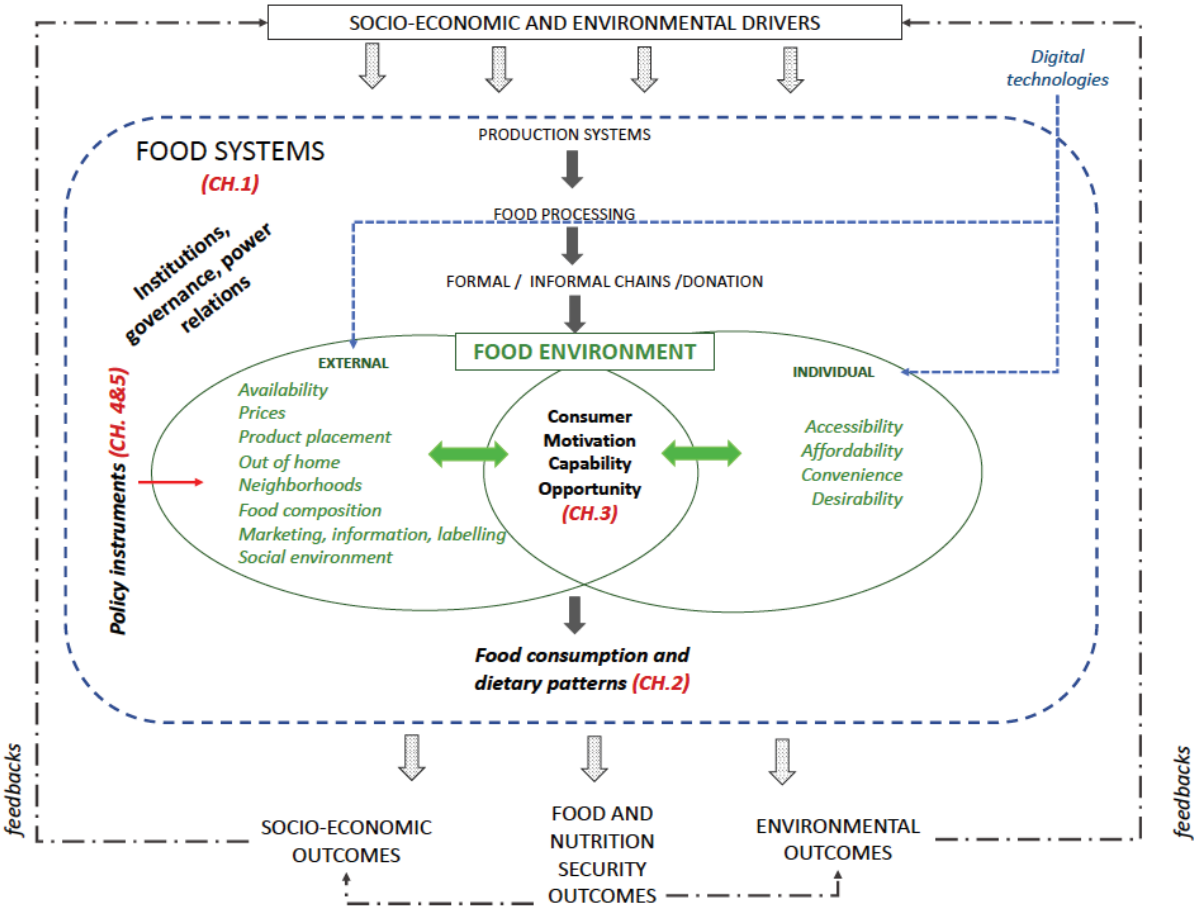

Figure 1. A food system perspective on food environment and food consumption: overview of report's chapters (1-5)

1.1. The food system concept: drivers, structures and dynamics

The food system has become an important concept as researchers and policymakers are confronted with complex (also called "wicked") food-related problems for which linear or reductionist thinking cannot provide sufficient answers (Fanzo, Haddad, et al., 2021). The food systems approach stems from systems thinking applied to agricultural and food science and is considered comprehensive and integrative enough to address the grand challenges of sustainability (Eakin et al., 2017).

Based on Ostrom (2009), food systems have been interpreted as complex socioecological systems that integrate social, economic, technological, and environmental processes. The food system includes the biophysical resources for food production, the resource use requirements of food processors and retailers, and consumer behaviour, including food preferences, preparation, and distribution patterns within households (Ericksen et al., 2010). Particularly during recent years of severe economic crisis, there has been renewed

attention to food and nutrition security in relation to food system vulnerabilities (Zurek et al., 2018). By capturing the interconnected food relationships at multiple scales in spatial, temporal, and legal terms, food systems thinking allows for an explicit focus on key tensions such as food and nutrition insecurity, environmental degradation, and chronic poverty (Godfray et al., 2010). Food systems represent one of the most critical entry points for achieving the multiple objectives of the Sustainable Development Goals, as over half of them relate to global food security and nutrition, with SDG2 (Zero Hunger) being the most critical (Fanzo, 2019).

There are a set of critical aspects in food systems thinking, starting with the description of the components and the relationships between them. The key components of food systems are structures that comprise actors, resources and activities (i.e., production, aggregation, processing, distribution, consumption and disposal, including loss or waste, of food products), that interact based on coordination mechanisms and governance (van Bers et al., 2019), to deliver outcomes such as food and nutrition security and other socioeconomic and environmental effects (Ericksen, 2008; HLPE, 2017; Ingram, 2011). As food systems are very diverse and location-specific, yet interconnected, they can be represented in different ways. Conceptualising food systems entails defining systems boundaries, building-blocks and linkages between them, while simultaneously being connected to other systems such as health, education, environment, economy and governance, and science and innovation systems.

The food system concept critically puts the emphasis on the outcomes of the processes taking place within it (p. 22). As stated in the earlier SAPEA report (2020), a sustainable food system is "one that contributes to food security and nutrition for all people in a way that sustains the economic, social, cultural, and environmental resources to provide food security and nutrition for future generations". Food system outcomes are identified and assessed in terms of food and nutrition security, socioeconomic impacts (income, employment), and the environment (biodiversity, climate). In most recent frameworks (HLPE, 2017, 2020), food and nutrition security entails six dimensions. Beyond availability, access, utilisation and temporal stability, there are two further overarching dimensions:

- **Agency** refers to the ability of individuals or groups to make their own decisions about what food they eat, what food they produce, and how that food is produced, processed, and distributed within food systems, including their ability to participate in processes that shape food systems policy and governance.
- **Sustainability** refers to the long-term ability of food systems to provide food security and nutrition in ways that do not compromise the economic, social and environmental foundations that create food security and nutrition for future generations (FAO, 2022a).

Distinguished authors emphasise the growing awareness of food system inequities and the connections between food and ecological systems that highlight the importance of

agency and sustainability (Clapp et al., 2022). Both agency and sustainability are important factors influencing both drivers and outcomes of food systems and the food environment.

Explicitly linking food system outcomes to the structures and activities in the food system is important for research and policy, because food security results from a complex set of interactions in multiple domains that are often not highlighted in conventional sector or food chain analyses which focus on food yields and flows (Borman et al., 2022; Ericksen et al., 2012).

Below is a list of food system outcomes (adapted from HLPE, 2020; van Berkum et al., 2018):

- Socioeconomic outcomes:
  - income
  - livelihoods
  - employment
  - wealth
  - social and political capital
  - human capital
- Food and nutrition security (incorporating stability, agency and sustainability):
  - food utilisation (nutritional value, social value, food safety)
  - food access (affordability, allocation, preference)
  - food availability (production, distribution, exchange)
- Environmental outcomes:
  - land
  - soil
  - fossil fuel
  - minerals
  - biodiversity
  - water
  - climate

Systems thinking views the behaviour of a system as a dynamic interaction between variables and across sub- or supra-systems, which goes beyond a simple chain of cause-and-effect relationships and aims to capture the root causes behind unsustainable food system outcomes. Food systems dynamics are expressions of specific human-environment interactions, characterised by uncertainty, error, learning, and adaptation (Rivera-Ferre et al., 2013). Both positive/reinforcing and negative/mitigating feedback effects explain the dynamic effects of interactions on the initial variables. Feedback loops are a distinguishing aspect because they occur between parts of the food chain and from the socioeconomic and environmental outcomes of food production and consumption,

back to that production and consumption. Mapping system dynamics using causal loop diagrams allows the identification of entry points and opportunities for change in the system (Brzezina et al., 2016; Galli et al., 2019; Kopainsky et al., 2018). Equilibrium and disequilibrium states, co-evolution of system components, self-organising properties, nonlinear dynamics, and multivariable structures are all consequences of the dynamic and uncertain behaviour of food systems (SAPEA, 2020).

Ultimately, systems thinking aims to identify the drivers behind systems dynamics, to address the root causes of the lack of sustainability and food and nutrition security. At the same time, food systems themselves are drivers of global change (Ericksen et al., 2012) as they have socioeconomic and environmental impacts. The relation between food systems and the environment is indeed complex because environmental changes are both a driver and an outcome of food systems (Fanzo, Bellows, et al., 2021). Such bidirectional relationships (between climate change and food and nutrition security) require adaptation and mitigation interventions that are both climate-smart and nutrition-sensitive (Fanzo et al., 2018).

Food systems drivers can be classified as internal or external, depending on how the boundaries of the system are defined. Drivers can be identified in relation to the durability of their effects on the food system: shocks and stressors that alter the food system equilibrium may not necessarily be drivers of change. They can be considered drivers to the extent that their recurrence or increase in frequency and intensity (e.g. of climate events) will lead people, individually or collectively, to adapt by changing their behaviours, eventually altering the system in a durable way. Three general categories of drivers can be identified (Béné et al., 2020):[11]

- drivers relevant to demand and consumers, such as population demographic transition, rise in consumer income, urbanisation and lifestyle change, and growing attention to diet
- drivers related to production and supply, such as technological innovation, intensification of the agricultural sector, improved access to infrastructure, general degradation in agro-ecological conditions, and climate change
- drivers related to trade and distribution, such as policies facilitating and mitigating trade, internationalisation of private investments, and growing concerns for food safety

The pathways to increased sustainability are open to debate, whereas drivers are often correlated and overlapping and show more or less significant correlations with food system sustainability (Béné et al., 2020; Béné et al., 2019). A recent report by FAO (2022a)

11 Recent analysis (Béné et al., 2020) concludes that only a few drivers display both significant and positive associations with food system sustainability. Changes in population growth, agricultural area, female employment in services and urban population are negatively correlated with country food system sustainability scores.

analyses eighteen interconnected socioeconomic and environmental drivers, and the related trends that could shape the future of agrifood systems:

- Systemic (overarching) drivers:
  - population dynamics and urbanisation
  - economic growth, structural transformation and the macroeconomic outlook
  - cross-country interdependencies
  - big data generation, control, use and ownership
  - geopolitical instability and increasing conflicts
  - uncertainties (e.g. pandemic)
- Drivers directly affecting food access and livelihoods:
  - rural and urban poverty
  - inequalities are widespread and deep-rooted
  - food prices
- Drivers directly affecting food and agricultural production and distribution processes:
  - innovation and science
  - public investment in agrifood systems
  - capital and information intensity of production
  - input and output market concentration
- Drivers regarding environmental systems:
  - consumption and nutrition patterns
  - scarcity and degradation of natural resources
  - epidemics and degradation of ecosystems
  - climate change
  - the 'sustainable ocean economies'

Interrelations among drivers occurring simultaneously, or through cause-effect relationships, contribute to determining agrifood systems outcomes, at different scales. The FAO (2022a) report provides a detailed understanding of the role of each driver in determining possible future patterns of agrifood systems.

Among the multiple food system drivers assessed in the FAO (2022a) report, changes in consumption and nutrition patterns over time play a key role, and occur as a consequence of a number of factors that interact in a complex manner. These include income, prices, demographic changes, urbanisation, trade, individual preferences and beliefs, cultural traditions and social norms, and modifications of lifestyle. Changes in dietary patterns and consumer behaviour are extensively addressed in Chapter 2 and Chapter 3 of this report. For now, it is sufficient to say that changes in the past decades have not been limited to what people eat, but also to how people consume foods in relation to lifestyle changes (including the digital environment, which is further addressed

in this chapter). Other key drivers, beyond the scope of the present report, are the consequence of sudden crises such as the COVID-19 pandemic, whose impact on eating behaviours is yet to be clearly understood (Alamri, 2021; González-Monroy et al., 2021; Hunter et al., 2023), or the outbreak of war, such as recently in Ukraine. Different forms of conflict and violence, including ecological violence, are at once driven by food systems and drivers of food insecurity, as stated by a recent report by the UN special rapporteur on the right to food (Fakhri, 2022), who emphasises "systemic violence and structural inequality in food systems" favoured by relationships of dependence (among individuals, countries, international financial institutions and corporations) and extractive practices that undermine human and environmental health.

Multiple perspectives and interests in food system activities and outcomes, along with differences in power across levels and scales, also means that it is very difficult to agree on solutions to food system problems. This is at the heart of trade-offs among food and nutrition security, socioeconomic and environmental outcomes (Ericksen et al., 2012; FAO, 2022b; van Berkum et al., 2018). Different perspectives, power relations and interests in different contexts determine how trade-offs are evaluated and hence how policy and other decisions are made. On the other hand, synergies arise if, for instance, socioeconomic outcomes such as growth in income increase food availability, and better food use (e.g. reducing waste) leading to positive environmental impacts. Trade-offs could instead arise if an increase in food production puts pressure on the environmental outcomes and choices concerning food access, leading to unequal socioeconomic outcomes. Dependence on foreign food production and imports versus the expansion of domestic cropland and productivity for self-provision is a key tension (MacDonald, 2013). Other examples of food system trade-offs can be identified in the tensions between food and biofuel energy production (see Gasparatos et al., 2011, for a systematic critical review), between organic farming, the use of genetically modified crops and productivity (Azadi & Ho, 2010), or between sustainable products and accessibility for low-income groups.

The following sections explore the structures and activities of the food system and briefly discuss food supply chains (p. 26), the food environment, and consumer behaviour. As mentioned earlier, it is important to keep in mind that these food system constituents are influenced by the various drivers mentioned above and help to shape dietary habits and determine the ultimate nutritional, health, economic, environmental and social outcomes of food systems. After addressing the core activities of the food system, we review the concept of the food environment, including its digital dimensions (p. 39). We then move from the general context to the individual level, discussing food consumption behaviour (p. 46). This leads to Chapter 2, p. 52, which focuses on dietary habits and takes a closer look at the impact of the food system on health and the environment.

1.2. Inside the food system

This section looks inside the food system by focusing on the main processes and relations that enable the exchange and consumption of food, leading to diverse food and nutrition security outcomes (Ingram, 2011).

Food systems encompass food value chains insofar as they include "a chain of activities from production ('the field') to consumption ('the table'), with particular emphasis on processing and marketing and the multiple transformations of food that these entail" (Ericksen, 2008). Key processes include (HLPE, 2017):

- **production:** all activities involved in the production of the raw food material
- **storage and distribution:** the range of intermediaries who link producers, processors, packaging to the final market
- **processing and packaging:** the various transformations that the raw food material undergoes before it is sent to the retail market for sale
- **distribution and markets:** the many actors involved in transport, delivery, logistics, warehousing, trading and marketing.

This section further distinguishes the domains through which people access food: either via the formal food system, in which exchanges are regulated mainly by contractual and market arrangements, or through other informal means, encompassing all other ways to obtain and exchange food beyond purchasing it on the market.

The economic relations within which food is produced, distributed and consumed extend beyond market-based interactions and include alternative market and non-market economic relations (including donations, for example). This is leading to a growing recognition of "more-than-capitalist configurations" (capitalist, alternative capitalist, non-capitalist) in agrifood systems (Koretskaya & Feola, 2020). Moreover, "the variations in and between agrifood systems" can be understood as a form of "diverse economy" (Gibson-Graham, 2006) where none of the market, non-market or alternative food systems should be conceptualised as monolithic or hegemonic, as they all overlap and interact with each other.

The inadequacy of reducing the economic system — and by extension, the food system — to its market-based variant is powerfully captured in the allegory of an iceberg (Gibson-Graham, 2002). The visible tip of the iceberg represents the formal, market-based part of the economy, while the multiplicity of alternative market and non-market relations are submerged.

Within the overall food system, we find the formal food system, alternative food networks (alternative to market food systems) and the informal food system including informal food production, gathering and sharing. Conceptualising the food system as more-than-

capitalist and hence comprising formal and informal elements also relates to the question of food system resilience in two ways. First, we can conceptualise resilience as the capacity to recover from a shock or disturbance: "The underlying idea is that the greater diversity of entitlements available to a person, household or community, the more likely they are to avoid becoming vulnerable and to be food-secure and consequently resilient" (Fendrychová & Jehlička, 2018). Alternatively, we can conceptualise resilience as future-oriented and change-enabling (DeVerteuil & Golubchikov, 2016). Individuals, households and communities that are able to combine diverse entitlements have greater opportunity to experiment and create ways of obtaining and consuming food that are novel and more sustainable (both environmentally and socially).

Many food consumers in Europe participate simultaneously in several variants of the food system (formal, market-based; alternative market; and non-market) and in their different configurations. The extent of their engagement in the latter varies significantly in different societies.

Formal and market-based value chains

Agrifood systems in the Global North are often understood and governed through the concept of value chains, which links the different functions of production, processing, trade and retail (Gereffi et al., 2005). Modern agrifood supply chains are governed by public regulations but also, importantly, by private standards concerning safety, quality and price, which structure the relationships between the actors via enforceable contracts and strict supply conditions (Fulponi, 2007).

The analysis of food value chains requires an understanding of nutrition, agriculture, food technology, economics, marketing, and more. Food value chain actors identify innovative ways to improve the availability, affordability and acceptability of nutritious foods, in the contexts of both undernutrition and overnutrition, and there is currently a push for conducting food value chain analyses in an integrated manner with multiple and diverse stakeholders (Fanzo et al., 2017). However, the potentially negative implications of the food industry, and how retail concentration can impact food system outcomes, are important concerns related to these actors (see e.g. Clapp, 2023; Wood et al., 2021).

Companies in the food value chain have an incentive to enlarge due to two mechanisms. Firstly, the relative decrease in agricultural prices over time has led to a higher concentration in industries purchasing raw inputs (Gaigné & Le Mener, 2014), while technology has fuelled economies of scale in logistics, purchasing and production. Secondly, companies have an incentive to escape competitive pressure by product differentiation, requiring economies of scale in marketing, which in turn is fuelled by technological innovation, free trade and globalisation. As a result, the concentration in multinational food companies and retailers has increased tremendously.

A recent study based on Euromonitor 2018 data found C4 concentration ratios (the sum of the%age of market share of the four largest firms) as high as 60% across the EU in packed food subsectors such as breakfast cereals, carbonated drinks, confectionery, energy drinks, ice cream, soups and sports drinks (Van Dam et al., 2022). The authors found concentration ratios to be significantly higher in subsectors offering ultra-processed packed food products. Therefore, the question arises of whether corporate concentration and globalisation have a negative impact on diets.

Evidence shows that technology, globalisation and corporate concentration may correlate with each other, but the exact mechanisms of cause and effect are more complex, leading to mixed evidence (see Zimmermann & Rapsomanikis, 2021 for a recent overview). Evidence supports both positive and negative effects of globalisation, free trade and communication on healthy and sustainable diets. For example, trade increases dietary quality and reduces malnutrition (Cuevas García-Dorado et al., 2019), but also increases access to less healthy and less sustainable foods and drinks, which results in an association between trade and obesity. In the same way, free communication may spread messages about the less healthy 'Westernisation' of diets, but at the same time also provide wider access to knowledge about healthy diets (Knutson & de Soysa, 2019).

An often-used argument (found in Fox et al., 2019), the Dependency/Worlds System Theory, is that economic and cultural globalisation has paved the way for the diffusion of a lifestyle that is detrimental to human and planetary health, which has been accelerated by free trade, profit-driven multinational corporations and technological changes which support more effective distribution and communication systems. An alternative argument (the Modernisation Theory) is that domestic processes of modernisation resulting from economic development and thus higher incomes, have both positive and negative consequences for diets. Urbanisation and democratisation leads to a nutrition transition and decreasing rates of physical activity, while women's empowerment results in higher participation in the workforce and thus higher demand for convenience. Using longitudinal data from 190 countries from 1980 to 2008, Fox et al. (2019) conclude that rising obesity is robustly predicted by processes of economic development, rather than globalisation.[12]

Evidence also shows both positive and negative effects of trade on environmental outcomes. The positive effect of trade includes a better use of natural resources globally (Roux et al., 2021). However, increased demand for imports can elevate environmental impacts in exporting countries beyond acceptable thresholds.

12 This statement seems to contradict observations that particularly the poor suffer from obesity (for example, Yach et al., 2005). However, those observations have not been confirmed by empirical studies. For instance, Goryakin and Suhrcke (2014) used a large set of demographic and health survey finding a positive and concave relationship between national per capita income and obesity.

A growing number of studies are raising concerns about large multinational corporations as driving forces in the increased consumption of sugar-sweetened beverages and processed food rich in salt, sugar and fat (Stuckler et al., 2012). Increasingly, studies point to the political activities of these companies (Baker et al., 2020; Sievert, Lawrence, Parker, & Baker, 2022), giving rise to a new literature on the commercial determinants of health (Kickbusch et al., 2016; Maani et al., 2022) and the role of power in particular (Lacy-Nichols & Marten, 2021). Recently, Gilmore et al. (2023) defined the commercial determinants of health as "the systems, practices, and pathways through which commercial actors drive health and equity", and proposed a comprehensive framework to analyse these determinants. In addition to political practices, such as lobbying, Gilmore et al. emphasise that companies are not only operationalising their power though political practices such as lobbying, but also by using practices related to finance, marketing, science, supply chain and waste, labour and employment and reputational management.

Alternative food chains, informal food provisioning and donation

This section provides a more holistic or 'real world' understanding of the way people obtain and exchange food to fulfil their food-related needs. As mentioned in the previous section, the concentration, specialisation and financialisation of largely global and market-based food systems and value chains has been criticised because of the externalities in terms of social, economic and environmental impacts (Ericksen et al., 2010). Here, we explore 'alternative market' concepts with respect to the conventional market, as well as the 'non-formalised' (non-market) exchange networks via key aspects linked to sustainable food consumption, and finally the role of food donation and third-sector networks.

Alternative food networks and short food supply chains

Various terms and concepts are used interchangeably to identify farmers' markets, community-supported agriculture, box schemes and other similar initiatives. There are dichotomies between conventional vs alternative, short vs long, localised vs global and traditional food chains that have been widely discussed in relation to how sustainable they are.

The term 'short food supply chain' refers to the physical and social distance between the producer (farmer) and the consumer. Local and global food chains are defined using several criteria that ultimately refer to the spatial distribution of the actors involved, with no clear distinction between them. Analyses show a highly dynamic local-global continuum exemplified by multinational companies adopting localisation strategies and local producers attempting strategies to integrate into the global market (Brunori & Galli, 2016).

Various movements and initiatives are committed to alternative models in the pursuit of sustainability goals, such as alternative food networks (AFNs) (Forssell & Lankoski, 2015; Michel-Villarreal et al., 2019). Such networks are 'alternative' because they allow consumers to make connections to the place of production, the production methods used, and/or the people who produce food (Ilbery et al., 2005; Marsden et al., 2002; Renting et al., 2003).

Bowen and Mutersbaugh (2014) identify two different approaches in alternative food research that focus on food (re-)localisation. The first approach, prevalent in Mediterranean Europe, emphasises 'terroir', 'slow food', and geographical origins to differentiate products by linking product quality to the specific conditions of production in a particular area. European Protected Designation of Origins and Protected Geographical Indications are emblematic in this sense and include a wide variety of different schemes used to create a link between a place and a product (Barham, 2003; Libery & Kneafsey, 1998). Because of their focus on food quality rather than social and economic reconfiguration, Watts et al. (2005) described these types of alternative food networks as "weak" alternatives.

The second approach, originated mainly in the United States and United Kingdom, focuses more on local food system initiatives that aim to reconnect producers and consumers (Albrecht & Smithers, 2018), to "resocialise" and "respatialise" food (Hinrichs, 2000; Milestad et al., 2010). Due to the emphasis placed on social embeddedness, Watts et al. (2005) referred to these food alternatives as "stronger" alternative food networks. Community-led initiatives are seen as an opportunity to foster networks founded on practical common interests that could help to enhance resilience and bring about broader food system transformation (Blay-Palmer et al., 2016).

It is important to emphasise that short food supply chains are not isolated models; they coexist, cooperate or competitively interact with other food chains, and they are always evolving (Thomé et al., 2021). 'Hybrid' or 'mid-tier' chains are also terms used to identify examples between local and global. A number of authors contest the simplistic opposition between conventional and alternative models (Holloway et al., 2007; Sonnino & Marsden, 2005) highlighting the risk of "defensive localism" (Winter, 2003), or missing the opportunity to take into account the diversity of local food systems (Mount, 2012). Furthermore, several short-chain initiatives involve more than one intermediary, without prejudice to those intermediaries who draw upon both local and global resources. Such examples combine conventional food system infrastructure with the more alternative goal of building local food systems (Bloom & Hinrichs, 2011).

The sustainability performance of conventional, alternative or hybrid food supply chains has received significant attention from researchers, finding there are no best-performing supply chains on all sustainability attributes. Evidence shows that local chains perform

better than their global counterparts for some sustainability attributes and worse for others. Results dependent strongly on the context, the actual behaviour of supply chain actors, the assessment methodologies, and the perception of external observers (Brunori et al., 2016).

While there seems to be a general agreement about the use of alternative food networks as a response to environmental and social consequences of the conventional agrifood sector, there is less of a consensus "when it comes to [their] ability to ameliorate or mitigate these issues" (Fendrychová & Jehlička, 2018). For instance, Sonnino and Griggs-Trevarthen (2013) note that even in affluent regions such as south-east England, with its history of strong civic activism, the persistence of alternative networks is dependent on dedicated individuals or small activist groups and external sources of funding. One key aspect to consider in relation to food access is that sustainability performance centres on the predominance of middle classes within alternative food networks (Goodman et al., 2013). This debate emphasises the inequitable nature of such alternative networks as a path to sustainability: higher prices relate to buying power and ultimately access to food (Smith et al., 2015).

Informal food provisioning

When considering informal and non-market food provisioning, we refer to Sen's (1981, 1984) concepts of endowment as elaborated by Osmani (1993). 'Endowment' denotes the resources owned by a person, both tangible (land, equipment) and intangible (skills, knowledge, membership in a community; and entitlement, all combinations of goods and services a person can obtain using their resources (Jehlička et al., 2019). These resources can be used to obtain food in three ways:

- **exchange**, where people use their labour to earn money to purchase food
- **transfer**, as members of their community people obtain food as a gift
- **production**, where people produce their food using their land and skills

In the Global South, many food markets operate informally. In industrialised countries, food trade outside of formal value chains is highly unusual, and often remains under the radar of research and policy (Pinto-Correia et al., 2021). Research efforts have helped to shed light on the unseen circuits of food self-provisioning across Europe, in which small farms play a central role. 'Unseen' means food exchange or consumption that happens under the radar of traditional economic assessment. This unseen food does not enter formal marketing routes, and is either consumed by the household, or exchanged or gifted amongst neighbours and family (Fendrychová & Jehlička, 2018; Schupp & Sharp, 2012; Teitelbaum & Beckley, 2006).

Non-market and informal food exchanges are captured particularly by literature from eastern Europe.[13] There is significant difference in the extent of engagement in food self-provisioning between eastern European EU countries and the rest of Europe. The%age of the population who grew food in their own households is:

- 51% of Czechs (in 2022 unpublished source)
- 36% of Hungarians in 2013 (Balázs et al., 2016)
- 50% of Croats (Jehlička et al., 2021)
- 54% of Poles in 2011 (Smith & Jehlička, 2013)

Along with home-grown food received as a gift within the omnipresent food-sharing networks (for instance, 61% of Czechs receive food as a gift), this informal food production accounts for significant volumes of food. In the case of Czech food-growing households, this informal economy is responsible for about 40% of their consumption of temperate zone fruit and vegetables (Jehlička & Daněk, 2017).

The food produced and then consumed by households and shared within inter-household networks holds value that is "expressed in terms other than price" (McMichael, 2015). The dominant motivations for food self-provisioning are healthy and fresh food, while financial savings ranking only third or fourth, with much lower significance than the first two motivations. While informal food production and sharing are predominantly motivated by the desire for fresh and healthy food, on a few occasions these motivations extend to sustainability or environmental protection. These informal practices represent the shortest possible food supply chain, relying on largely organic production methods and contributing to strong social bonds. Despite the weak environmental motivation behind these practices, they bring significant and tangible sustainability benefits, and for this reason they have been referred to as "sustainability by outcome rather than intention" (Jehlička et al., 2020).

Food donations and redistribution

Household food insecurity has been defined as "the inability of people to acquire or consume an adequate or sufficient amount of food in a socially acceptable manner, or the uncertainty that one will be able to do so" (Dowler & O'Connor, 2012). In this sense, food poverty is primarily conceptualised as the lack of access to a safe and healthy diet, explained by insufficient income and poverty (O'Connor et al., 2016). It also refers to psychological wellbeing, which is affected by feelings of uncertainty and consequently fear, as well as possible exclusion from social life (Riches & Silvasti, 2014).

13 For instance, data show that between a fifth and a quarter of Polish and Czech populations are involved in the informal production of organic food and vegetables, avoiding use of industrially-made fertilisers and pesticides and accounting for a large proportion of their consumption of these foodstuffs (Smith et al., 2015). Hence, the extent of organic food production and consumption is far greater than the level suggested by analyses based only on organic food purchases.

Food aid initiatives take different forms, with several variations existing in practice to complement or innovate with more traditional initiatives (Hebinck et al., 2018), leading to an extremely diverse landscape. Lambie-Mumford and Silvasti (2020) provide a broad typology, which includes:

- food parcels provisioning, such as parcels of food that people can take away, prepare and eat, assuming that recipients have the facilities to do so
- prepared food, such as soup kitchens that provide cooked food that people can eat or take away
- new forms of food aid such as subsidised food shopping, reliant on EU-subsidised foods and supplied through additional donations, for example, social supermarkets with some form of membership card
- subsidised prepared food, such as in social cafés and canteens

Additionally, food drives and food recovery initiatives are often organised at local or national level to respond to growing demand, involve citizens and raise awareness of food surplus and redistribution to meet social needs.[14]

Decisions at the EU level impact on the operation of social welfare in European countries, but there is no common social policy at the EU level, in contrast with the Common Agricultural Policy. Responsibility for social and poverty policies lies primarily with national governments. Historically, there have been major differences in the governance of welfare and the political and cultural histories across Europe. In the European Union, Programme Européen d'Aide alimentaire aux plus Démunis (PEAD), a programme of surplus food redistribution rooted in the Common Agricultural Policy, existed for almost 30 years to make agricultural surplus from the CAP available to European food charities for redistribution to disadvantaged people (Caraher and Cavicchi, 2014).

In 2014, PEAD was replaced by FEAD (Fund for the European Aid for the most Deprived), which is part of social policy, compulsory and co-funded by all EU member states. FEAD integrates actions carried out by EU countries, to provide food aid and material assistance to the most deprived, such as essential goods for personal use, beyond food. The aim is to provide short-term assistance and immediate, emergency support on the most basic needs. This helps provide the necessary (but not sufficient) conditions to find a job and step out of poverty.

Charitable organisations were, and still are, appointed as frontline distributors of FEAD resources. The provision of food by charities has a long tradition in Europe and in some countries, such as Italy and Spain, religious actors have played a major role in the history

14 The European Federation of Food Banks was founded in 1986 and has members from 24 European countries.

of welfare state development and the operation of charitable food assistance (Galli et al., 2018; Lambie-Mumford & Silvasti, 2020).

In 2019, a mid-term evaluation of FEAD was carried out for the period 2014–2017. The Commission Staff Working Document[15] presents the main findings that confirm the fund's effectiveness (helping beneficiaries make ends meet), coherence, and relevance. There was some criticism relating to the efficiency and cost of the policy. After the COVID-19 pandemic outbreak, the European Commission made an amendment to the FEAD regulations, most recently in 2021, to increase available funds for the following years.

Over the years, particularly in the US and Europe, research on charitable food aid has increased. This research highlights a number of criticisms of current food aid policies and practices. For example, there is conflicting evidence on the effectiveness of food banks and other food assistance practices in alleviating household food insecurity (Loopstra, 2018) with reference to the U.S. context). The contradiction between food poverty affecting a large part of the global population and the everyday wastage of food, particularly in high-income countries, has pointed academic and public attention to the practice of using food surplus (sometimes referred to as 'food waste') to fulfil the needs of the poor. This gives rise to possible tensions between food poverty alleviation and food waste reduction. On the one hand, actors in the food chain should prevent the generation of food waste, by collecting and redistributing edible food according to a hierarchy of destinations.[16] On the other hand, food surplus is a key resource for food poverty mitigation, so the dependence of food assistance organisations on food surplus for poverty mitigation makes them vulnerable and exposes them to several drivers of change (Galli et al., 2019).

There is a fundamental tension between charity and the right to food. Several authors in the field of social policy criticise charitable initiatives as insufficient measures that prevent governments from responsibly protecting the right to food. The retreat of welfare states reinforces the role of charitable food assistance, which by definition is not universal (Lambie-Mumford & Silvasti, 2020; Riches, 2018). There are also major concerns about the nutritional quality of food assistance, but new practices in charitable food assistance appear to address this issue. While food banks play an important role in providing emergency solutions to severe food deficiencies, they are limited in their ability to improve overall food security because they provide insufficient quantities of nutrient-dense foods, especially dairy products, vegetables and fruits (Bazerghi et al., 2016). This research suggests that food banks have the potential to improve food security if operational resources are adequate, perishable food groups are available, and client needs are identified and addressed.

15 https://op.europa.eu/en/publication-detail/-/publication/0e03aa7b-025f-11e8-b8f5-01aa75ed71a1

16 See, for example, https://www.eca.europa.eu/Lists/ECADocuments/SR16_34/SR_FOOD_WASTE_EN.pdf, Figure 1, p. 10.

1.3. Situating the food environment within the food system

The food environment is a pivotal concept in this report, describing the context in which food is acquired and eaten. It is a key constituent of the food system and comprises the multidimensional physical, economic, political and sociocultural situations in which consumers carry out the practices which relate to the planning, acquisition, transport, storage, preparation, eating and disposal of food.

In concrete terms, this includes a huge variety of settings, not only retail but also hospitality services, food banks, homes, workplaces, public facilities, restaurants, transport, other public and private venues, social media platforms, and so forth. One recent and comprehensive definition of food environments, intended to be applicable to low-, middle-, and high-income countries, is:

> the consumer interface with the food system that encompasses the availability, affordability, convenience, promotion and quality, and sustainability of foods and beverages in wild, cultivated, and built spaces that are influenced by the sociocultural and political environment and ecosystems within which they are embedded
>
> *(Downs et al., 2020)*

The food environment is the 'interface' which mediates people's 'interaction', and these two facets need to be emphasised in order to explicitly link it to people's daily lives, activities and diets. The food environment is an interface in the sense that it mediates the acquisition of foods by people within the wider food system and lies between an external and an individual domain (Turner et al., 2018). The external domain of the food environment includes the physical space where food is made accessible, in which infrastructure such as the built environment is set, and prices, information and promotion are provided. The individual domain of the food environment relates to the conditions for individual consumers' food access, which relate to daily routines and practices which can be affected by multiple factors, such as physical distance from points of purchase, time availability, individual mobility (for instance, working close to home or commuting; the ability to move autonomously or dependence on other people's support), purchasing power, convenience, the possibility of self-producing, harvesting and preparing one's own foods, cultural conventions and acceptability, and proximity to knowledge and skills. The external domain of the food environment has been studied more extensively than the personal domain (Penney et al., 2014; Turner et al., 2018).

In absolute terms, the food environment is unique for each individual (and community) and it is clear that such interaction is shaped by multiple interlinked factors. In order to understand the drivers of change, and the key underlying mechanisms, the food environment should be contextualised within the food system of reference. The food environment evolves alongside the ways in which people access, prepare and consume

food. These methods have shifted progressively, over time and space, from locally produced and purchased foods to globally supplied, long-distance transported products and purchases (Herforth & Ahmed, 2015; Mozaffarian, 2016).

The food environment can also be approached at different levels, like the wider food system, ranging from the individual, to the household/community, to the higher national, regional and global levels (Caspi et al., 2012). Each level brings significant implications in terms of the monitoring and assessment of food environments (Downs et al., 2020). In addition, the conceptualisation of the food environment can be more or less narrow, or expansive at each level, depending on which aspects need to be considered (and ultimately, which problem needs to be addressed). The following broad categories are important elements of the food environment that influence consumer food activities and diets: physical and economic access to food; food promotion; advertising and information; and food quality and safety (Hawkes et al., 2015; Swinburn et al., 2015).

The underlying assumption, or hypothesis, is that healthy food environments enable consumers to engage in nutritionally balanced food practices, with the potential to improve diets and reduce the burden of malnutrition. Conversely, unhealthy food environments promote less healthy dietary practices by consumers. Conceptualising 'accessibility' to healthy food was fundamental to the development of food environment re-definitions, with food access dimensions including: availability, as the presence of the supply; accessibility, in terms of how easy to get to the location by time and distance; affordability, meaning price, or worth relative to cost; acceptability in terms of attitude and satisfaction; and accommodation, how well local food sources adapt to local residents' needs (Penchansky & Thomas, 1981).

The literature on healthy food environments has evolved considerably with respect to 'food deserts', and barriers to healthy food access (Walker et al., 2010). There is growing evidence that a healthy food environment plays an important role in healthy food choices, although it is important to remember that choices are not influenced solely by the food environment. Healthy conditions in the food environment are not necessarily a guarantee that healthy choices will be made, but it becomes very likely that they are (Caspi et al., 2012).

Conceptualising food purchasing and consumption patterns in terms of the number of grocery stores or the availability of food risks viewing people as passive consumers who are simply confronted with a physical space that provides a set of market-based consumption incentives. Consumers also play an active role in shaping the food environment by demanding the availability of certain foods, such as the increasing availability of organic foods, fair trade foods, or plant-based foods and meat substitutes in supermarkets (see Fuentes & Fuentes, 2022). On the other hand, buycotts and boycotts

are additional means by which consumers can express their concerns, priorities, values, and interests about food.

Each dimension of the food environment — physical (availability, quality, and promotion), economic (cost), policy ('rules') and sociocultural (norms and beliefs) — has a substantial impact on consumers' food activities and diets (see Figure 2 below, enlarged from Figure 1, p. 20). Unhealthy food environments that are dominated by energy-dense, nutrient-poor, ultra-processed food products, relatively inexpensive and heavily promoted, create a supply-side 'push' effect on less healthy diets and energy overconsumption, which is a driver of population-level food habits and negative health outcomes (Brouwer et al., 2021).

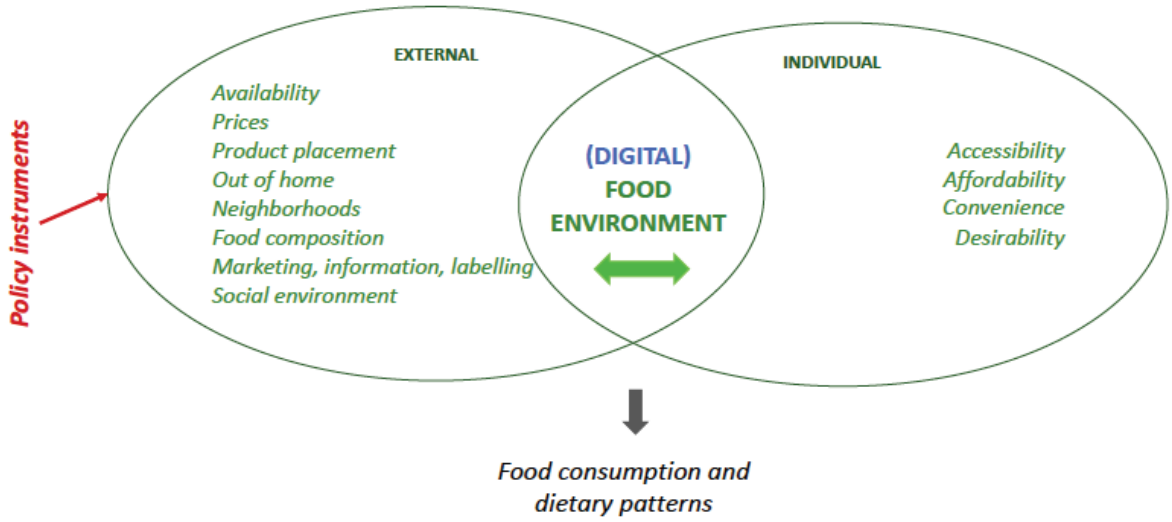

Figure 2. Focus on food environment dimensions.
Authors' elaboration, based on Turner et al. (2018) and Downs et al. (2020). This is a section of Figure 1, p. 20..

The dimensions of the food environment that are addressed later in this report (Chapter 4, p. 83), with regard to the impact of public and private policy instruments on healthy and sustainable food consumption, are briefly summarised here:

- **Price.** The economic environment plays a fundamental role in sustainable and healthy diets, as prices drive people to adopt behaviours that may prove more or less sustainable. Changing the incentive structure, whether through taxes or subsidies, affects prices and in turn people's choices, particularly in relation to their budget constraint (affordability).
- **Physical availability.** This relates to the physical product and the extent to which food availability affects sustainable and healthy food consumption in different settings, such as supermarkets, shops, restaurants, canteens, schools and neighbourhoods.

- **Product placement.** Prominent placement of food products (e.g. at eye-level or on displays) is a promotion tool frequently used by supermarkets and food companies to increase sales with target products. These measures can also be used to promote healthy and sustainable foods.
- **Out-of-home consumption opportunities.** In addition to the effect of physical availability in the (grocery) purchase environment, placement also matters in other contexts of food consumption. These include, among others, food consumption in schools or restaurants and canteens.
- **Neighbourhoods.** The neighbourhood food environment refers to the broader context in which individuals find themselves. Its impact on diet quality and health outcomes can be understood in terms of the diversity, density, and proximity of food stores.
- **Food quality and composition.** In recent years, attention has shifted to the composition of individual foods (for example, ingredients, formulations, and types of processing), because the level of processing has a major impact on dietary health. Reformulation of products can help to improve nutritional quality.
- **Marketing, information campaigns and advertising.** This refers to the information environment created for consumers by food businesses competing in the market along the food value chain.
- **Labelling.** Food labelling is a broad area of research that spans nutrition and health as well as environment and ethical qualities of food products and processing. Food labels are effective to the extent to which the buyer reads and understands the message that the labelling aims to convey.
- **Social environment.** People make reference to others within their social environment and this exerts a powerful influence on behaviours, including food consumption. Social influence and norms can be part of both the problem and the solution to sustainable and healthy food systems.

Among the multiple factors that contribute to shaping food environments, food systems institutions (the system of rules embodied into collective behaviour; the 'rules of the game') are crucial to the modes of interaction that are set and implemented in food systems. These include cognitive rules (i.e., cultural assumptions), normative rules (i.e., social obligations) and regulative rules (i.e., legislation and institutional rule systems) (Scott, 1995).

Food supply is mostly provided by the private food industry, which determines to a large extent its availability, quality and price. It also promotes the consumption of ultra-processed foods and fast food, while shaping social norms and beliefs about food. Governments' policies, laws and regulations provide the rules by which the private sector must operate (Swinburn et al., 2013). Policy instruments shape the food environment by changing production and processing (supply), by affecting consumption (demand), and by

directly changing features of the local food environment (Galli et al., 2020). Governments can also influence sociocultural norms through health promotion and social marketing.

Based on cultural norms for food and cuisines, and through traditional, cultural and religious practices, individuals interact with the food environment and shape their diets. Personal habits, preferences, education and income all come into play. In addition, there are interactions between the food industry, governments and society, not only at the food environment interface but also on many other levels, such as through policymaking, science funding, lobbying and agenda-setting. Particular concern has been raised recently about the increasingly high level of influence that the private sector has on governments, with its enormous market concentration and lobbying power, especially when regulations and fiscal policies are proposed. Industry bodies are often given a seat at the 'policy-development table' (for example, government advisory committees, task forces) even when deep conflicts of interest exist between commercial benefits and public health benefits (Maani et al., 2022; Swinburn et al., 2013).

In order to reduce obesity and diet-related noncommunicable diseases, there is a call for research to better understand interventions on the external and structural food environment dimensions which can support individual behaviours (Swinburn et al., 2011). Policy should also support and enable 'healthy food environments' which shift population diets, especially those of socially disadvantaged populations, towards diets that meet dietary guidelines.

There is a need for careful and comprehensive monitoring of food environments, including the evaluation of the impact of public and private sector policies (Hawkes et al., 2015; Swinburn et al., 2013). The INFORMAS framework includes several modules that monitor the impact of the nutrient composition of available foods, food labelling, the extent and nature of food marketing, the provision of foods, the availability of foods in communities, prices and the affordability of foods, and the risks to food environments within trade and investment agreements (see among others, Ni Mhurchu et al., 2013; Swinburn et al., 2015; Vandevijvere & Swinburn, 2014). The effectiveness of food environment policies in improving population diets is addressed by a recent review (Hansen et al., 2022) and demonstrates significant potential for the EU to strengthen its policies, priority actions and infrastructure support in order to improve food environments (Djojosoeparto et al., 2022).

1.4. The digital food environment

For more than a decade, digitalisation has propelled changes within the food environment. Increasingly, digital infrastructures and technologies mediate how people seek, share and interpret food-related and eating-related information and practices

(Schneider & Eli, 2021). There are many practices that have become common for European consumers, including online grocery shopping, ordering and requesting the delivery of takeaway food through digital platforms, dietary self-tracking, and searching for recipes online. Although unequal access to the internet and digital devices limits this concept, some researchers propose that consumers are living in a "digital food environment" (Granheim, 2019; Granheim et al., 2022). Even if "no evidence-based conceptual framework or definition of the term exists", Granheim (2019) proposes that "three factors […] could influence diet-related outcomes: digital actors (such as governments, the food industry, the media and individuals), digital settings where such actors operate, and digital activities performed by such actors in the digital sphere".

Granheim et al. (2022) conducted a systematic scoping review of 357 research articles that covered two main search terms, "digital technology" and the "food environment", aiming to map existing research on the topic.[17] They identified research trends relating to digital food environments and explored how the external and individual domains of food environments (see p. 35 of this report) change in a digital society. In short, they found that:

> all food environment dimensions are subject to digital transformation. Food environments are increasingly experienced through technology, and also shaped by it in many ways
>
> *(Granheim et al., 2022)*

They also identified three emerging issues that go beyond, or do not easily fit into the dimensions of, Turner et al.'s (2018) conceptualisation of the food environment: digital settings, digital food culture and the interconnectedness of physical and digital food environments. Thus, digitalisation adds further complexity to an already intricate food environment that shapes food and eating practices.

We review Granheim et al.'s findings in more detail in the following sections, and supplement their scoping review with findings from additional relevant studies that have examined the digitalisation of food and eating.[18] As the interdisciplinary field of digital food studies is a rapidly-growing field (Granheim et al., 2022) (see also Leer & Krogager, 2021; Lewis, 2020; Lupton & Feldman, 2020; Schneider et al., 2018), it is important to draw on more recent publications as well as on those that use different terminology, such as "digital foodscapes" (Goodman & Jaworska, 2020; Schneider & Eli, 2021), which refer to the same underlying issue.

Granheim et al. (2022) emphasise that the external domain of the digital food environment has been studied more extensively than the personal domain. In particular, the

17 The team acknowledges that the reviewed studies were "heavily skewed towards high-income countries, where 88% (n=314) of studies were conducted" (Granheim et al., 2022, p. 6).

18 Granheim et al. did not include and consider these papers for one of two reasons: either the studies did not engage with the concept of the food environment, or they had been published online since December 2019, as Granheim et al.'s review paper only reviewed papers published before this date.

dimensions of desirability, vendor and product properties, marketing and regulation have been studied most.

Digitalisation enables (Granheim et al., 2022):

- new forms of selling and buying food, for example, online grocery shopping and food delivery services (see also Fuentes & Samsioe, 2021; Samsioe & Fuentes, 2022)
- the potential to increase the availability of foods
- digital information and services (for example, online recipe portrayals) are the product or service that is consumed
- digital food marketing and related personal data harvesting have expanded
- the use of different computer interfaces, product placement on websites, and the kind of food images presented, which have been found to influence consumer choice

The digital food environment can best be understood as an expansion of the physical food environment and as an augmented experience of it, mediated by digital technologies (Granheim et al., 2022). Granheim et al. also call for more attention to "seemingly immaterial transformations" in digital settings that remediate experiences and relationships with food and eating. A number of researchers from sociology, human geography, media studies and related fields have started to investigate these transformations, with a focus on different digital settings including digital platforms such as Instagram (e.g. Contois & Kish, 2022) or restaurant reviewing platforms (Kobez, 2018; Onorati & Giardullo, 2020), and mobile phone apps for purposes such as self-tracking and food delivery (e.g. Lupton, 2021).

Part of what is referred to as the digital food environment is the so-called 'sharing economy'. In the area of food, this includes both profit-making commercial and non-commercial forms of food deliveries mediated via digital platforms. The profit-making platform-based companies connect providers of food (a meal prepared in a food outlet) with customers via an online platform or mobile app. The providers often claim to offer cheaper meals in a more convenient way (in terms of making choices and the setting of consumption) to the customer as a result of 'disrupting' the restaurant business. However, the environmental benefits of this model of the profit-making sharing economy are questionable.

The original idea behind the digital platform-based, non-profit-making sharing economy was to exploit unused or underused resources through efficient and trust-assuring communication and, as a result, to reduce the environmental impacts of food consumption. With the transformation into the profit-making sharing economy, these digital-platform based companies no longer seek to make use of the otherwise unused or idle resources and instead offer new, on-demand services with attendant environmental consequences that may not have arisen without the availability of efficient

digital communication. These commercial transactions facilitated by digital platforms can be contrasted with non-commercial forms of food-sharing that can be either facilitated by digital platforms or by personal communication. This non-commercial, food-sharing economy tends to be invisible to policymakers and researchers but is surprisingly widespread in a number of affluent countries of the Global North as diverse as Japan (Kamiyama et al., 2016) and Czechia (Jehlička & Daněk, 2017). Whether digitally based or not, these forms of the sharing economy are likely to bring more environmental and social benefits than the commercial ones.

Another scoping review has systematically explored the link between digital food communication and analogue food behaviour (Bartelmeß & Godemann, 2022). The authors suggest that "traditional approaches to food behavior no longer capture the complexity of food actions in digitalized societies and require an update with the emergence and increasing usage of social media". The authors of the review build on Contento and Koch's (2021) socioecological model of food behaviour that considers food behaviour as "determined by a conglomerate of different variables and processes operating in three distinct, interrelated domains: the food-related, the person-related, and the socioecological domains" (Contento & Koch, 2021, as cited in Bartelmeß & Godemann, 2022). They emphasise that this model considers communication as part of the information environment that forms part of the socioecological domain.[19]

Despite the potential advantages of drawing on the socioecological model of food behaviour, Bartelmeß & Godemann stress that the model's assumption that considers media and social media (as a form of communication) as part of the information environment needs to be critically reflected on, as it advances a teleological understanding of communication. Ultimately, they propose that behavioural models that conceptualise communication as having a linear influence on behaviour are outdated in a media environment that is defined by fast-paced social media communication in which food and eating are very prominent topics (see also Feldman, 2021; Goodman & Jaworska, 2020; Kent, 2021).

To illustrate the linkages between digital food communication and three areas of food behaviour (food choice, dietary intake and eating behaviour), we quote Bartelmeß & Godemann (2022):

- **Food choice** (preferences, preparation and intentions):
  - "Variables of all domains of the socioecological food behavior model are linked to digital food consumption in food choice" (p. 8)

19 Some other models, such as the theory of planned behaviour or health belief model, fail to address communication, or view it as part of the individual behaviour variable and not in relation to the social communication context.

- "Social media users are now socialized in their food behavior in multiple ways, leading to the emergence of new, socially informed preferences and food choice patterns" (p. 8)
- "In the experience-related dimension, personal physiological conditioning becomes less important, as other communicators now share their experiences with certain foods, dishes, or restaurants online, evaluate them, and thus, act as deputy experiencers" (p. 8)
- "Variables such as knowledge or social and cultural norms are elevated from a formerly intrapersonal level to an interpersonal level through food communication on social media, blurring the boundaries of categories even within domains" (p. 9)
- "Online communities serve as culinary support by providing guidance, motivation, and inspiration for using and recombining, contributing to a reservoir of practical knowledge within online communities that guides member users in analog food preparation and planning" (p. 9)
- "Engaging in social media food communication is understood as a reciprocal process in which different variables of the food behavior model interact and influence each other and affect certain outcomes of food choice behavior" (p. 9)

- **Dietary intake** (healthy or unhealthy, food components, etc.):
  - "The area of dietary intake is the only one for which there is empirical evidence of a direct link between communication and behavior, possibly due to the fact that outcomes in this area can be measured" (p. 9)
  - "This field assumes a very abbreviated, linear understanding of the linkages of food communication on social media platforms and the analog behaviors performed; comparably, dietary intake also addressed the fewest behavioral variables, with links made only to determinants in the socioecological environment and the person-related domain" (p. 9)
  - "Studies are typically behavioral science studies that are experimental in design and measure the effects of exposure to food communication on behavioral outcomes in laboratory settings" (p. 10)

- **Analogue eating behaviour** (habits, occasions, portions, etc.):
  - "Review found that in the area of eating behaviour, habits, occasions, dieting, and disordered eating may be linked to social media food communication" (p. 6)
  - "In the experience-related dimension, the studies reviewed indicate that social media platforms function as a social affective context that provides a digital platform for the social conditioning of analog eating behaviors" (p. 7)
  - "The linkages of social media food communication and analog food behavior are described as performative, in that the use of social media to communicate about and during eating directly influences eating behavior outcomes" (p. 7)

- "Within the person-related domain, intra- as well as interpersonal determinants are affected by social media communication and are inferred to subsequently inform analog eating behaviors; it is argued that eating habits or dieting practices are governed through digitally conveyed food meanings and virtual social relationship networks that serve as collective identity pools that construct and provide symbolic structures for the orientation of analog eating behavior practices" (p. 7)

In conclusion, Bartelmeß and Godemann (2022) propose that, for the most part, variables of the person-related domain and the social-ecological environment have an effect on the linkages between digital communication and analogue behaviour. Yet, their review did not find a demonstrable overarching impact on the three areas of food behaviour, or the influence of social media food communication on analogue behavioural outcomes.

The impact of digital innovation on the food environment

Digitalisation is a driver of change in the food environment that has an impact on both external and personal domains. External domains include food availability, prices, vendor and product properties, marketing and regulation, while personal domains involve individual level dimensions, including food accessibility, affordability, convenience and desirability. Although research on the topic is increasing, the majority of studies do not assess the effect of digitalisation on all aspects of the food environment simultaneously. Moreover, only limited research considers the digitally-enabled interactions between external and personal domains. This means that current evidence is predominantly available about certain dimensions such as convenience in relation to specific case studies (for example, food delivery apps).

In this section, we selectively review existing research on digital innovation with a focus on digital food retail services (following Fernandez & Raine, 2021) and dietary tracking, seeking to emphasise how digitalisation reshapes the food environment and the impact this can have on healthy and sustainable food consumption. Food ordering and delivery apps and food tracking apps are the most downloaded food-related apps (together with games; Lupton, 2021). In Europe, the number of users of the online food delivery market including grocery and meal delivery have been steadily increasing between 2017 and 2021 (Statista, 2023).[20] In 2022, the estimated number of European users of online meal delivery platforms amounted to 211.1 million users and of online grocery delivery up to 164 million users (Statista, 2023). Nutrition apps, which includes dietary tracking apps, have also grown in popularity. Overall, the number of users of nutrition apps has been growing between 2017 and 2020 in Europe (Statista, 2023a).[21] Beyond

20 https://www.statista.com/forecasts/1297721/users-online-food-delivery-europe

21 https://www.statista.com/outlook/dmo/digital-health/digital-fitness-wellbeing/digital-fitness-wellbeing-apps/nutrition-apps/europe

commercial platforms, it is important to consider the role of non-commercial platforms and their impact (Bos & Owen, 2016; Eli et al., 2015; Hoelscher & Chatzidakis, 2021), while acknowledging potential digital labour and data extractivism of digital platforms that are free of charge (Schneider & Eli, 2022).

In their review paper on digital food retail, Fernandez and Raine (2021) foreground how the digitalisation of the food environment (see Granheim et al., 2022) provides opportunities for food retailers that have led to the emergence of various novel digital food retail services that enable consumers to purchase groceries and meals through websites and apps. They state that three categories of digital food retail services are particularly prominent given their reach and market penetration, whose impact is as follows:

- **Online groceries.** There is great potential for online groceries to support healthy eating, as online grocery shopping reduces the amount consumers spend on food and the quantity of less healthy foods they purchase. "Generally, consumers are more likely to spend more money on items when benefits are immediate and tangible (for example, in-store purchases) and are more likely to purchase items with short-term benefits (for example, tasty foods high in sugar, salt, fat) rather than long-term benefits (for example, healthy foods)" (Fernandez & Raine, 2021).
- **Food delivery.** Food delivery apps tend to stimulate out-of-home food consumption and therefore the intake of nutrient-poor and energy-dense foods (Fernandez & Raine, 2021). This also poses a risk factor for the increase of noncommunicable diseases (see also WHO Regional Office for Europe, 2021).
- **Meal kits.** The evidence on the impact of meal kit services suggests they can support healthy eating, although they have limited reach today. "Meal kits can remove the food preparation burden (planning and shopping), making it easier to actually cook meals at home and prepare foods that fit with dietary preferences, restrictions, or health concerns" (Fernandez & Raine, 2021; see also Hertz & Halkier, 2017). Other studies explore the potential of digital food provisioning platforms for more sustainable shopping (Fuentes & Samsioe, 2021; Heidenstrøm & Hebrok, 2022; Samsioe & Fuentes, 2022). Meal box providers advertise a subscription to a meal box as a way to reduce food waste because no food will be left over if each meal is prepared and consumed according to the instructions that accompany the meal box ingredients (Heidenstrøm & Hebrok, 2022). In addition, meal kits containing mainly local and vegan foods are presented as a sustainable means of food consumption. Potential limits on the uptake of meal boxes are the cost of the service, which leads to households with higher incomes subscribing to a service (Fernandez & Raine, 2021), and the accompanying re-organising of household practices that meal kit subscription instigate (Fuentes & Samsioe, 2021).

Digitalisation can also enable the bypassing of the food retail sector. New digitally-enabled initiatives have emerged that seek to foster direct producer consumer relations.

For instance, the company Crowdfarming allows farmers to sell directly to consumers across the EU. The company has built a digital platform which provides logistics and customer service so that farmers can sell their produce directly to end consumers. Consumers can also adopt produce which gives farmers the chance and certainty to grow a crop knowing that someone will buy and consume it. This reduces potential food waste and guarantees an income to farmers. In this case, digitalisation enables the establishment of an alternative supply chain, which could support the development of a sustainable food system.

However, we currently lack systematic reviews and evidence on the impact of digital platforms on supporting the development of a more resilient and sustainable food system. Studies that have focused on the digitalisation of agricultural production (not consumption) problematise overly optimistic outlooks related to social sustainability by pointing out that new digital technologies and platforms impact labour and rural communities and attest a need to develop equitable, non-exploitive agricultural technology (Carolan, 2020; Rotz et al., 2019; for a review see Klerkx et al., 2019).

1.5. Food consumption behaviour

One of the key constituent elements of food systems is consumer behaviour. Consumer behaviour is a rich but disparate and divided field of research (Warde, 2022). There is no single and uniform way of defining consumption and consumers, given the varied disciplinary traditions in this area. According to Warde (2022), and tracing back to the etymological root of the verb 'to consume', there are two general meanings of consumption. One has a clear affinity with the disciplinary tradition of orthodox economics and psychology, focusing on exchange and commodification. In this case, the 'consumer' is an 'individual' that shops or buys products and services in the 'market' according to their individual preferences and choices. The other meaning points towards appropriation and utilisation encompassing the scientific field of sociology, cultural geography, anthropology, among other social sciences. In this second meaning, what is emphasised is social embeddedness, i.e. the context that frames the sociomaterial use of goods and services, and everyday social activity (Warde, 2022). In this vein, consumption is framed as a collective and sociocultural phenomenon where issues of identity, material culture and practice are highlighted.

There has been an effort to bring both meanings together, by focusing on consumption as encompassing all the activities of planning, acquiring, using and maintaining as well as disposing of goods, services, activities and experiences over time. One consequence of such a multidisciplinary approach is that consumers can be portrayed in a variety of ways, as choosers, buyers, citizen-consumers, practitioners, users, caregivers,

care-receivers, and identity-seekers, among others. It is important to note that such a plurality of framings for consumption and consumers is conducive to different forms of understanding, which depart from different research questions asked, leading to diverse conclusions which serve distinctive purposes. Thus, all approaches have their merits and limitations. Each one highlights aspects of consumption, consumers and their behaviour, while neglecting the contribution of other factors.

In this report we take an interdisciplinary approach, departing from a definition of consumption that has the advantage of offering versatility, to encompass manifold problem framings and agendas:

> consumption is a process whereby agents engage in appropriation and appreciation, whether for utilitarian, expressive or contemplative purposes, of goods, services, performances, information or ambience, whether purchased or not, over which the agent has some discretion
>
> *(Warde, 2005, p. 137)*

This definition stresses that consumers have some (and not whole) discretion in consumption processes. This means that they are often not in control over what to choose, being dependent on the configuration of the food environment, and the food system at large, for shifting their practices. It highlights that food consumer behaviour involves a set of moments, namely acquisition, appropriation and appreciation of food (Warde, 2010).

> Acquisition refers to the dynamics, arrangements and conditions of economic and social exchange in consumption whereby goods and services are procured. Appropriation covers the variations of how consumers use goods and services and what is being done with goods and services in which processes. Appreciation concerns the meaning-making made in relation to consumption activities.
>
> *Halkier et al. (2017, pp. 1–2)*

However, given the recent response that these moments are centred at the 'front end' of consumption, it is important to consider the counterpart to each of these three moments at the other end, namely disposal, divestment and devaluation (Evans, 2019).

Disposal can be considered the counterpart to acquisition, as goods, services, and experiences are acquired they can also be disposed of in a variety of forms. Some can go to the waste stream, while others can be reused or transformed (for example, leftovers for future meals). Devaluation can be considered the counterpart to appreciation, as people cease to attribute value (either economic or symbolic) and meaning to eating particular foods. For example, in the transition to an increasingly plant-based diet, a process of devaluing the importance of eating meat on a regular basis takes place. Finally, divestment is considered the counterpart of appropriation: just as goods, services and experiences around food can be used, "personalized and domesticated, so too can these attachments be undone" (Evans, 2019, p. 506). For example, people may divest from cooking with familiar kitchen tools (for example, pots and pans) and replace them with

less domesticated cooking robots or digitally mediated technologies that demand to be appropriately handled by learning new skills to navigate competently, with new cooking equipment and technologies. In this case, they divest time and skills in particular cooking practices and reinvest new skills and time learning how to cook in digitally mediated food environments.

By including disposal, devaluing and divestment in the definition of food consumer behaviour we address all the modes and ways in which consumers "get rid of things, empty them of meaning, throw out, re-use and re-craft them" (Halkier et al., 2017, p. 2).

One advantage of this definition is the compatibility of the various consumption moments that exist before — acquisition, appropriation, appreciation, devaluation, divestment and disposal — with the more established 'food journey' concept. The latter encompasses all consumer-related activities with regards to food and nutrition across the lifespan of food, including planning, purchase, transport, storage, preparation, eating and disposal. In each of these phases of the food journey, consumers engage in instances of:

- acquisition when planning and shopping in market-based value chains, either face-to-face or online, but also when acquiring food through informal food provisioning chains and donations
- appropriation when transporting, storing and preparing the food with recourse to technologies, kitchen equipment and tools
- appreciation when eating alone or having a meal with others while judging the quality and taste of the food
- disposal, including food waste

They can also be engaged in divestment and devaluation, instances that are visible in social change processes when one food practice is substituted by another. For example, consumers divest from preparing meals with high environmental impact ingredients and empty them of meaning (devaluing) and attach new meanings (and motivations) to eating more climate-friendly meals (revaluing).

Another advantage of this definition of food consumer behaviour is that it enables the inclusion of both deliberative and semi-automatic processes, allowing recognition of the importance of the unreflective, emotive and habitual processes in food consumer behaviour. This adds nuance to the overestimated conscious deliberation and decision-making processes associated with the sovereign consumer that is often portrayed as "meaningfully *choosing*" what to eat (Warde, 2016, emphasis in original). This opens the opportunity to work with systematic and integrative approaches to behaviour change that are interdisciplinary and integrate evidence from distinct but complementary disciplines that address food consumer behaviour and change, such as psychology, sociology,

history, economics, marketing, political science, agricultural and food science (Graça et al., 2019).

One potential integrative framework that was developed within the field of psychology but achieved out of disciplinary compromises is the COM-B model,[22] further detailed in Chapter 3, p. 68. The COM-B model has shown promise across contexts and domains, and we draw on this comprehensive model of behaviour change to clearly frame the barriers to healthy and sustainable food consumption. The model assumes that, to trigger behaviour change (Graça et al., 2019, p. 20):

- consumers need to be **capable** of performing the behaviour, which includes psychological and physical/dexterity features
- the context must facilitate and support the behaviour, providing **opportunity**, which includes both social and physical features, and can be considered the external domain of the food environment
- consumers have to be **motivated** to perform the behaviour, which includes both reflective and automatic psychological features

Thus, in this model, behaviour change is always the outcome of the relations and links between these three elements: capability (skills, competences, body and mental abilities), opportunity (material and social contexts), and motivation (for example, automatic and reflective conduct).

22 It is important to note that this model still positions individual behaviour as the unit of analysis and the target of policy intervention, which is incompatible with alternative sociological frameworks that offer a critique to methodological individualism, such as practice theory. Another incompatibility is in the component of 'motivation', which in the COM-B model resides in the mind (or brain) of individuals. The brain, according to cognitive science, is composed of two systems that generate behaviour: system 1 that is more automatic and emotion-driven, and system 2 more reflective and deliberative (Warde, 2016). In a sociological approach informed by practice theory, the individual and the mind (cognitive processes) are decentred and it is practice that is the unit of analysis and of policy intervention. In this vein, it is through consumers' engagement in daily practices that motivation emerges and is configured. In other words, the pleasure and motivation of doing something derives from the very act of doing that something. Similar to learning by doing (or by practising), people are also motivated by and because of engaging in social practices. Still, the COM-B model has the merits for bringing to the fore the importance of capability, opportunity and the automatic and non-reflective features of behaviour, which marks a significant advance compared to previous orthodox consumer behaviour models that overestimated deliberate and voluntary decision-making processes.

1.6. Key messages

- The food systems approach focuses on food system functions (food and nutrition security) and identifies actors and activities that contribute to fulfilling them. By focusing on dynamics and feedbacks, it aims to understand the impacts that external drivers of change have on food systems and in turn, the impacts that the food system has in terms of socioeconomic and environmental outcomes.
- The multiple perspectives on food system activities and outcomes, along with differences in power across levels and scales, also means that it is very difficult to agree on solutions to food system problems. This is at the heart of the trade-offs among food and nutrition security, social, economic and environmental objectives and values.
- It is important to acknowledge the diversity of food systems in Europe and to account for both formal and informal food provisioning systems, not only market but crucially non-market based relations of exchange (for example, gift economy, donations and food redistribution). They not only continue to have importance in Eastern and Southern European countries as legacies of their recent rural histories, but are also gaining traction everywhere in Europe as places of social innovation and experimentation to mitigate the effects of economic, climate, energy, food and sanitary crises. Many Europeans in their daily lives navigate and move seamlessly across various combinations of these systems.
- The food environment is the context in which food is accessed and eaten and entails an external domain (i.e., physical availability, the infrastructural environment, the price of food, the information environment and labelling, the social environment) and the individual domain (i.e., affordability, accessibility, convenience and desirability) which relates to the conditions for individual daily routines and practices.
- Public and private policies contribute to directly shaping the food environment's external dimensions, indirectly impacting on the personal ones in different ways in diverse contexts.
- Digitalisation has become a key driver of change of food environments. Increasingly, digital infrastructures and technologies mediate how people seek, share and interpret food and eating-related information and practices. The effects of the digital food environment on (un)sustainable and (un)healthy food consumption are mixed and interrelated, while there is a risk of "technological determinism" in the debate.

- There is increasing evidence that consumer behaviour in everyday life is less deliberative and reflective and more automatic, emotion-driven and the outcome of habituation. Consumers tend to eat in a partially-distracted way (or semi-automatic way) and these features should be increasingly taken into account in sustainable food consumption policy.
- Consumer behaviour models should draw on systemic, integrative and interdisciplinary knowledge and include the relations between social, material and digital contexts; cultural conventions, social norms and values; meanings, beliefs and motivations; mental and physical/body features; emotions and feelings; know-how, skills and competences.

Chapter 2. Nutritional and environmental food system outcomes

The research fields of food and health, food systems, and sustainability are largely multidisciplinary areas that bridge natural sciences, social sciences and several other disciplines. Data sources between these fields are not always identical and cannot always be harmonised, which brings challenges in interoperability and traceability, as well as scientific concepts being used differently across these research fields.

In this chapter, we will define core concepts that relate to the nutritional and environmental outcomes of food systems. These definitions will serve as a background for the subsequent chapters, on topics including dietary patterns, food consumption behaviours and sustainability dimensions. We will also introduce, define and set out boundaries for the main challenges and conflicts between health and sustainability.

2.1. Dietary patterns

Definition

A dietary pattern comprises the combination of foods that constitute the usual dietary intake over time, i.e., what is actually eaten. A dietary pattern is defined as the quantities, proportions, variety, or combination of different foods, and the frequency with which they are habitually consumed.[23] Instead of isolated nutrients, food components, foods or food groups, the diet is considered as a whole. The nutritional quality of a dietary pattern can be assessed by comparing its nutrient contents with dietary reference values. However, the focus of nutritional sciences has gradually shifted from the health effects of single nutrients to foods and dietary patterns.

There are several reasons for this shift. Since each food contains numerous compounds with complex interactions, it is not feasible to isolate and examine their separate effects on disease in a traditional reductionistic manner. Food components may have additive, synergistic or antagonistic effects. The food matrix, the physical micromolecular or macromolecular structure and domain, may also affect the bioavailability and bioactivity of nutrients and other food components. Thus, nutrients may allow us to make potential predictions about health effects in a few cases. However, establishing direct relationships

23 https://www.dietaryguidelines.gov/

between single nutrients to specific outcomes is challenging, especially in view of individual and divergent physiological conditions.

Many health effects of foods cannot be traced back to the health effects of specific nutrients and their mode of administration. Thus, nutritional sciences do not only focus on the role of food as a source of nutrients eliminating deficiencies, but also on the role of food in the prevention of chronic diseases. Furthermore, predicting the role of individual foods is challenging since an increase in the consumption of one type of food will most often lead to a decrease in the consumption of others. The increased unravelling of the complexity and interactions of dietary intake with health outcomes has contributed to the recent recognition that studies on dietary patterns as a holistic approach are necessary alongside those on individual foods and individual nutrients.[24]

Dietary pattern diversity in Europe

There are considerable differences in dietary patterns and food consumption among European countries (Ranta, 2014; Slimani et al., 2002; Woolhead et al., 2015). It should be noted that generalisations of dietary patterns in regions and countries should be done with care. However, generally speaking, the highest fruit, vegetable and pulses consumption is in Mediterranean countries, followed by northern central European countries, and lowest in eastern European countries. Mediterranean countries also generally have a lower consumption of processed meats than countries in central and northern Europe (Linseisen et al., 2002). In general, the Mediterranean countries share a dietary pattern characterised by more plant foods (apart from potatoes) and lower consumption of processed foods. The consumption of beverages (alcoholic and non-alcoholic) is generally higher among central and northern European populations. The dietary patterns of Mediterranean, central and northern Europe are more diverse than the eastern European countries.

A north/south gradient in European dietary patterns can also be observed. It reflects climatic, agricultural, and economic disparities between the respective populations. In most instances, the variation in eating practices is a response to varying climatic circumstances. Many traditional foods have been consumed regionally or locally for a significant period of time, in some cases dating back centuries, and are fundamental to nutritional diversity, demonstrating key elements of the differences in dietary patterns. People evolved agricultural, processing, and preservation techniques in order to be self-sufficient. As time progressed and communities evolved, nutritional preferences, especially traditional foods, became a part of their collective identity, as revealed by

24 In nutritional sciences, dietary patterns can in principle be defined in two ways: (1) an investigator-driven manner where the dietary patterns is developed based on *a priori* knowledge (such as Mediterranean, Western, prudent, Nordic, and plant-based dietary patterns) (Suri et al., 2020; Schulz et al., 2021), or (2) a data-driven manner which is developed by statistical methods such as principal component analysis or cluster analysis (Zhao et al., 2021).

Béhar (1976). Traditional foods represent cultural inheritance and have left their mark on different dietary patterns, even though current lifestyles discourage their preservation in our everyday lives and traditions (Trichopoulou et al., 2007).

The Comprehensive Food Consumption Database by EFSA is a source of information on food consumption in many, but not all, European countries.[25] EU member states, however, use different methods to collect food consumption data, which makes it difficult to carry out EU-wide analyses or country-to-country comparisons. EFSA's EU Menu project aims to provide standardised information on what people eat in all countries and regions across the EU.[26] This new project may improve the comparability and usability of the Comprehensive Food Consumption Database.

Dietary patterns and food consumption do not only vary considerably from country to country and region to region in Europe, but also over time. For example, the traditional Mediterranean diet, which is the dietary pattern prevailing among the people of the olive tree-growing areas of the Mediterranean basin before the mid-1960s, is quite different from the diet in present-day Mediterranean countries (Trichopoulou et al., 2014). There may also be a more acute change during a national or international crisis such as the supply shock provoked by the blockade of Ukrainian exports, coupled with record price levels for energy and basic commodities, which led to unpredictability in the global food supply.

2.2. Healthy diets

Updated national food-based dietary guidelines (FBDGs) are probably the best source of information for a healthy dietary pattern. Dietary patterns defined in an investigator-driven manner, where the dietary pattern is developed based on *a priori* knowledge, are given priority in most recent national FBDGs. Thirty-three countries in Europe have established national FBDGs, and in some cases regional guidelines such as the Nordic Nutrition Recommendations (2012; see also Herforth et al., 2019) guide their populations towards a healthier diet.

There is a wide consensus in the recommended dietary patterns across countries to predominantly eat a plant-based diet, rich in vegetables, fruits, whole grains, pulses and fish,[27] with moderate amounts of low-fat dairy products, and limited amounts of red

25 https://www.efsa.europa.eu/en/data-report/food-consumption-data

26 https://www.efsa.europa.eu/en/data-report/food-consumption-data

27 The Norwegian Scientific Committee for Food and Environment has come to the general conclusion that the benefits of fish and seafood consumption by far outweigh food safety risks. Seafood is generally regarded as nutritious and the benefits to human health are related to many physiological functions. Seafood, with a few exceptions, compares favourably to other protein sources. In seafoods, lean proteins are combined with healthy long chain polyunsaturated fatty acids of the omega-3

and processed meat, salt, added sugar and high fat animal products. Some guidelines also include guidance on increased consumption of nuts. The Dietary Guidelines for Americans[28] and the World Health Organization[29] have also reached a similar conclusion on healthy dietary patterns. With small variations, these dietary guidelines are similar to the traditional Mediterranean dietary pattern with its focus on olives and olive oil (Obeid et al., 2022; Trichopoulou et al., 2014), the Nordic dietary pattern's focus on berries (Akesson et al., 2013) and the Dietary Approaches to Stop Hypertension diet.[30] In addition to a holistic approach to the role of diet for chronic diseases, these dietary patterns also take into account the role of single nutrients and foods for deficiencies and chronic disease, such as the role of sugar-sweetened beverages for obesity or added sodium for hypertension.

Dietary patterns defined in a data-driven manner (developed by statistical methods such as principal component analysis or cluster analysis) by the Global Burden of Disease collaboration[31] have recently been used as an additional tool to inform the formulation of national FBDGs.[32] This collaboration uses data from 195 countries and territories, as well as subnational data from many countries, to model diet and other lifestyle exposures with health outcome associations. The dietary risk factors studied include low intake of fruits, vegetables, legumes, whole grains, nuts and seeds, milk, seafood, n-3 fatty acids, n-6 polyunsaturated fatty acids, calcium and fibre, as well as high intake of red meat, processed meat, sugar-sweetened beverages, trans fatty acids, and sodium. While the collaboration does not consider all dietary exposures, the majority of its findings strongly support most recent national FBDGs.[33,34,35]

A main challenge in Europe and elsewhere is the rise in overweight and obesity over the last few decades, and the increased risk caused by obesity for many chronic diseases. The WHO European Regional Obesity Report 2022 estimates that overweight and obesity affect almost 60% of adults and about 30% of children in European countries (WHO Regional Office for Europe, 2022d). Overweight and obesity is now the fourth most common risk factor for chronic diseases in the region, after high blood pressure, dietary risks and tobacco. It is also the leading risk factor for disability.

class (marine n-3 LCPUFAs) and highly bioavailable micronutrients. Seafood is a vital part of a balanced diet and contributes important nutrients (VKM, 2022).

28 https://health.gov/our-work/nutrition-physical-activity/dietary-guidelines

29 https://www.euro.who.int/__data/assets/pdf_file/0003/294474/European-Food-Nutrition-Action-Plan-20152020-en.pdf

30 https://www.nhlbi.nih.gov/education/dash-eating-plan

31 https://www.healthdata.org/gbd/2019

32 https://www.helsedirektoratet.no/english/nordic-nutrition-recommendations-2022

33 https://health.gov/our-work/nutrition-physical-activity/dietary-guidelines

34 https://www.euro.who.int/__data/assets/pdf_file/0003/294474/European-Food-Nutrition-Action-Plan-20152020-en.pdf

35 https://www.helsedirektoratet.no/english/nordic-nutrition-recommendations-2022

A recent study documented the rise in dietary supplements (vitamins, food supplements) in Europe, a rise that was said to be accelerated by the COVID pandemic.[36] According to Ronis et al. (2018), there is little evidence of any health benefits for well-nourished adults who use these supplements.

2.3. Environmentally sustainable diets

Current food systems are major drivers of environmental impacts (Willett et al., 2019). In terms of climate change, the global food system contributes approximately one third of global anthropogenic greenhouse gas emissions. In industrialised regions like the EU, approximately half of emissions associated with the food system come from agriculture and associated land use, including land use change (i.e., the conversion of other land, such as forest, to agricultural land). The other half come from energy-related activities downstream, including transports, processing and packing (Crippa et al., 2021). The ratio of food-related emissions to total greenhouse gas emissions is smaller in industrialised countries due to overall higher total energy use. In the EU, approximately 14% of emissions associated with final consumption come from food, beverages and tobacco (Beylot et al., 2019). The EU food sector also uses considerable amounts of energy (17% of EU's gross energy consumption in 2013) of which agriculture uses one-third and industrial processing uses 28% (European Commission et al., 2015). Fossil fuels dominate as the energy source in the food chain, and continued investments are needed in increasing energy efficiency and the use of renewable energy in food processing and transport.

Greenhouse gases associated with EU diets are emitted domestically and abroad, depending on where the food is produced. Approximately half of food-related emissions in member states are emitted in the country where the food is consumed, and half are emitted outside the country, predominantly in Asia, followed by other EU countries (Sandström et al., 2018).

A substantial part of trade-related emissions come from tropical deforestation. Approximately 15% of the total climate impact from food consumption in EU member states can be attributed to deforestation (Pendrill et al., 2019). Tropical deforestation driven by globally-traded agricultural commodities (for example, beef, soy and palm oil) also causes detrimental effects on biodiversity (Chaudhary & Brooks, 2019). Food has also been shown to be a major contributor to acidification, eutrophication (the addition of nutrients to water in lakes and rivers, which encourages plant growth that can take oxygen from the water and kill fish and other animals), land and water use in the EU. Food, beverages and tobacco contribute between them approximately 30–60% of the total such impacts from consumption in the EU (Beylot et al., 2019).

36 https://www.ipsos.com/en/nutrition-pill-europeans-attitudes-towards-food-supplements

While the energy and transport sectors are the main contributors to climate change, agriculture is the main driver of several other environmental challenges including biodiversity loss, eutrophication and water stress (Gordon et al., 2017). Therefore, when considering the environmental impact of the food system, much attention is put on the agricultural phase in the supply chain of foods.

Food production has diverse and substantial impacts on local ecosystems and global earth system processes. Mitigation of environmental impacts caused by the food system is needed on both the supply side and the demand side. Supply-side mitigation options include abolishing fossil energy use along the whole supply chain; careful and efficient manure and nitrogen management; agricultural production systems with well-planned crop rotations that minimise the need for external inputs such as synthetic fertilisers and pesticides; and catering for biodiversity-enhancing landscapes. Incentivising such measures requires policy measures on the production side, such as regulations on the use of fertilisers and pesticides or payments to farmers for ecosystem services within agricultural policies. To some extent, production-side improvements can also be incentivised by food choice, such as through demand for organic products or those produced under other environmental certification schemes, but the impact from such measures is limited and does not reduce the need for production-side policy.

Impacts are highly context-specific and variable. However, based on the current evidence, it is possible to conclude that high-impact food behaviours include:

- wasteful food consumption behaviours, both food waste and metabolic waste (overconsumption)
- dietary patterns that are high in:
  - animal products
  - fish and seafood sourced from unsustainably managed stocks
  - products from tropical areas such as palm or coconut oil, tropical fruits, coffee, tea, cocoa
  - meat from tropical areas
  - water-demanding crops such as nuts and fruits, and crops from water-scarce areas
  - foods from monoculture cropping systems with high pesticide use

While animal products dominate the climate impacts of the food system, a non-negligible and increasing share of impacts is associated with the consumption of foods low in nutritional value such as coffee, alcoholic beverages, sugar-sweetened beverages and confectionery. A study from Sweden showed that these products contributed approximately 20% of the climate impact of the average Swedish diet (Moberg et al., 2021). Coffee, tea, and cocoa also contributed substantially to the biodiversity impact in this

study, together with tropical fruits and vegetable oils, due to these being grown in areas high in biodiversity.

Animal-sourced versus plant-based foods

When comparing different food products, animal-sourced foods have substantially higher environmental impacts compared to plant-based foods, especially in terms of climate change, both in total and per kilogram of food. Globally, production of animal-sourced food causes 57% of greenhouse gas emissions from food production (Xu et al., 2021), while supplying only 17% of global calories and 33% of global protein (FAO, 2022b). In the EU, livestock production occupies 28% of the land surface corresponding to 65% of agricultural land. Further, the livestock sector contributes 78% to terrestrial biodiversity loss, 80% of soil acidification and air pollution, 81% of climate impact, and 73% of water pollution out of agricultural environmental impacts in the EU (Leip et al., 2015).

In terms of emissions from the EU food supply, meat and egg consumption represents an average of 56% (ranging from 49%–64% across member states), while consumption of dairy products represents an average of 27% (ranging from 16%–36%). Consumption of grains accounts for 4% of EU food supply-related greenhouse gas emissions (Sandström et al., 2018). Protein from beef, pork, fish, chicken and egg respectively cause approximately 20 times higher, 4 times higher, 3 times higher, 3 times, and 2 times higher greenhouse gas emissions per kilogram than plant-based protein sources like cereals and legumes (Poore & Nemecek, 2018).

The reasons why animal products cause substantially higher greenhouse gas emissions than plant-based foods can be summarised in three main points. First, ruminant animals (for example, cattle, sheep, goats) emit methane in the digestion of feed and methane is a potent greenhouse gas. Second, the storage, handling, and spreading of manure causes emissions of methane and nitrous oxide. Third, animals eat substantial amounts of feed.

Globally, producing 1 kg of protein from animal products requires 80 kg of feed (Mottet et al., 2017). Even though a substantial part of this feed is non-digestible for humans, most importantly grass from grassland, on a global level, 3.1 kg of human edible crops is used to produce 1 kg of meat (Mottet et al., 2017). Cultivation of crops causes greenhouse gas emissions from:

- **land use**, such as nitrous oxide from fertilisers and carbon dioxide from carbon-rich soils
- **energy**, such as diesel in field machinery and the production of mineral fertilisers and other inputs
- in some cases, **land-use change**, such as deforestation

Higher inputs of feed per kilogram of meat produced leads to higher emissions per kilogram of food product. Because of high feed use and methane emissions from feed digestion, meat from ruminant animals causes substantially higher emissions than meat from pork and poultry (Poore & Nemecek, 2018). However, ruminant animals are not dependent on human-edible crops like cereals and grain legumes, as monogastric animals like pigs and poultry are. Therefore, ruminants do not cause feed/food competition if raised on grassland and other roughages. Ruminants might also be favoured over monogastric animals to minimise the cropland needed to feed a growing population (van Selm et al., 2022) or to decrease imports of soybeans for feed into the EU (Karlsson et al., 2021). In addition, there might be further trade-offs between other environmental impacts. For example, Nordborg et al. (2017), found higher ecotoxicity impacts per kilogram of meat for pork and poultry than for beef, due to high use of soy in the pork and poultry systems studied. Further, in some areas, grazing animals are important for biodiversity conservation in traditional grasslands (Rodríguez-Ortega et al., 2014). In addition, as animal welfare differs significantly across species and production systems there may also be trade-offs between reduced environmental impacts and impacts on animal welfare. For example, poultry meat causes considerably lower emissions than ruminant meat, but typical poultry systems are associated with considerable animal welfare challenges (De Jong & Guémené, 2011; Hartcher & Lum, 2020).

Despite the positive role that livestock can play for ecosystems in some landscapes, there is a broad consensus that limiting the consumption of meat and dairy, especially in affluent settings where consumption is high, is a crucial strategy to mitigate climate change, together with the reduction of food waste and supply side improvements (Bryngelsson et al., 2016; IPCC, 2022; UNEP, 2022; Willett et al., 2019). It also combats further biodiversity loss by reducing the demand for land (Henry et al., 2019; IPBES, 2019). Emissions of greenhouse gases and land use can be reduced by 50–70% from reductions of animal products in diets, the size of reduction depending mainly on the extent to which animal products are removed from diets (Hallström et al., 2015; Röös et al., 2017; Röös et al., 2022). If the land made available by decreasing livestock production is used for vegetation regrowth (such as afforestation), there is a large potential to sequester carbon from the atmosphere and mitigate climate change (Röös et al., 2017; Röös et al., 2022; Smith et al., 2013).[37]

37 Within the food group, variability of environmental impacts is also large, especially for beef, reflecting different production systems, production intensities and regional climate and soil conditions. For example, the greenhouse gas emissions from beef from pure beef herds vary from 40 kg–210 kg CO_2e per kilogram (10th–90th percentile), and for global bone-free dairy beef the corresponding values are 18 kg–51 kg CO_2e. For crops, variability in impacts are also considerable: for wheat, maize, and rice, 90th-percentile impacts are more than three times greater than 10th-percentile impacts for greenhouse gas emissions, land use, eutrophication, acidification and freshwater withdrawals (Poore & Nemecek, 2018). Within food groups, variability in a specific region with the same climate and soil conditions indicate a potential to reduce some impacts through increased efficiency and best available technology and management. However, reduction of certain

Emissions of greenhouse gas from blue foods are also highly variable, with farmed seaweeds and bivalves causing the lowest emissions, while flatfish and crustacean fisheries produce the highest (Gephart et al., 2021). Emissions from aquaculture arise mainly from the production of feed, while fuel use in fishing vessels dominates emissions in capture fisheries. Other environmental stressors from aquaculture and capture fisheries are genetic pollution, the introduction of invasive species, antibiotic use and the spread of disease (Gephart et al., 2021). In addition, overfishing and physical disturbance, as is caused by bottom-trawling in capture fisheries, are major drivers of marine biodiversity loss (IPBES, 2019). Capture fisheries also commonly change the size structure and abundance of captured species (Svedäng & Hornborg, 2014) and cause bycatch that negatively impact non-targeted species (Pérez Roda et al., 2019).

Organic food

The EU Farm-to-Fork Strategy has an explicit goal to increase the agricultural land under organic farming to 25% by 2030 (European Commission, 2020).

When organic foods are compared to conventional foods (per kilogram) using the most commonly applied environmental indicators, they are shown to cause a similar climate impact to conventional systems, but require more land and cause more eutrophication (Clark & Tilman, 2017). However, the benefits of organic farming are not well captured by these indicators (Meier et al., 2015; van der Werf et al., 2020), because a key benefit of organic farming is the avoidance of the use of synthetic pesticides. The use of pesticides is a major driver of damage to biodiversity (IPBES, 2019; Sánchez-Bayo & Wyckhuys, 2019). Despite ambitious policies for the reduction of contamination of surface and ground water in many EU member states, pesticides and veterinary drugs are still commonly found in EU waterways (Casado et al., 2019).

In addition, the comparison of organic and conventional production systems (per kilogram of food) using life-cycle assessment does not capture indirect effects, which are very difficult to assess (van der Werf et al., 2020). For example, the assumption that the additional land used by organic farming could otherwise be used for natural revegetation or the prevention of further deforestation has burdened organic products with the emissions caused by the missed 'carbon opportunity', making organic products considerably worse from a climate perspective (Searchinger et al., 2018; Smith et al., 2019). While in theory land 'spared' by more intensive forms of farming could be used for reforestation and hence carbon sequestration and climate mitigation, there is no such direct causal link. Land use dynamics are difficult to capture, and there are examples of

impacts (such as greenhouse gas emissions) per kilogram of produce through e.g. yield increases can involve trade-offs with other environmental impacts and other sustainability dimensions like animal welfare (Röös et al., 2018).

intensification leading to higher profits and therefore further land expansion rather than land sparing (Barretto et al., 2013; van der Werf et al., 2020).

Organic production has some undisputable benefits, most importantly the avoidance of synthetic pesticides but also, in some cases, superior soil fertility and social impacts (Reganold & Wachter, 2016; Seufert & Ramankutty, 2017). However, to supply the same amounts of food, more land is needed compared to more intensive forms of agriculture. If total demand for food and feed can be managed through dietary change (fewer animal products) and reductions in food waste, there are possibilities to reap the benefits of organic farming while avoiding further agricultural land expansion.

Local foods

There is a growing consumer interest in local foods, which are perceived by consumers as more environmentally sustainable and healthier (Hasselbach & Roosen, 2015; Hempel & Hamm, 2016; Wägeli et al., 2016). However, it has been shown repeatedly that savings of greenhouse gas emissions from choosing local foods are minor, due to the relatively small contribution from transport to overall emissions from the food system. For example, from EU diets, transport caused only 6% of overall emissions (Sandström et al., 2018). For substantial reductions in greenhouse gas emissions, reduced intake of animal products is vastly more effective.

However, as rapid emission reductions are urgently needed to mitigate climate change, reduction of emissions in all supply chain stages are likely needed. Global emissions from refrigeration supply chains are expected to rise (Crippa et al., 2021) which points to a growing importance of considering transport and storage emissions. In addition, when including additional indicators, such as indicators capturing social aspects, into the assessment, the benefits of local versus more global products are less clear. For example, a study performing a multicriteria ranking exercise between products of the same kind (cheese, ham, bread and wine respectively) along a gradient of localness found that products from more globally oriented supply chains generally were ranked last (Schmitt et al., 2017). More local products were favoured over more global products for aspects such as nutrition, biodiversity, information and communication, creation and distribution of added value, territoriality, resilience, animal welfare and governance.

For these reasons, comparing sustainability outcomes of local versus global foods is heavily influenced by the indicators used and how 'local' and 'global' are defined. Brunori et al. (2016) caution about comparing 'local' and 'global' supply chains, as the way that different chains are classified is arbitrary. In addition, many sustainability issues relevant to this comparison are difficult to quantify.

Box 1. Data sources for food availability, food consumption and environmental impacts of food

In general, country-specific environmental footprints of foods, food groups and food systems are calculated by adding up the environmental impact of all resources and processes used for country-specific food availability or food consumption. The environmental impact of resources and processes is then calculated using a standard IPCC Tier 1 (i.e. bottom-up or life-cycle assessment) methodology. As with all models that analyse aggregate level data and impacts, the estimates provide an indication of impacts and a relative comparison between countries, foods and food groups. They do not calculate the impacts of food production at the granular, detailed level within countries, such as specific amounts of the numerous foods produced using a number of specific agricultural techniques.

All models for country-specific environmental footprint of foods, food groups and food systems depend on the specific data sources and handling used. In environmental analyses, datasets from the Food and Agriculture Organization (FAO) on food availability and agricultural production are often used alone, or in combination with other datasets such as surveys and meta-analyses, to develop country-specific environmental footprints. Food availability and agricultural production methods may vary considerably between countries. Every year, authorities in over 245 countries and territories submit national food and agriculture statistics, as well as micro-datasets collected through farm and household surveys, to the FAO. In the FAOSTAT database, national food supply is estimated as the average per capita food available for consumption, based on domestic production, adjusted for exports, imports, and non-food uses. National authorities, who annually supply data to FAOSTAT, are not required to use standardised methodologies when collecting, categorising and grouping data. Thus, while FAOSTAT data are important for FAO's strategic work to reduce hunger and malnutrition, the data should be used with an understanding of such limitations in country-specific environmental modelling studies.

To analyse the environmental impact of food availability, data from FAOSTAT are often paired with comprehensive country-specific databases of environmental footprints or life-cycle assessment data. To various degrees, these databases include primary production, including feed requirement, processing factors, transport, packaging, and share of processed commodities, and may also consider food loss and waste. These models build on numerous assumptions and theoretical considerations. Increasingly often, coding and data inputs used to produce such complex models are made available either via the publisher or via contact with the authorial team, but this is not standard practice. Despite their commonly held limitations with all types of complex modelling endeavours, these somewhat 'black box' models of environmental footprints are innovative and represent the state of the art.

Country-specific food availability concerns the availability of sufficient qualities and quantities of foods supplied through domestic production or imports. Food consumption or dietary pattern is defined as the foods that are actually ingested by people. Thus, the amounts of foods consumed by a national population are often much lower than the foods that are available for the country. Since composite food group categories (such as cereals) often are not identical in food availability and food consumption datasets, comparisons across datasets should be done with care. The gold standard for assessing food consumption is surveys using food records or 24-hour diet recall methodologies. When interpreting data, it is important to realise that dietary patterns and food consumption estimated from food balance sheets may vary from the food consumption assessed by food records or 24-hour diet recall methodologies.

2.4. Integrating environmental sustainability and health

While most national food-based dietary guidelines (FBDGs) are based on the assessment of health outcomes, a small number of countries have initiated processes that integrate sustainability into national FBDGs. Recently, the FAO and WHO have developed guiding principles for developing sustainable FBDGs (FAO & WHO, 2019). They define a set of eighht principles for assessing health outcomes, five principles for assessing environmental impacts, and three principles for assessing sociocultural aspects (see Box 2). The main report, the principles and the background papers are an important step towards harmonising the process of developing such guidelines. Wood et al. (2023) also present a framework with concrete steps for developing sustainable FBDGs that integrates environmental sustainability on equal footing as health.

In a recent modelling study, Springmann et al. (2020) analysed the healthiness and sustainability of national FBDGs in 85 countries. The results suggest that adoption of national FBDGs would, on average, be associated with 15% reduction in premature mortality, as well as mixed changes in environmental resource demand, including a reduction in greenhouse gas emissions of 13% (regional range −34%–35%). They concluded that most FBDGs are incompatible with the Paris Climate Agreement, plus land use, freshwater, and nitrogen targets. This analysis suggests that national guidelines could be both healthier and more sustainable.

Box 2. FAO/WHO guiding principles for sustainable healthy diets

Principles regarding the health aspect:

- start early in life with early initiation of breastfeeding, exclusive breastfeeding until six months of age, and continued breastfeeding until two years and beyond, combined with appropriate complementary feeding
- are based on a great variety of unprocessed or minimally processed foods, balanced across food groups, while restricting highly processed food and drink products
- include wholegrains, legumes, nuts and an abundance and variety of fruits and vegetables
- can include moderate amounts of eggs, dairy, poultry and fish, and small amounts of red meat
- include safe and clean drinking water as the fluid of choice
- are adequate (i.e. reaching but not exceeding needs) in energy and nutrients for growth and development, and to meet the needs for an active and healthy life across the lifecycle
- are consistent with WHO guidelines to reduce the risk of diet-related NCDs and ensure health and wellbeing for the general population.
- contain minimal levels, or none, if possible, of pathogens, toxins and other agents that can cause foodborne disease

Principles regarding environmental impact:

- maintain greenhouse gas emissions, water and land use, nitrogen and phosphorus application and chemical pollution within set targets.
- preserve biodiversity, including that of crops, livestock, forest-derived foods and aquatic genetic resources, and avoid overfishing and overhunting
- minimize the use of antibiotics and hormones in food production
- minimize the use of plastics and derivatives in food packaging
- reduce food loss and waste

Principles regarding sociocultural aspects:

- are built on and respect local culture, culinary practices, knowledge and consumption patterns, and values on the way food is sourced, produced and consumed
- are accessible and desirable
- avoid adverse gender-related impacts, especially with regard to time allocation (e.g. for buying and preparing food, water and fuel acquisition)

(Source: FAO & WHO, 2019)

There is a strong link between health and environmental sustainability of dietary choices (Tilman & Clark, 2014). For example, on a nutrient level, replacing animal-based foods with plant-based foods decreases premature mortality up to 12%, as well as some environmental impacts, such as greenhouse gas emissions, by up to 84%. On the other hand, it increases other environmental impacts such as freshwater use by up to 16% (Springmann, Wiebe, et al., 2018). For other dietary patterns, flexitarian, pescetarian, vegetarian or vegan diets reduce premature mortality by about 19%–22%, greenhouse gas emissions by 54%–87%, nitrogen application by 23%–25%, cropland use by 8–11% and freshwater use by 2–11% (Springmann, Wiebe, et al., 2018).

2.5. Food waste

Reducing food waste is another key mitigation option for tackling environmental impacts.[38] Research suggests that a 50% reduction in food waste would result in reductions in environmental impacts associated with food production in the range of 5%–10% (Bryngelsson et al., 2016; Read et al., 2020; Röös et al., 2017).[39] In addition,

38 There is a Sustainable Development Goal target (12.3) with the aim to "halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses" by 2030.

39 Another type of food waste is metabolic food waste, for example, the amount of food leading to excess body fat. In addition to health problems associated with overconsumption of food, excessive intake of food can also be seen as a type of food waste causing additional emissions of greenhouse gases and other environmental impacts (Edwards & Roberts, 2009). Toti et al. (2019) assessed environmental impacts from metabolic food waste for different world regions. They found that the EU is responsible for the greatest amounts of metabolic food waste and associated environmental impacts, approximately 14 times more than sub-Saharan Africa. A study from Sweden showed that

there is a growing discrepancy between both stakeholders' and researchers' emphasis on food waste prevention (i.e. stopping food from becoming waste), in the context of the efforts to halve the volume of food waste by 2030. This is a policy top priority, including EU Directive 2008/98/EC on Waste and the waste management practices in which "food waste prevention has been subsumed into measures aimed at diverting or averting waste" (Messner et al., 2020). Some scholars criticise the reliance on consumers and households for food waste reduction as disproportionate, and as having an inconclusive effect on the effectiveness of resource use in upper segments of the food chain (Chaboud & Daviron, 2017). In the context of the search for insights regarding the capacity to prevent food from becoming waste, it is nevertheless important to study the situations where households generate significantly lower volumes of food waste than the EU average.

There are segments of European societies that already produce significantly less food waste than the EU average and it is not known why. For instance, analysing bins with municipal mixed waste from a small number of village households, Sosna et al. (2019) found that Czech rural dwellers may produce as little as 7.9 kg of edible food waste per person per year. Drawing on large-scale research in an urban environment, Kubíčková et al. (2021) discovered that Czech urban households produced 37.4 kg of edible food waste per person per year (the figure does not include food waste flushed down the toilet and food waste that ends up in organic waste bins). This is a highly reliable finding, as food waste was repeatedly and anonymously collected from 900 households in Brno, the second-largest Czech city (population 380 000), across three years. A different research project aimed at food waste was conducted in the small town of Boskovice (population 12 000, with food waste produced by 4000 inhabitants analysed) confirmed low volumes of food waste produced by Czech households. The amount of edible food waste per person per year ranged from less than 2 kg to 31 kg, depending on the type of residential area (Kormaňáková et al., 2021). For comparison, the average amount of food waste (both edible and inedible) from an EU household is estimated to be 92 kg ± 9 kg per person per year (FUSIONS project, 2016).

Therefore, in addition to researching how to raise consumers' awareness of the meaning of 'use by' and 'best before' dates (the current preferred approach to the issue of food waste), or promoting digital solutions such as the uptake of food waste reduction mobile phone apps, a better and more comprehensive understanding is also needed of how some people in Europe already produce little or almost no food waste. In other words, in addition to understanding the barriers to wasting less food, we need to understand the enabling factors that facilitate frugality and unwasteful behaviour. The complexity of the issue of food waste requires consideration and understanding of a range of factors, including "household self-supply, food preparation at home, the financial situation of the household, sociodemographic factors, access to shops and perceiving the symbolic value of nutritives in the context of their disposal" (Kormaňáková et al., 2021).

the amount of surplus food intake was 66% larger than the total amount of avoidable household food waste per year (Sundin et al., 2021).

2.6. Key messages

- A dietary pattern is defined as the quantities, proportions, variety, or combination of different foods, and the frequency with which they are habitually consumed. Dietary patterns and food consumption vary considerably from region to region in Europe, but also over time.
- There is a broad consensus in the recommended dietary pattern across countries: to predominantly eat a plant-based diet, rich in vegetables, fruits, whole grains, pulses and fish, with moderate amounts of low-fat dairy products, and limited amounts of red and processed meat, salt, added sugar and high-fat animal products.
- National nutrient recommendations and food-based dietary guidelines are not only the main foundation of national food policies, but also affect individual food choices.
- Current food systems are major drivers of environmental impacts, especially biodiversity loss, eutrophication, water stress, land degradation and climate change.
- Dietary choices are one of the biggest drivers behind rising obesity and the prevalence of noncommunicable diseases, so shifting consumer choices towards healthier foods can help to mitigate these threats.
- Animal-sourced foods in general have substantially higher environmental impacts compared to plant-based foods, especially in terms of climate change, both per kilogram of food and in total.
- There is a broad consensus that limiting the consumption of meat and dairy, especially in affluent settings where consumption is high, is a crucial strategy to mitigate climate change, to stop biodiversity loss, halt obesity and fight chronic non-transmissible diseases.
- Ruminant animals (e.g. cattle and sheep) cause higher greenhouse gas emissions per kilogram of meat than meat from pigs and poultry. However, ruminants are not dependent on human-edible crops like cereals, grain and legumes, as pigs and poultry are.
- Organic production has benefits such as the avoidance of synthetic pesticides, but has similar climate impacts per kilogram of produce as conventional production. Organic production without demand side-changes (reduced consumption of animal products and reduced waste) is not a climate change mitigation strategy.

- Savings of greenhouse gas emissions from choosing local foods are minor due to the relatively small contribution from transport to overall emissions from the food system, but local food systems can have other (social) benefits depending on the indicators used to compare local and global supply chains.
- Reducing food waste has the potential to reduce greenhouse gas emissions by 5%–10%, but the food waste generated is highly variable.
- Food waste strategies should focus on prevention — stopping food from becoming waste — rather than on diverting surplus food and food waste to redistribution channels.

Chapter 3. Consumer behaviour: Barriers to sustainable and healthy food consumption

How to encourage behaviour change among consumers is one of the central questions in the discourse about sustainable and healthy food consumption. Given the magnitude of the challenge — that is, the disparity between current consumption patterns and the target of sustainable and healthy food consumption, as discussed in Chapter 2 — the answer is not simple. There is a growing body of literature on the effectiveness of interventions and tools, which we discuss later in Chapter 4, p. 83. However, before we discuss the different tools, this chapter provides a structured overview from a behavioural perspective of the different types of barriers that consumers face, in order to identify which tools are effective for different behaviours and consumer segments.

The shift to sustainable and healthy food choices is a complex challenge, especially for the individual consumer, since it requires far-reaching changes in all aspects of food consumption:

- **a shift in dietary patterns:** consumers need to change the composition of foods and diet types they are eating, e.g. less meat, more legumes, more fruits and vegetables, more nuts and seeds, fewer unhealthy snacks or ultra-processed foods, and so on
- **a shift towards (more) sustainable production systems:** e.g. from 'normal' apples to apples from organic production or other types of eco-friendly and biodiversity-friendly production systems (for a detailed discussion on the benefits and impacts of organic production, see p. 60)
- **shifts in practices to reduce food waste at household level:** changing food preparation, planning and shopping practices

The challenges and the barriers differ across the various impact behaviours outlined here. While the shift in dietary patterns requires consumers to give up certain foods, some of which provide large hedonic pleasure, and eat other foods instead, the shift towards food from more sustainable production systems is a matter of substitution, with the largest barriers being higher costs, lack of availability or accessibility, and lack of trust in eco-labels. Meanwhile, avoiding food waste requires changing everyday habits and practices.

The problem with the transition to sustainable and healthy food consumption is that it requires consumers to make trade-offs (Grunert, 2011) between sustainability and health on the one hand, and perceived negative outcomes on the other, such as inferior taste,

higher prices and inconvenience, contributing to the gap between consumer values, attitudes and intentions on the one hand, and their behaviour on the other hand (Vermeir et al., 2020). While more and more consumers nowadays are worried about both their personal health as well as the effect of their consumption practices on the environment, they tend not to choose foods in a consistent and systematic way, or spend their money according to these worries, a situation often referred to as a 'value-action gap', an 'attitude-behaviour gap', or an 'intention-behaviour gap'.

Moreover, it is uncontested that consumers have some agency, but not complete agency, over consumption processes when it comes to sustainable and healthy food consumption (Warde, 2005). This means that consumers are not always in control of what to choose, but are dependent on contextual factors such as the configuration of the food environment (Chapter 4, p. 83), and the food system at large (Chapter 1, p. 19). The different models for understanding consumer behaviour and identifying barriers to sustainable consumption vary in the degree to which they incorporate individual-level factors as well as contextual factors (SAPEA, 2020). Both of these factors need to be included when identifying barriers, as well as the interplay between the two.

This report uses the so-called COM-B framework for providing a comprehensive and structured overview of barriers to sustainable and healthy food consumption (introduced in the following section), and complements this approach with insights from practice theory.

3.1. Theoretical framework to identify barriers in sustainable and healthy food consumption

We draw on the COM-B framework to provide a structured overview of barriers that consumers face when it comes to sustainable and healthy food consumption, while simultaneously embracing the manifold approaches to understanding consumer behaviour (see Cane et al., 2012; Carey et al., 2018; Michie et al., 2011).

Here we explain the COM-B framework in more detail. According to this framework, behaviour (B) is generated by the interaction of motivation (M), capability (C) and opportunity (O). While personal motivation is an important driver to perform a behaviour, it is often not sufficient. Consumers additionally need the capabilities and resources to perform a behaviour, as well as the opportunities that make a behaviour possible or prompt it.

- **Motivation** is defined as "all those brain processes that energise and direct behaviour" (Michie et al., 2011). Motivation is important when the behaviour in question has a personal relevance, as it determines the evaluation of the expected outcome of a

behaviour, independently of whether the decision process is automatic or reflective. When behaviour is based on reflective decision-making processes, motivational factors such as attitudes, preferences, beliefs about capabilities or consequences, personal norms or goal-setting play a role. But most daily food-related decisions are made automatically, driven by motivational factors such as emotions or impulses. Some motivational factors. such as identity, values, likes or food-related attributes (for example, taste, texture and appearance) could direct both reflective and automatic decision-making, and anything in between.

- **Capability** is defined as the individual psychological and physical resources required to perform a behaviour. This includes resources such as physical capacities, cognitive capacities, nutrition-related knowledge, skills or habits as well as resources such as time, money or self-regulation capabilities.
- **Opportunity** is defined by the physical and social environments surrounding consumers that can either support or inhibit sustainable food consumption. For example, consumers can only acquire sustainable foods that are available and accessible in the physical environment. Important drivers in the decision-making process are, for example, convenience and salience of sustainable alternatives. As the health and sustainability consequences of behaviours are often distant and opaque, a strategy used by consumers is to refer to others (Sparkman et al., 2021). Hence, the social environment exerts a powerful influence via social and cultural norms, and those norms are often rather less healthy and sustainable.

It is important to highlight the interrelations between motivation, capability, opportunity and behaviour. For example, motivation and the underlying drivers of food preferences, beliefs, and attitudes are highly influenced by capability, opportunity, and behaviour itself (i.e., past experience). A motivation to prepare a sustainable and healthy meal and perform the behaviour can be promoted by existing knowledge about, and skills for preparing, sustainable and healthy meals (capability), but also by experienced social support or availability and easy accessibility of the required food products (opportunity). In this context, it is worth making the link to what economists refer to as 'endogenous preferences' (see 'Combinations of tools', p. 111). A motivation to consume healthy and sustainable foods can, in turn, lead consumers to self-select supportive physical and social environments. The experience of performing the desired behaviour also exerts some influence on motivation, capability and opportunity.

3.2. Barriers to healthy and sustainable food consumption

The literature on barriers to sustainable and healthy food consumption stems from different academic disciplines, such as food sciences, public health, consumer

psychology, marketing, economics and food policy, while drawing upon different theoretical frameworks, including social-cognitive theories, most prominently the theory of planned behaviour, and behaviour change frameworks such as COM-B and stages of change.

The barriers preventing consumers from engaging in sustainable and healthy food consumption are summarised in Boxes 3 to 6 (p. 72), broken down into four key impact areas:

- reducing consumption of meat and animal foods, and increasing consumption of plant-based foods
- reducing the consumption of unhealthy foods, i.e. those that are high in fat, salt and sugar, or ultra-processed
- increasing the consumption of organic foods
- reducing food waste at household level

These four key impact behaviours were chosen because of their impact on sustainable and healthy diets, and the (relatively) high agency consumers have in these areas. Other relevant types of food choices with high impacts on climate, biodiversity, land use, water, etc. are summarised in Box 7, p. 77.

The barriers are organised along the main categories of the COM-B framework. The COM-B framework serves as a means to structure the numerous and interrelated barriers into thematic groups; we are not proposing that this framework is the best model for predicting behaviour. Rather, an overview of existing major barriers towards healthier and sustainable food consumption is given without doing justice to the complexity and the interplay of those barriers within and across categories.

The following premises are important for interpreting the schematic boxes:

- Reciprocity of consumer internal and external factors: Internal drivers of consumer behaviour ('motivation' and 'capability') are strongly interconnected with the social and physical environments ('opportunity') in a reciprocal way.
- Food consumption is essentially a set of practices strongly embedded in social and cultural norms, not only fulfilling functional needs but also providing symbolic meaning. The shift to sustainable food consumption requires the individual consumer to adopt (partly) new practices and abandon existing ones.

The boxes provide an overview of common barriers in European countries. There are slight variations across the countries in terms of which barriers are most prominent, but largely speaking there are more commonalities than differences across the countries, which is why we do not go into detail about country-specific exceptions. Rather, it is important to emphasise that there are large variations across consumer segments within

each country regarding the barriers that hinder the individual consumer from behaving more sustainably, and the extent to which consumers are already consuming sustainable and healthy food.

The barriers outlined here can be translated into enablers: removing a barrier can facilitate the transition to sustainable and healthy food consumption. The barriers and enablers represent potential entry points for interventions and policies aimed at fostering sustainable and healthy food consumption.

Box 3. Barriers to reducing the consumption of meat and animal foods and increasing plant-based foods consumption

Motivation:

- Liking and preferences: strong liking of meat and animal products (taste, texture, …), disliking of plant-based foods (influence of social and cultural norms)
- Attitudes: positive attitudes towards meat and animal products, negative attitudes towards plant-based foods (influence of social and cultural norms and conventions)
- Perceived benefits & risks: for example, belief that (large amounts of) meat and animal foods are necessary for a healthy diet
- Perceived high prices of meat substitutes and vegetables (compared to animal products)
- Scepticism and prejudice towards the terms/labels 'vegetarian' and 'vegan'
- Lack of environmental or climate concern
- Lack of perceived responsibility or obligation
- Lack of perceived behavioural control
- Emotions and affect: positive emotions linked to meat and animal products, negative emotions linked to plant-based foods
- Negative expectations about outcomes (for example, costly, little self-efficacy, no environmental effect, unhealthy)

Capability:

- Food familiarity:
  - Lack of familiarity with novel foods
  - Prior experiences/aversion/liking
  - Food neophobia
- Lack of skills (planning, acquisition, storing, preparing, cooking e.g. meat-free recipes)
- Lack of nutrition-related knowledge (planning, acquisition, storing, preparing, cooking)
- Physiological factors such as hunger, satiety or appetite linked to meat and animal products
- Lack of knowledge about environmental, climate and health impacts of meat consumption
- Self-regulation (lack of self-control) — personality trait: lack of conscientiousness leads to impulsive eating and loss of self-control
- Difficulty or inability to change habits and routines
- Lack of time (throughout all consumption phases, for example, to try new meat-free recipes)

Opportunity:

- **Physical environment:**
  - Perceived low availability and low salience/visibility of plant-based alternatives in supermarkets, canteens, restaurants etc.
  - Perceived inconvenience of plant-based alternatives
  - Prominent positioning and omnipresence of meat and animal products in supermarkets, canteens, restaurants etc.
  - Prices (cheap meat products - possible through subsidies and industrial factory farming?)
  - Visual cues, smells or other sensory stimuli (affect perception of portion size, intake or satiation)
  - Large portion sizes of meat and animal products by default
  - Difficult accessibility of plant-based foods (e.g., unattractive labelling and naming/framing, e.g. as 'vegan' or 'vegetarian')
  - Obesogenic/unsustainable environments (e.g., neighbourhoods with higher density of fast-food outlets and lower density of supermarkets and grocery stores - so-called food-deserts)
- **Social environment:**
  - Lack of support for eating plant-based eating foods from close others (family, friends, colleagues)
  - Social norms ("meat = default")
  - Food culture and tradition: Meat is traditionally part of the food culture in European countries
  - Social prejudice
  - Social identity and lifestyles determined by food consumption
  - Symbolic meaning of meat (e.g. red meat symbolises human power)

Sources: Appleton et al., 2016; Bauer & Reisch, 2019; Benelam, 2009; Bucher et al., 2016; Chen & Antonelli, 2020; Evers et al., 2018; Graça et al., 2019; Munt et al., 2017; Nguyen et al., 2022; Stautz et al., 2018; Stoll-Kleemann & Schmidt, 2017.

Box 4. Barriers to reducing the consumption of unhealthy foods (e.g. high in fat, sugar and salt or ultra-high processed foods)

Motivation:

- Liking and preferences: strong liking of sugar-sweetened beverages, sweet and savoury snacks etc. (taste, texture, etc.)
- Attitudes: positive attitudes towards foods high in fat, sugar and salt
- Negative expectations about outcomes (e.g., little self-efficacy associated with amount of sugar consumed)
- Emotions and affect (e.g., comfort eating or stress-induced eating; negative emotions associated with increased eating in restrained eaters; positive emotions associated with increased eating)
- Mindless eating (e.g., eating while watching TV associated with consumption of foods high in fat, sugar and salt)
- Impulsive food choices in favour of foods high in fat, sugar and salt
- Hot-cold empathy gap (in a hot state more rewarding food is consumed)

Consumer behaviour: Barriers

- Habits or routines in favour of unhealthy food consumption, e.g., sugar-sweetened beverages

Capability:

- Nutrition-related skills (planning, acquisition, storing, preparing, cooking)
- Nutrition-related knowledge (planning, acquisition, storing, preparing, cooking)
- Low levels of health literacy are associated with high sugar intake
- Satiety from sugars or fats is lower compared to satiety from proteins or complex carbohydrates
- Physiological factors such as hunger, satiety or appetite enhance likelihood to consume unhealthy foods (and rely heavier on automated processes)
- Lack of time (throughout all consumption phases, e.g., processed food instead of cooking)
- Misjudgement of long-term costs and short-term benefits
- Skills to solve goal conflicts (e.g., eat healthy vs. indulging in food) -> goal activation
- Low level of self-regulation
- Difficulty / inability to change habits and routines

Opportunity:

- Physical environment:
  - Portion sizes (larger portion sizes lead to more consumed food)
  - Larger packages or plates lead to higher quantities consumed (Delboeuf illusion, e.g. portions are judged in relation to plate size)
  - Parallel activities increase consumption (e.g. TV viewing)
  - Misinformation or information overload
  - Availability and salience of unhealthy products: visual cues, smells or other sensory stimuli (affect perception of portion size, intake or satiation); product placement; neighbourhood (e.g., density of fast food outlets and convenience stores)
- Social environment:
  - Social influence or reference points, e.g. eating with others increases unhealthy food consumption
  - Social norms affect food choice and quantity eaten (e.g., portion sizes, frequency of sugar consumption)
  - Social and cultural norms around hospitality and receiving guests (e.g. celebratory occasions, birthday parties, Christmas, hosting dinner parties are occasions where dishes high in fat, sugar and salt are perceived as 'proper' food)

Sources: Bauer & Reisch, 2019; Benelam, 2009; Bucher et al., 2016; Buja et al., 2021; Calabro et al., 2023; Chen & Antonelli, 2020; Evers et al., 2018; Gupta et al., 2018; Mazarello Paes et al., 2015; Munt et al., 2017; Schneider et al., 2021; Stautz et al., 2018; Warde et al., 2020.

Box 5. Barriers to increasing the consumption of organic food consumption

Motivation:

- Unwillingness to pay higher prices for organic food
- Liking and preferences:
  - Other attributes are more important than organic (e.g. taste, convenience, local origin)
  - Perception that organic = less tasty, shorter shelf-life, less appealing
- Lack of trust in organic certification
- Confusion and scepticism about the benefits of organic food and organic production (e.g. health, environment)
- Lack of environmental concern
- Lack of perceived responsibility to act
- Lack of perceived behavioural control
- Positive attitudes towards non-organic products: consumers are loyal customers of non-organic products and brands, and are satisfied with these products
- Habits: purchasing non-organic food is a habit many consumers have never questioned

Capability:

- Lack of knowledge about organic production methods, standards and the control system, including lack of knowledge about the benefits of organic food (e.g. health) and organic production (e.g. environment)
- Difficulties identifying certified organic food
- Lower income or perceived lack of financial resources
- Lower level of formal education
- Lack of time: perception that buying organic food involves extra time
- Difficulty or inability to change habits and routines

Opportunity:

- Physical environment:
  - Higher prices of organic food
  - Perceived low availability and low salience or visibility of organic food in supermarkets, canteens, restaurants etc.
  - Perceived limited variety or product assortment of organic products
- Social environment:
  - Scepticism about the environmental benefits of organic production among close others (family, friends, colleagues)
  - Lack of support for paying the organic price premium from close others

Sources: Aertsens et al., 2009; Hansmann et al., 2020; Hughner et al., 2007; Kushwah et al., 2019.

Box 6. Barriers to reducing food waste at household level

Motivation:

- Competing (good) motives at the moment of purchase despite increasing awareness of negative environmental consequences (e.g., the move to healthier eating patterns has been associated with a higher propensity to waste food because consumers purchase more fruit, vegetables and other categories that have a higher risk of getting wasted)

Capability:

- Food-related skills (planning, acquisition, storing, preparing, cooking, eating, managing leftovers)
- Food-related knowledge, e.g., regarding best before and use by dates, or adequate portion sizes
- Food safety concerns when it comes to the consumption of leftovers or interpretation of date labels
- Lack of planning (meal planning, shopping lists)
- Lack of time to prepare the food that has been acquired
- Lack of time can lead consumers to substitute already purchased food that demands preparation with quicker alternatives (convenience food, take-out food, restaurant meals)
- Difficulty or inability to change habits and routines (planning and purchasing routines, but also shopping frequency and cooking routines)

Opportunity:

- Physical environment:
  - Large packages or packages that are difficult to empty lead to leftovers and waste
  - Promotions and discounts, such as 'buy 1 get 2', lead to more food purchased than can be consumed
  - Other sensory stimuli, such as visual cues, smells, product placement can induce consumers to acquire more food than needed
  - Low price of food makes avoiding waste not a priority. Wasting food may be cheaper than another trip to the grocery store for a forgotten food item
  - Ubiquity of alternatives (convenience food, take-out food, restaurant meals) makes it easy to change food-related plans, with the risk of food that has been acquired, but is not prepared, going to waste
- Social environment:
  - Social norm of providing more than enough food for family members and guests
  - Social identity of being a good provider and caterer to all family member's wishes

Sources: Aschemann-Witzel et al., 2015; Brunner et al., 2010; Evans, 2011, 2014; Graham-Rowe et al., 2014; Quested et al., 2013; Schanes et al., 2018; Welch et al., 2021.

Box 7. Other high-impact behaviours

The four key impact behaviours highlighted here are not the only relevant behaviour changes needed to move to sustainable and healthy food consumption (see Chapter 1, p. 19). Food consumption and production have to change even further to reduce the negative impacts on climate, environment (biodiversity, land use, soil, water, etc.), and social issues.

When it comes to consumers' food choices and practices, consumers often have little to no possibility to retrieve information about the impact of their behaviour on climate, environment, and social issues — beyond the four key areas highlighted above. For climate impacts of food choices, for instance, consumers can access information about the greenhouse gas emissions of different food categories (for example, published by NGOs), neglecting variations *within* food categories. For biodiversity impacts of food choices, consumers do not even have the possibility to retrieve information, neither at product category level nor at product level. The organic label is the only 'proxy' for biodiversity impacts consumers can currently look for, neglecting variations between farmers and products. The same holds true for impacts on water, soil, and land use. The organic label is also problematic as meat can still be labelled although the environmental impact of meat is considerably higher than plant-based foods, which can be confusing. However, considering the higher price of organic meat, recommending the consumption of organic meat might still lead to reductions in impact through decreased overall consumption.

Consumers have limited agency to consume in a sustainable manner due to a lack of transparency and information about the actual impacts of individual food choices (and products) on climate, environment and social issues.

The analysis of barriers across the four high-impact behaviours reveals that barriers exist at all levels: at the individual consumer level in the form of lack of motivation and personal capabilities, and at the contextual level in the form of lack of physical and social opportunity. These barriers represent potential entry points for policies and interventions aimed at fostering sustainable and healthy food consumption.

These high-impact behaviours share a commonality, in that large barriers exist at all levels of the COM-B framework, with slight variations regarding the significance of specific barriers (see the above boxes for details). The following summary should be understood through the lens of the premises outlined in the preceding section:

- **Lack of motivation:** Consumers lack the motivation to change their food-related behaviours. Some consumers lack concern for sustainability and personal health altogether; others do not feel responsible to act; while others would like to change their behaviour but find the sustainable and healthy option insufficiently attractive (for instance, in terms of taste, convenience or price) and they are satisfied with their current food choices. Variations between the impact behaviours exist as to what consumers dislike about the sustainable options: taste preferences are a major barrier for meat reduction and healthy eating, while high prices are a major barrier for organic food consumption. While most consumers dislike wasting food, other motives such as making sure there is enough food available seem to be dominant at the moment

when food is acquired. Apart from these cognitive and attitudinal factors, another important motivational barrier is that consumers are locked in unsustainable habits and automatic routines, as further elaborated below.

- **Lack of capability:** Consumers lack the capability to make sustainable and healthy food choices. The lack of cognitive capabilities includes the lack of cooking and food preparation skills, the lack of knowledge about sustainable and healthy food, expiration dates and food literacy in general, and difficulties identifying sustainably produced food. Consumers further lack mental capabilities, e.g. self-control to resist temptations, or willpower to change their habits. In terms of resources, consumers mostly lack financial resources for paying the higher price of sustainable food, and time resources to plan and prepare food.
- **Lack of opportunity:** Consumers lack opportunities for sustainable and healthy food consumption. The physical environment does not adequately support sustainable and healthy food consumption in terms of food availability, accessibility, affordability and visibility. Unhealthy and unsustainable options are omnipresent in supermarkets, restaurants, canteens and so on, preventing consumers from making sustainable and healthy choices. Package sizes are often too large, and discounts and promotions can steer consumers towards unhealthy food or overprovisioning.

The social environment is another type of barrier. Sustainable and healthy food consumption is not always supported by close others (family, friends, colleagues, etc.), and social norms often work against sustainable food consumption, especially in the case of reducing the consumption of meat and animal products. With regards to other high-impact behaviours (see Box 7, p. 77), consumers have limited agency to consume in a sustainable manner due to a lack of transparency and information about the actual impacts of individual and collective food choices on climate, environment, and social issues.

These barriers to sustainable and healthy food consumption further illustrate how, at the individual consumer level, the following three types of psychological processes are involved to varying degrees when consumers make food choices:

- habits, routines, and semi-automatic processes
- cognitive processes, i.e. deliberate thinking and information processing
- affective processes, i.e. emotions and impulsive reactions

Large barriers exist at all three levels, in that habits and routines, cognitive processes, and affective processes work against sustainable and healthy food consumption. This is the case for all types of high-impact behaviours investigated here.

Habits, routines and semi-automatic processes

Food consumption is largely characterised by repeated and semi-automatic processes, and for many consumers these habits are not in line with sustainable and healthy food consumption. Food habits are notoriously difficult to change (Vermeir et al., 2020). We do not yet fully understand how food habits evolve, hence breaking and establishing new habits is difficult and an under-researched area (Rees et al., 2018). It becomes even more difficult when consumers are not motivated to change their behaviour (Vermeir et al., 2020). To add to the complication, taste preferences are also linked to habits, since taste preferences are largely developed over time (Diószegi et al., 2019) and embedded in food cultures (Wright et al., 2001). This is especially challenging since a preference for the taste of meat and unhealthy snacks, and a dislike of the taste of legumes, vegetables and wholegrain foods, is one of the strongest barriers to sustainable and healthy food consumption. Overcoming the barrier of taste dislike is an under-researched area.

Cognitive barriers

A large number of cognitive processes influence food consumption (Chen & Antonelli, 2020) and prevent consumers from making sustainable and healthy choices (Biasini et al., 2021). Consumers compare and evaluate different food options and prioritise other characteristics over sustainability and health. Their decisions and evaluations might suffer from: a lack of cognitive capabilities, including the lack of knowledge about sustainable and healthy food and food literacy in general; difficulties identifying sustainably-produced food; and a lack of cooking and food preparation skills. Some consumers lack concern for sustainability and personal health altogether, while others do not feel responsible to act.

Affective barriers

Consumers experience pleasure and positive emotions when consuming certain foods, and this is especially the case for foods that are not in line with sustainable and healthy food consumption (Evers et al., 2018). Furthermore, many food choices result from impulsive reactions triggered by situational cues from the physical and social environment. Impulsive food choices also often clash with sustainable and healthy food consumption (e.g. Wouters et al., 2018).

3.3. Entry points for policy interventions

The large magnitude and variety of barriers to sustainable and healthy food consumption calls for a broad set of policy interventions and tools to be implemented. The policy mix needs to take into account the following points, simultaneously if possible:

- **Type of barrier.** What type of barrier does the intervention primarily aim to reduce? Lack of motivation, lack of capability, or lack of opportunity? Which other barriers are intertwined with the targeted one?
- **Nature of the target behaviour.** Which type of psychological process dominates the target behaviour at hand? Habits and routines, cognitive processes, or affective processes? Depending on which type of psychological process dominates the food-related behaviour at hand, contextual factors and the food environments play slightly different roles in affecting consumer behaviour, and different types of interventions and tools are most promising for overcoming the barriers to sustainable and healthy food consumption.
- **Target group.** Which consumer segment is the intervention trying to reach? There are large variations across consumer segments within and across countries regarding the barriers that hinder the individual consumer from behaving more sustainably and healthy. Personalised feedback tools offer promising possibilities to effectively induce behaviour change among specific target groups (see the information on personalised feedback tools, p. 109).
- **Unintended side effects.** Policy interventions can have unintended side effects, steering consumer demand in the opposite direction from that which is desired (rebound effects, reactance, licensing). As an example, it is important to consider that some people do not feel responsible for acting in a sustainable way, but still perform their everyday practices with low-resource intensity and low ecological footprints, referred to as "inadvertent environmentalism" (Hitchings et al., 2013) or "quiet sustainability" (Smith & Jehlička, 2013). It is crucial to preserve these beneficial but unintended sustainable behaviours, and not demotivate these consumers through the introduction of policy measures.

Most public policy interventions use cognitive barriers and lack of personal capabilities as the entry point for behaviour change and try to build capacity through information provision and — to a lesser extent — aim to provide financial (dis)incentives. Target group-specific public policy interventions and the use of personalised feedback tools are rare. The current approach neglects that food-related behaviour is often dominated by (semi-) automatic decision-making and affective processes. Disruptive measures promoting healthier and more sustainable physical and social environments, such as taxes, bans and mandatory reformulations are needed to change consumer behaviour towards more sustainable and healthy food consumption.

Food environments are key levers for creating opportunities, strengthening consumer capabilities, and increasing consumer motivation (see Chapter 4). They offer platforms for implementing disruptive measures. Ideally, the policy mix combines broad measures with target-group specific measures.

3.4. Key messages

- **From the consumer perspective, a transition to sustainable and healthy food consumption patterns involves a trade-off between sustainability and health on the one hand, with taste, price, social norms, symbolic meaning, and convenience on the other hand. It requires consumers to adopt (partly) new practices and abandon existing ones.**
- **Barriers preventing the transition to healthier and more sustainable food consumption patterns are situated at the individual consumer level in the form of a lack of motivation and personal capabilities, and at the contextual level in the form of a lack of physical and social opportunities, with reciprocal relationships between these levels.**
- **Consumers may lack individual agency to make healthy or sustainable food choices, particularly if they are from disadvantaged backgrounds and lack the resources to make such choices. The food environment becomes more influential in these circumstances and much evidence demonstrates the obesogenic nature of the current food environment, favouring less healthy and sustainable choices.**
- **Three types of psychological processes are involved when consumers make food choices: (a) habits, routines, and semi-automatic processes; (b) cognitive processes, i.e. deliberate thinking and/or information processing; and (c) affective processes, i.e. emotions and impulsive reactions.**
- **Most public policy interventions aim at increasing motivation and personal capabilities, and focus on altering the cognitive processes of food choice.**
- **However, given that habits, routines and semi-autonomous processes, as well as affective processes, are important determinants of food choice, policy measures need to address these as well. In this regard, interdisciplinary approaches within SSH are important to take into account, namely from sociology, anthropology, human geography and other interpretive social sciences.**
- **Disruptive measures that alter the context of food-related behaviour, in particular the physical and social environment (for example, taxes, bans, mandatory**

reformulations), can alter routines and semi-autonomous processes. Such approaches are important in creating a food environment that favours healthy and sustainable choices without the need for high agency at consumer level, and a powerful way of reducing dietary inequalities.

Chapter 4. Shaping the food environment for healthy and sustainable diets

This chapter deals with interventions and instruments that make changes to the close food environment[40] and the implications for dietary quality in terms of health or sustainability. More general policy interventions addressing the food system as a whole and rebalancing power relationships will be addressed for specific policy packages in Chapter 5, p. 116.

Considering the mandate of the working group that wrote this report, we mostly deal with the effects of public and private policy instruments. A multitude of frameworks already exists that aim to classify policy instruments, such as the NOURISHING framework from the World Cancer Research Fund International that distinguishes between interventions in the food environment, the food system and communication tools.[41,42] An alternative taxonomy applies the policy categories of the behavioural change wheel that address the different dimensions of the COM-B framework, as outlined in Chapter 3; it distinguishes between fiscal measures, guidelines, environmental and social planning, communication and marketing, legislation, service provision and regulation.

In this chapter, we will assess various interventions in the close food environment of consumers, according to the change in the food environment that is addressed, as listed in the external food environment in Figure 1, p. 20. We will not distinguish specifically between economic and behavioural-based approaches, instead focusing on the components of the food environment where they intervene. We consider interventions based on the concept of nudges as important, and treat them at the level which they address, for example, as nudges in the arrangement of food in the environment or informational nudges.

40 As defined in 1.3, p. 35, the food environment describes the context in which food is accessed and eaten. Research has shown that it is the (geographically) close environment that determines food availability and accessibility. We stress this here by emphasising the proximity of the food environment.

41 See https://www.wcrf.org/policy/policy-databases/nourishing-framework/

42 NOURISHING stands for: Nutrition label standards and regulations on the use of claims on food; Offer healthy foods and set standards in public institutions and other specific settings; Use economic tools to address food affordability and purchase incentives, Restrict food advertising and other forms of commercial promotion; Improve the quality of the food supply; Set incentives and rules to create a healthy retail environment; Harness supply chain and actions across sectors to ensure coherence with health; Inform people about food and nutrition through public awareness; Nutrition advice and counselling in health care settings; Give nutrition education and skills. In this classification, 'NOURIS' belong to the domain of the food environment, 'H' to the domain of the food system, and 'ING' to the domain of behaviour change communication.

Shaping the food environment

Interventions can come out of either private or public policies. It is important to keep in mind that they alter the incentives for various actors in the food system and trigger additional changes, for example in marketing practices or consumer behaviour. This review will summarise the existing evidence on the effectiveness, efficiency and distributional impact of these instruments.

The evidence reported in this chapter is based on different types of studies:

- **Observed market outcomes** are found in some studies, after an intervention has been introduced. Given the complexity of the food environment described in Chapter 2, direct causal effects are sometimes hard to identify. For example, causality may run in two ways when considering the correlation between obesity rates and the number of fast-food restaurants in a location. To disentangle simple correlations from causal effects, experimental methods are needed. Typically, either field or laboratory experiments are conducted.
- **Field experiments** are convincing because of their external validity, they produce data commensurate with actual consumer behaviour in typical purchase or consumption environments. In laboratory experiments, the internal validity can be better controlled, allowing for the clear identification of the causal effect (Falk & Heckman, 2009).
- **Laboratory experiments** may suffer from simplification of the complexity of the natural environment, where consumers typically have various behavioural options available. For example, experimenting with food prices in a vending machine may have a large impact on behaviour at the vending machine, but at the same time yield shifts in purchase behaviour to other food outlets which are not measured in the specific environment.
- When actual observations or experimental evidence are not available, **simulation studies** are often implemented, for example, when using elasticities (percentage changes in one variable of interest in response to the%age change in its determinant) to predict behavioural responses, such as a reaction to fiscal interventions like food taxes or subsidies. Simulation studies can also be used to generalise the results of consumer experiments about the effectiveness of new labels on market outcomes, including demand shifts and price changes. Simulation studies are also important in situations when various groups in the value chain have agency: consumers may not be the only ones to respond to fiscal policies; manufacturers may respond by modifying the recipes and composition of their products and retailers may alter their assortment when deciding which products to list. Consequently, the close food environment may itself respond to interventions aimed at altering consumer behaviour.

Considering the range of existing food policies in various countries, the forms of evidence on the effectiveness of changes to the food environment is quite diverse. While various

food labels on health and, increasingly, on sustainability do exist, their impact has been mostly evaluated in experimental and survey studies. Observational studies are increasingly used to understand the effects of sugar taxes that have been implemented on specific products such as sugar-sweetened beverages, including how much of the tax is passed through to consumer prices. Sustainability aspects, such as carbon taxes, have so far mostly been studied using simulation approaches.

The chapter will review the various dimensions of the food environment which the consumer interacts with: the economic environment and fiscal food policies (below); physical availability (p. 93); food composition (p. 99); the information environment (p. 100); and the social environment (p. 110). The chapter concludes with a summary of the state of knowledge on combining interventions from these different dimensions, including the relationship between pricing and changes in preferences (p. 111).

4.1. Economic environment and fiscal food policies

Introduction

The most important lesson we can take from the study of the economic environment's role on sustainable and healthy diets is that people change behaviour according to incentives, and not primarily because of information provision. These incentives need not be monetary, but monetary incentives are generally the most studied. This section examines how relative prices will need to be changed to deliver healthy and sustainable food consumption — meaning either how much cheaper healthy and sustainable diets will need to be, or how much more expensive unsustainable and unhealthy diets will need to be. There are several levers to modify prices, which can be brought about explicitly through taxes, subsidies or emissions trading.

The effectiveness of price interventions in changing dietary behaviour depends on how strongly consumers react to changes in food prices. To put price interventions in context, in a meta-review of 160 studies, Andreyeva et al. (2010) found price elasticities from 0.27 to 0.81 (absolute values) as a measure of how consumers react to changes in food prices. Food consumed out of home, soft drinks, juices, and meat are the most responsive to price changes (0.7–0.8). Focusing on healthy diets, Powell et al. (2013) provide a systematic review that found price elasticities of demand for sugar-sweetened beverages, fast food, fruits and vegetables to be −1.21, −0.52, −0.49 and −0.48 respectively, demonstrating how consumers are particularly responsive to price increases in sugar-sweetened beverages compared with other food items. In a meta-analysis, Andreyeva, Marple, Moore, et al. (2022) found the effect of a subsidy on fruits and vegetables sales in the order of −0.59, but did not identify a significant change in consumption.

There is a body of literature, highly relevant to this report's definition of healthy and sustainable diets, that models the effect of price interventions on key outcomes of interest, such as a healthy diets that follow WHO guidelines, the reduction of meat consumption and sugar, and reductions of obesity rates (Griffith & O'Connell, 2010; Hawkes et al., 2015; Latka et al., 2021; Powell et al., 2013; Roosen et al., 2022; Springmann et al., 2016; Willett et al., 2019). Studies looking at access to food for low-income households and making price interventions progressive are also considered (Allcott et al., 2019; Dubois et al., 2020; Klenert et al., 2022; Penne & Goedemé, 2021). In economics, the most developed body of literature is on pricing sugary products, which are a key lever for achieving healthier diets and reducing obesity.

This section of the report covers explicit price interventions. Implicit price changes resulting from the effects of bans, labelling, or quality standards are not covered, as the effects of these interventions, which can lead to implicit price changes, are covered in later sections.

The research assessed covers almost exclusively public interventions, i.e. fiscal policy. Private price interventions are scarce but do exist, for example as discounts on food products soon to expire. Hansen et al. (2021) find that price discounts on soon-to-expire products increase the likelihood of consumers' choosing them, and together with re-ordering by expiration date can reduce food waste in a representative store of a European grocery retailer. Nguyen et al. (2022) showed that personalised price promotions in the form of coupons are effective in leading to a healthier selection of menus in a university canteen setting.

Recent research on public price interventions in applied economics characterises which prices should be levied on key components of our diets. We highlight four key results from recent research:

- Latka et al. (2021) quantify necessary tax levels to achieve dietary recommendations. They find that specific taxes on food groups, such as animal products or food high in salt or sugar, are effective in reaching health and environmental sustainability targets, but that considerably high tax levels are required. For environmental sustainability, pricing animal products is key.
- Pieper et al. (2020) show that, in order to correctly account for climate change impacts, conventional and organic animal-based products should be priced by 146% and 71% surcharge on producer price levels, conventional dairy products by a 91% surcharge, while organic plant-based products only by a 6% surcharge.
- Funke et al. (2022) summarise the evidence for climate change impacts and nutrient pollution from meat consumption and find that the price of beef would be US $5.75–US$9.17 per kilogram higher if it reflected the true environmental costs to society. Accounting for diet-related health impacts, including the statistical value of life years

lost from premature mortality, further increases these costs, by up to an order of magnitude for processed meat.

- Allcott et al. (2019) calculate optimal sugar taxes for the United States: accounting for concerns about the regressivity of the tax, they show optimal sugar taxes could be higher rather than lower when accounting for distribution.

As there is a large body of literature on pricing food, this section limits itself to addressing three key fields of policy interest:

- price interventions for making less healthy and sustainable foods more expensive: pricing (red) meat (below)
- price interventions for making less healthy foods more expensive: sugar taxes (p. 90)
- price interventions for making more healthy foods more accessible to low-income households: subsidies for healthy food (p. 92)

From these studies, it can be concluded that less healthy and sustainable foods need to be more expensive to meet societal objectives on healthy and sustainable food consumption. Importantly, pricing (red and processed) meat in accordance with its negative impacts on the environment and health is a key intervention point for delivering on both healthy and sustainable diets.

Price interventions for reducing less sustainable and healthy food: animal-based products

Animal products, and especially ruminant meat, are severely underpriced with regards to their costs to society from environmental damages that are not accounted for (Funke et al., 2022; Pieper et al., 2020). Reducing greenhouse gas emissions from the agricultural sector implies bringing down consumption of animal products and globally moving towards plant-rich diets (Clark et al., 2020). In terms of price interventions to achieve sustainable diets, we discuss the evidence around greenhouse gas-based taxes on food alongside consumption taxes on meat or dairy together.

Processed meat and red meat also contribute to the burden of a number of diseases (Godfray et al., 2018; Springmann et al., 2016, see also Chapter 2, p. 52). Despite recent discussions in Germany and the Netherlands about the introduction of an 'animal welfare levy' or 'meat tax', so far animal-based foods have not been explicitly priced in any country in the world, with the exception of New Zealand which is planning to price greenhouse gas agricultural emissions by 2025 (see Chapter 5, p. 116). However, through economic models and price elasticities, there is substantial evidence about the effectiveness, efficiency and equity effects of taxing animal-based products, and especially red meat, to deliver on healthy and sustainable diets. All animal products are

resource-intensive, with dairy and other ruminant products playing an especially large role in land-use-related environmental problems, more so than poultry (see Chapter 2), but the research available is almost exclusively on general meat taxation, including based on greenhouse gas emissions.

The effectiveness of meat pricing in reducing meat consumption depends on demand reaction and price pass-through. A meta-analysis by Gallet (2010) covering 419 earlier studies and reporting 4121 estimates finds a median own-price elasticity of -0.77 (percentage change of reduction in meat demand in response to a price increase), with considerable variation. For reducing environmental impact, Wirsenius et al. (2011) estimate that a 60€ per ton greenhouse gas emissions weighted tax on animal food products in the 27 member states of the EU would reduce agricultural emissions by 32 million tonnes, and that most of this effect results from reduced ruminant meat products. Moberg et al. (2021) studied various options for environmental taxation and VAT increases on animal products for Sweden. They find that basing taxation on weighting of several environmental impacts resulted in a reduction in the impacts for all environmental categories, for example a 0.98 Mt (-5.2%) reduction in greenhouse gas (Moberg et al., 2021). Roosen et al. (2022) have estimated elasticities for meat consumption in Germany and found the unconditional own-price elasticities is around -0.9, but with substantial income effects (i.e. changed consumption patterns due to change in income). Demand reactions are highest for beef and lowest for mixed-meat products and the tax incidence falls more on older than younger citizens. Increasing VAT to 19% would reduce German meat consumption by 11% for all meat types (Roosen et al., 2022).

Modelling studies are based on a wide range of elasticity estimates for food, meaning there is a quantifiable degree of uncertainty about the effectiveness of meat taxes. One cannot assume that taxes are fully passed through to consumers, given imperfect market structures such as market power for slaughtering and 'price psychology' (see section 4.6, p. 111). Once a jurisdiction levies a form of meat pricing, analysis of such policy could clarify these additional effects. Furthermore, the effectiveness of meat taxation for achieving environmental and health goals depends on avoiding the substitution of other environmentally harmful or unhealthy products, or cheaper, lower quality meat products (Bonnet et al., 2018; Funke et al., 2022).

Springmann, Mason-D'Croz, et al. (2018) studied the effectiveness of meat taxes on health outcomes globally. To account for the health-related costs to society attributable to red and processed meat consumption, especially their potential to cause cancer, they found that processed meat should be taxed at a 100% price increase in high-income countries, compared to only 4% for unprocessed red meat. They found "consumption of processed meat decreased by 16% on average [...] whilst red meat consumption remained stable as substitution for processed meat compensated price-related reductions" globally. Also "the number of deaths attributable to red and processed meat consumption decreased

by 9% [...] and attributable health costs decreased by 14% [...], in each case with greatest reductions in high and middle-income countries" (Springmann, Mason-D'Croz, et al., 2018, p. 2).

Finally, the Danish tax on saturated fats in 2011 (repealed at the end of 2012) led to a significant reduction in demand for selected meat products (Jensen et al., 2016). However, Mytton et al. (2007) suggest that health-motivated meat taxes need to be carefully designed to avoid encouraging consumers to substitute with other unhealthy products. Furthermore, taxing the highest-emission food groups such as animal products to subsidise the lowest-emission food groups could have adverse health effects (Briggs et al., 2013; Caillavet et al., 2019). Subsidising meat replacement products (especially 'cultured meat') to bring down their cost could also be a valuable policy instrument if combined with pricing the environmental damages in agriculture (Treich, 2021; see p. 123 for examples on recent R&D government funding for 'cultured meat'), but there is no evidence yet of the effectiveness of such subsidies.

Taxing meat is an economically efficient policy to reduce meat consumption, as it delivers reductions of meat consumption with the least cost to society. However, for any specific environmental protection objective, pricing greenhouse gas emissions and nitrogen pollution directly at the source is more efficient and has a larger steering effect, as it provides producers with incentives for localised reduction of environmental harms, beyond the demand-side effect from reduced meat consumption (Funke et al., 2022). For reducing greenhouse gas emissions, emissions trading could lead to efficiency gains, especially including agricultural emissions into the existing and future EU emission trading systems (Grosjean et al., 2016). Schmutzler and Goulder (1997) show that, when costs to monitor compliance are high, consumption taxes can be more economically efficient than pricing emissions at the source, if production-side abatement options are limited and the taxed goods can be easily substituted. However, in practice, a significant proportion of agricultural emissions and mitigation potential could be covered by an emission trading design that targets large farms and few emission sources, thereby reducing transaction costs (Grosjean et al., 2016).

For greenhouse gas emissions, there is evidence that the potential for decarbonising traditional livestock farming in rearing and production is limited (Wirsenius et al., 2011). There is, however, some evidence from Sweden that globally desirable reduction in beef consumption conflicts with maintaining biodiversity-rich, semi-natural pastures (Moberg et al., 2021). Moreover, in an EU context, for optimal environmental pricing (levied where environmental damages occur), some form of border adjustment would be needed to ensure environmental gains are not undermined by increasing imports from overseas, and for protecting local farming industries from competitive disadvantage. Consumption taxes on meat can easily circumvent this concern, as imports can be taxed and exports exempted. Finally, in comparison to levying consumption taxes on meat in line with the

different meat type's environmental and health impacts or in comparison to greenhouse gas-based pricing on meat, simply altering the value-added tax rate is rather inefficient because it does not reflect how different types of meat can be more or less harmful to society.

When it comes to the distributional effects of meat taxation, taxes on food levied according to the greenhouse gas emissions of the product are slightly regressive with respect to income when the use of the tax proceeds is not considered (Caillavet et al., 2016; García-Muros et al., 2017; Roosen et al., 2022; Säll, 2018). In the United Kingdom, it was shown that such taxes have a disproportionate effect on households in the lowest socioeconomic class (Kehlbacher et al., 2016). The regressive effect can be mitigated by exempting certain subsistence goods such as cereals (García-Muros et al., 2017). Klenert et al. (2022) found for 24 EU countries that the distributional burden of meat taxes is mild and can be turned progressive by redistributing meat tax revenues via lump-sum transfers. Using meat tax revenues to lower value-added taxes on fruit and vegetables dampens, but does not fully offset, the mild regressive effect. As richer households in the EU consume more expensive and more greenhouse gas intensive meat products on average, differentiating tax rates based on average greenhouse gas content, or increasing VAT on meat products, have milder regressive effects than uniform taxes (Klenert et al., 2022). Pitt and Bendavid (2017) investigated the effect of changing meat prices on the burden of obesity by race and gender for the United States and found that males and black females are expected to realise greater reduction in obesity prevalence by 2030 from higher meat prices than white females, while black males benefit less in terms of longer life expectancy.

Price interventions for reducing less healthy food: sugar

Obesity is a very complex phenomenon (Hawkes et al., 2015). While overall calorie intake in diets is the key determinant, food preference learning, labelling and economic instruments have to work together as tools to deliver on obesity reduction (Alston et al., 2016; Griffith, 2022; Hawkes et al., 2015) with an important role for well-directed taxes on calories, sugar, or fat (Alston et al., 2016). The recent policy practice and evidence assessment in economics is on taxes on sugar, and sugar-sweetened beverage (SSB) taxes especially, as these are assessed as having little nutritional value when compared to most other foods. A general price rise on food to reduce its consumption would be ineffective and unjust (Griffith, 2022); however, the relative price between unhealthy and healthy foods meaningfully influences consumption choices. Specifically with high sugar consumption, taxes should be assessed jointly together with advertising restrictions and food availability. However, those who consume very high levels of sugar tend to consume a disproportionate share of soft drinks and confectionery, which explains the emphasis in present research on evidence for economic instruments on sugar taxes (Griffith et al., 2020).

For improved public health, the taxation of sugar and SSBs especially are an effective measure. Griffith et al. (2020) and Griffith (2022) discuss 27 studies of sugar-related taxes in eleven jurisdictions in the UK, and concluded that all studies find taxes lead to increased prices and reduced consumption. In settings of national economies like the UK, taxes are fully passed through to prices, while pass-through of the taxes is lower in smaller jurisdictions. Most studies found that taxes led to substantial reductions in purchases of SSBs. For instance, Powell et al. (2013) found that imposing a tax which raises prices of SSBs by 20% can lead to a reduction in consumption of around 20%. An earlier assessment by Cabrera Escobar et al. (2013) already showed that higher prices would be associated with lower demand for SSBs and lower obesity rates. In a recent meta-analysis based on 62 studies, Andreyeva, Marple, Marinello, et al. (2022) found that tax pass-through is 82%, suggesting tax undershifting. Given the high elasticity of demand (-1.5), a mean reduction in sales of SSBs by 15% is found. Recent research focuses on ex-post evidence of implemented sugar taxes in major economies outside the EU (see Chapter 5, p. 116 for existing sugar taxes and their design). In a systematic review, Teng et al. (2019) found that the equivalent of a 10% increase in SSB tax led to a 10% decline in beverage purchase and dietary intake.

We focus our discussion on the two most-studied cases, Mexico and the United Kingdom:

- **Mexico:** Colchero et al. (2017) find that, within the first two years of the Mexican sugar tax implementation, it showed an average reduction of 7.6% in the purchase of taxed SSBs. Additionally, that research found that for households with the least income, purchases were reduced by as much as 11.7%. Conversely, a 2.1% increase was identified in purchases of untaxed beverages, especially purchased bottled water. Álvarez-Sánchez et al. (2018) found that Mexican individuals aware of the sugar tax further decreased their sugar consumption more than those not aware, pointing out the interaction between pricing and awareness campaigns (see 'Combinations of tools', p. 111).
- **United Kingdom:** Bandy et al. (2020) find that sugar consumption from sugar sold in soft drinks was significantly reduced in reaction to the UK 'soft drink industry levy' and the consequent actions by industry. It confirms the modelling by Briggs et al. (2017), who quantified the reduction of obesity, type-2 diabetes and dental caries as a result of potential effects of the levy. Griffith et al. (2021) further simulate the outcome of a tax on all added sugar of £3 per kilogram and added salt of £6 per kilogram. They find reductions in sugar will be in the order of 10g per person per day and salt of 0.5g per person per day, depending on product reformulation and consumer responsiveness to the price increases (Griffith et al., 2021).

Sugar taxes are not efficient for obesity reduction, but might be optimal given actual policy constraints. An efficient economic policy for reducing obesity would be to increase the price of calories for those at risk of obesity, but in practice such an instrument is

unfeasible, while a general price rise on calories to reduce their total consumption would be ineffective and unfair (Griffith, 2022; Kalamov & Runkel, 2022). With regards to changing relative prices and making less healthy foods more expensive, taxing SSBs and confectionery are most promising (as well as saturated fat taxes), as these are of little nutritional value compared to other ways of eating excess calories and demand is reactive to price increases (Powell et al., 2013). Hence, sugar taxes are an important tool for reducing obesity, along with labelling, food quality and learning food preferences (Griffith, 2022; Hawkes et al., 2015).

Dubois et al. (2020) studied who is impacted by the sugar taxes locally in the United Kingdom and the United States, finding that, for out-of-home consumption, the taxes are effective at targeting the sugar intake of the young, and are less successful at targeting the intake of those with high total dietary sugar. They are in general more effective at targeting the young than older members of the population. They further find that the welfare loss, ignoring potential health benefits, is 20% higher for those in the bottom half of the distribution of total annual grocery expenditure (as a proxy for income). Allcott et al. (2019) calculate optimal sugar taxes for the United States: accounting for concerns about the regressivity of the tax, they show optimal sugar taxes could be higher rather than lower when accounting for distribution, if poorer households make more mistakes in translating their consumption preference to purchasing behaviour.

Price interventions for healthy food

For subsidies for improving health, Pancrazi et al. (2022) explore how price distortions (when prices do not reflect demand and supply) can be part of the reason why there is a gap between the recommended and the actual intake of fruits and vegetables. They focus on the share of fixed cost in a product, which is significantly larger for healthy than less healthy products. They found that fiscal intervention could correct these distortions, so that all consumers can be made better off. Broeks et al. (2020) study the effects of introducing a meat tax of 15% and a subsidy on fruits and vegetables of 10% simultaneously in the Netherlands. They find that the health benefits of the fruits and vegetable subsidy alone could be between €1.8 billion and €3.3 billion, although the benefits from the meat tax increase would be twice as high.

Food subsidies are implemented as a way of making healthy food more affordable for low-income households (Hawkes et al., 2015). However, there is some field experimental evidence from the Netherlands that shows subsidising healthy foods could lead shoppers in a supermarket to purchase more calories overall (Waterlander et al., 2012). In the EU, policies that aim to address food insecurity and deliver healthier diets include food aid, nutritional education and financial incentives, but these policies are not targeted at the problem of insufficient income as an underlying cause of less healthy diets (Penne & Goedemé, 2021). In contexts in which healthy foods are more expensive to produce,

there are equity reasons to provide targeted subsidies to low-income households to reduce their costs (Griffith, 2022). Indeed, a meta-review by An (2013) finds that targeted food subsidies for a healthy diets in high-income countries shift behaviour, while Black et al. (2012) caution about a lack of limited high-quality evidence. Hirvonen et al. (2020) estimate a lower bound for the affordability of a healthy diet across the world. In high-income countries (which includes all EU countries except Bulgaria), they find that less than 1% of the population cannot in principle pay for a healthy diet. Nevertheless, accounting in more detail for the cost of a healthy diet in 24 EU countries, Penne and Goedemé (2021) find that in 16 of those countries, particularly Bulgaria, Romania and Greece, at least 10% of the population in urban and suburban areas risk income-related food insecurity. They caution against delivering healthy diets to those households by food subsidy programmes alone, arguing that food policies need to be embedded in economic and social policies that address poverty more generally.

The nutritional quality of food donations is understudied. Mousa and Freeland-Graves (2019) assess the effect of food donations on the dietary quality of food pantry recipients.[43] They found that supplemental food provisioning can be an important resource for improving the nutrient intake of low-income populations. However, the study was based on 112 subjects only. A UK study on the parcels delivered by 11 food banks (Fallaize et al., 2020) found that donations were in excess of energy requirements and provided disproportionately high sugar and carbohydrate, and inadequate vitamin A and vitamin D, compared to the UK guidelines. Better cooperation with food donors and attention to dietary guidelines will be important in the use of food donations for healthy and sustainable diets.

4.2. Physical availability

This section summarises the evidence on how the physical environment influences sustainable and healthy food consumption, and more specifically how the availability and prominent placement of sustainable and healthy foods (or unsustainable and unhealthy foods) can affect consumers' food choices in supermarkets, shops, restaurants, canteens, schools and neighbourhoods. Interventions in the physical food environment are often designed and intended to correct existing market outcomes. Consumer preferences and competition among other market participants can result in a product assortment and built environment that imposes barriers on consumers' choices for healthy and sustainable products.

43 Food pantries are organisations that distribute food, e.g. from a food bank.

Product placement and availability within supermarkets and other shops

Greater availability and more prominent placement of target products (for example, at eye-level or on special displays) is a promotion tool frequently used by supermarkets and food companies to increase sales with target products. These measures can also be used to promote healthy and sustainable foods — in this context they are referred to as 'choice architecture nudges'.

Healthy foods

Greater availability and more prominent placement of healthy food products in supermarkets and other food shops is associated with healthier patterns of purchasing and diet. Evidence comes from a systematic review of 17 observational and 22 interventional studies published up to 2019 (Shaw et al., 2020). The majority of studies showed that greater availability and more prominent placement of healthy foods, or reduced availability of less healthy foods, was associated with healthier diet-related behaviours, as determined by measures of diet, body mass index or sales and purchasing. Not all studies demonstrated a positive effect, and the quality of evidence varied, but the balance of evidence indicated favourable effects on healthier purchasing and diet outcomes. Similar results were found in a meta-analysis by Cadario and Chandon (2020) which found mostly modest effects. Lindstrom et al. (2023) carried out a systematic review on nudges and choice architecture. They found that nudge applications, in particular priming,[44] in food purchasing settings are an effective tool to promote healthier food choices; but a recent study based on a randomised controlled trial from a real-life online supermarket showed no overall significant effect of in-store nudges on healthy food choices (Stuber et al., 2022). More research is needed on optimal combinations of intervention strategies.

A more recent study in a UK discount supermarket chain to increase the availability of healthy foods by placing them in more prominent locations and removing unhealthy products from prominent locations has also been shown to have positive effects on customer purchasing patterns and on dietary patterns (Vogel et al., 2021). The intervention involved positioning new fruit and vegetable displays at the front of stores to create increased availability and more prominent placement, as part of the supermarket chain's phased store refurbishment scheme. Evaluation in a matched controlled cluster design showed increased store sales and customer purchases of fruit and vegetables maintained up to six months post-intervention. In the same study, removal of confectionery from checkouts and end of aisles opposite led to decreased confectionery sales, though customer purchasing was not affected. The study was relatively small-scale

44 'Priming' refers to a technique where a cue is placed to activate specific associations before a target cue is placed. For example, an advertisement for fruit and vegetables viewed before a choice task leads makes the healthier choices more likely.

but is now being evaluated at scale as the supermarket chain's refurbishment scheme is rolled out across the UK.

The accumulating evidence on the influence of placement on consumer purchasing has led to the introduction of legislation in the UK to restrict the placement of foods high in fat, salt and sugar in prominent locations — end of aisles, store entrances and checkouts — in supermarkets and grocery stores of a certain size.[45] There is some evidence, however, that retailers might exploit loopholes in the legislation, creating, for example, new displays of crisps, confectionery and sugary drinks in the middle of aisles (Muir et al., 2022). The legislation was introduced on 1 October 2022 and will be evaluated in a study funded by the UK National Institute of Health Research.

Sustainable foods

Only few studies have analysed the effects of choice architecture nudges (greater availability and more prominent placement) on consumer choice of foods from sustainable production. Evidence from field experiments in supermarkets is surprisingly limited in this regard. We expect that the above-mentioned positive effects of greater availability and prominent placement observed for healthy foods are likely to be transferable to sustainable foods. The analysis of market data over time supports this assumption. For example, market data on organic food sales (from countries with larger market shares like Denmark and Germany) suggests that increased availability and higher salience of organic food in supermarkets had a large effect on consumers' uptake. As soon as 'regular' supermarket chains started selling organic food, sales of organic food, as well as the group of consumers buying organic food, grew substantially. Evidence from Denmark based on household scanner data exemplifies how consumers extend organic food purchases from one category to another over time (Juhl et al., 2017).

Meat consumption

The evidence on how consumers can be nudged towards healthier foods through increased availability and product placement of healthy options raises the hope that these measures are also successful in nudging consumers away from (red) meat and towards plant-based protein alternatives. First evidence from field experiments with supermarkets suggests that product placement of plant-based alternatives side-by-side with their meat counterpart is an effective measure for increasing sales of plant-based alternatives (Coucke et al., 2022; Vandenbroele et al., 2021). A supermarket field experiment tested the effect of an increased display of poultry products (increased size of the display area and quantity of displayed products) and a simultaneous decreased display for less sustainable meat products. The measures resulted in a significant

45 www.gov.uk/government/consultations/restricting-promotions-of-food-and-drink-that-is-highin-fat-sugar-and-salt/outcome/restricting-promotions-of-products-high-in-fat-sugar-and-salt-bylocation-and-by-price-government-response-to-public-consultation).

increase in the sales of poultry during the intervention period, while the sales of less sustainable meat products remained unchanged (Coucke et al., 2019). Overall, we conclude there is clearly a need for more evidence from field experiments on how to nudge consumers away from meat and towards plant-based proteins in supermarkets, to untangle the effect of decreases in meat assortment size and prominence, and increases in salience and attractiveness of plant-based protein alternatives, including not only meat substitutes ('mock meat') but especially legumes and low processed plant-based alternatives.

Online stores and ordering platforms

Interestingly, there is evidence that the transition to online grocery shopping can actually support consumers in making healthier choices. Literature has found online shopping baskets to contain healthier products than their counterparts in brick and mortar stores, because the products are presented less vividly, and are therefore less gratifying and tempting (Huyghe et al., 2017).

Out-of-home consumption

Out-of-home consumption, which is an increasingly important part of consumers' diets, includes food consumption in any premises other than the household, including restaurants, canteens, schools, street food and so on (though definitions across Europe are not harmonised, sometimes including school and workplace restaurants and sometimes not; WHO Regional Office for Europe, 2022a).

Based on data from 1997–2000 in 10 European countries, Orfanos et al. (2007) estimated that out-of-home consumption contributed between 12% and 28% of calories per individual. In the UK, the share is estimated at 25% of calories and more than 50% of expenditures (WHO Regional Office for Europe, 2022a).

Schools

Placement matters in other contexts of food consumption, as well as in purchasing environments. Studies have focused on aspects of the school food environment and its impact on dietary habit and health outcomes. Neto and Gama Caldas (2018) studied the use of green criteria in the public procurement of food products and catering services. They noted a wide variety of procedures in place at national, regional and local levels, or for specific organisations (i.e., a school). Evaluating 23 green public procurement schemes, they found that the main food products covered by the criteria are fruits and vegetables, dairy, fish and seafood, and meat. Most green public procurement schemes set criteria at the early stages of the supply chain (for example, organic production, seasonality). Some criteria also focus on ethical issues, such as animal welfare, fair trade and food safety.

- Micha et al. (2018) looked at the effectiveness of school food environment policies on children's dietary behaviours and found that, in 91 interventions, direct provisioning increased fruit intake (0.27 servings per day) and vegetable intake (0.04 servings per day). Furthermore, competitive standards reduced intake of sugar-sweetened beverages and unhealthy snacks. School meal standards were also found to be important, but no effect on health (such as adiposity or metabolic factors) could be identified.
- Verdonschot et al. (2022) studied the role of fruit and vegetable provision, gaming and the school curriculum, measuring changes in both fruit and vegetable intake and nutritional knowledge. They found that provision of fruit and vegetables had the largest impact on fruit intake, while gaming/computer delivery had the largest impact on vegetable intake and the curriculum had the largest impact on on nutrition knowledge.
- Hendrie et al. (2017) studied strategies to increase children's vegetable intake in home and community settings (outside of school) and identified 22 studies between 2004 and 2014. Planning for social support, vegetable exposure and provision of staff training were commonly used techniques for effective interventions. 12 of the 22 studies showed short-term effects, while 6 showed long-term effects.
- Nathan et al. (2019) identified a weak impact of lunchbox interventions in improving children's dietary intake.
- Ismail et al. (2021) studied the effectiveness of fruit and vegetable distribution interventions (alone or as a component), and found a positive effect of distributing fruit and vegetables as a snack in schools, enhancing access and exposure.
- In an umbrella review on fruit and vegetable interventions, Wolfenden et al. (2021) found that choice architecture, in combination with strategies to increase accessibility and making food more tasty or palatable, are promising avenues to increase intake and reduce food waste.

Restaurants and canteens

Limited evidence from field experiments relating to more sustainable and healthy food choices in restaurants and canteens suggest potential for behavioural interventions combined with information-based interventions to increase healthier choices and to reduce unhealthy choices, to increase the consumption of meat-free meals, and to reduce food waste. Evidence from field experiments relating to food from sustainable production (for example, organic) is scarce.

Decreasing the convenience of unhealthy options by making them less accessible in cafeterias has been found to have some effect. In the systematic review by Cadario and Chandon (2020), summarising the effect of cognitively, affectively or behaviourally oriented nudge interventions in a range of settings and population groups, interventions

had greater effect on decreasing unhealthy food choices than on increasing healthy choices. In addition, those in cafeteria settings were more effective at decreasing unhealthy food choices than those in grocery stores, though overall effects were small. While there are inevitable biases in such experiments, such as selection bias and lack of control over the intervention, these findings do indicate the potential for reducing less healthy food choices in out-of-home settings.

The influence of menu labelling on customer choices in relation to calories has suggested modest effects in terms of reduction in calories chosen and on those consumed. Sinclair et al. (2014) conducted a systematic review and meta-analysis of 17 studies published up to 2013. Ten of the studies were experimental. Overall, calorie labelling of menus had only small effects on calories chosen or consumed. Effects were greater, however, if contextual information was added to the menu, indicating a healthier choice. Other systematic reviews published in 2015 (Long, Tobias, et al., 2015; Nikolaou et al., 2015) similarly indicate only small effects of menu calorie labelling on calories purchased or consumed.

Neighbourhoods

In the wider food environment, studies identified effects of the neighbourhood food environment on diet quality and health outcomes. Based on a review of 38 papers, Caspi et al. (2012) found moderate evidence of the effect of neighbourhood food environments on dietary health. In a systematic review for China, An, He, et al. (2020) found that variety, density and proximity of food outlets were positively associated with dietary diversity, portion size and daily caloric intake. Density and proximity of fast-food outlets and convenience stores were positively associated with adiposity in some studies, but not all. Similar results are found in Cobb et al. (2015) without a regional constraint. They also find many null associations, which may in part be related to siting of supermarkets and fast-food restaurants (Currie et al., 2010). Atanasova et al. (2022) looked at causal studies, where work andschool environment studies were excluded. They found that in-kind or financial incentives, healthy food salience and health priming, but not calorie menu labelling, significantly improved dietary quality of children and adults, while effects on body mass index were null. The distance and number of fast-food or healthy food shops had the expected effects for children but only for selected groups of adults. Black et al. (2014) showed that inequalities in community and consumer nutrition environments are mostly observed in the US and less in other developed countries. Increasingly, studies have focused on the neighbourhood food environment comparing urban to rural space (for example, Love et al., 2019). In Europe, there is less evidence on spatial patterns in food environments and its resulting impact on dietary quality (Pinho et al., 2019; Titis et al., 2022).

By supporting the informal food system, interventions can equally enable healthy and sustainable food self-provisioning. Urban gardens are such an alternative system. Garcia et al. (2018) and Hume et al. (2022) provide a systematic review of the impact of urban gardens or community gardens on adequate and healthy diets, including 12 and 53 studies respectively. Impacts were identified of greater fruit and vegetable consumption, better access to health foods, greater valuing of cooking and enhanced importance of organic food. However, the authors of both reviews highlighted the need for more methodological rigour in this field of research.

4.3. Food composition

In addition to the physical availability of healthy and sustainable food, attention has shifted in recent years towards the composition of individual food products considering the large impact of (ultra-) processed food on the healthiness of the diet.

The reformulation of product recipes can help improve dietary quality. Research has shown that an assessment of the effectiveness of reformulation policies has to consider potential substitution effects with existing and new products in consumers' shopping baskets. These substitution effects limit the extent of possible improvements of the diet. Griffith et al. (2017) showed that reformulation towards lower sodium content improved consumers' shopping baskets more than an information campaign did in the UK. Spiteri and Soler (2018) showed similarly for France that reformulation can have an impact that is partly offset by new product launches and consumer substitution. Jensen and Sommer (2017) showed in a Danish study that silent reformulation had the effect of lowering the overall calorie content of consumption baskets also after accounting for substitution effects. Consumer reactions to various firm-specific or industry-wide reformulation scenarios have been studied, for example, by (Staudigel & Anders, 2020).

Experience with reformulation policies has been mixed. Often reformulation targets are built into voluntary agreements, limiting the effectiveness of the policy approach, in particular if the food industry is composed of many players and if agreements cover only a part of the product category (Leroy et al., 2016). Results in the UK indicate that the soft drink levy is more effective than the voluntary reformulation program (Public Health England, 2020).

Making healthier options more convenient or easier to consume has been found to be a comparatively effective nudge in steering consumers towards healthier choices. The same holds for interventions aiming to regulate portion sizes, such as providing larger plates for healthier and smaller plates of unhealthy options (Cadario & Chandon, 2020).

Recent research has also studied the acceptance of processed food products replacing meat. Considerable effort has been undertaken for consumer acceptance. It has been shown that featuring vegetarian options as 'dish of the day' can help to improve the selection of vegetarian alternatives (Saulais et al., 2019). However, nudges that trigger greater vegetable intake must be carefully assessed to ensure that more vegetable intake is not accompanied by more food waste (Qi et al., 2022).

4.4. Information environment

To a large extent, private and public policies target the information environment. Public marketing campaigns (for example, the five-a-day campaign), labels and scores, and regulation of advertising, all belong to this set of instruments (Hobbs & Roosen, 2022). A prime example is the use of various labels signalling healthiness or sustainability of a product.

In addition to these 'classical' instruments, personalised feedback tools have emerged over recent years with the growth in digitalisation of food selection and purchase. Many of these interventions in the information environment, as in the physical environment, are based on behavioural principles and have been recently reviewed (Reisch et al., 2021).

Information campaigns

Studies have investigated the effect of the 'five-a-day' campaign (for example, Capacci & Mazzocchi, 2011). Other studies have compared the effectiveness of public campaigns in the light of ongoing reformulation efforts (Griffith et al., 2017). In this comparative assessment, it turns out that the relative contribution from reformulation is larger compared to the effect of the information campaign, and this is particularly true for households of low socioeconomic status.

Labelling

The effect of food labelling has been extensively studied, both in the field of nutrition and health and in the field of sustainability (referring to environmental, climate, social and animal welfare impacts). Labels are attractive information tools, as in theory they allow for the expression of heterogeneous consumer preferences. The effect of labels will depend on consumers' motivation to understand and use labels in their product choices (Grunert & Wills, 2007).

In the field of nutrition and health, studies in general distinguish between nutrition facts tables and front-of-pack labels. In this context, labels can be mandatory or voluntary. Because consumers may shy away from products that have negative attributes

communicated on a label, it may be necessary to implement mandatory labelling to make negative attributes also appear in the market (see 'Mandatory vs voluntary labelling schemes', p. 105).

Front-of-pack labels aim to simplify information to make it more actionable. These come in various forms, from simple check-marks that a production standard is fulfilled (for instance, the organic label) to warning labels such as 'high in salt' or 'high in sugar', to more complex scoring systems which assess various dimensions at a time (for instance, the Nutri-Score label assesses nutrients). Scoring systems usually combine a product rating that summarises various dimensions with a colour scheme. Extensive evaluations of the Nutri-Score in France and other countries have shown that such scoring systems are helpful for judging the healthiness of products, and enable ease and speed of interpretation (Hercberg et al., 2022). Experimental studies have shown that the nutritional value of food baskets improves, both in lab experiments (Crosetto et al., 2019) and in field experiments (Dubois et al., 2021).[46]

Given the complexity of the existing labelling landscape, policy changes to address new issues face the question of whether to augment existing labels or create new ones. For example, deforestation is not considered when labelling food as organic, but it is very important for biodiversity protection. Whether to add a label on deforestation rules, such as the one of the Rainforest Alliance, or augment the specification of the organic label, is a difficult question. Research looking at the effect of multiple sustainability labels shows that conflicting messages may lead consumers to trust labels that they are already familiar with (De Bauw et al., 2022).

Nutritional labels and information

Several meta-analyses shed light on, and generalise empirical insights about, the effect of nutritional labels (and health-related information in general) on consumer attitudes and purchase behaviour.

- **Sugar:**
  - Based on 23 studies, An, Liu, et al. (2020) established that sugar-sweetened beverage warning labels reduced the likelihood of choosing sugar-sweetened beverages. A graphic with health effect labels had the largest impact.
  - Grummon and Hall (2020) conducted a meta-analysis of 23 experimental studies on sugary drink warnings, and also found that sugary drink warnings not only cause negative emotional reactions, but also reduce consumption and purchase (and purchase intentions).

46 Bastounis et al. (2021) provide a systematic review and meta-analysis for consumers' willingness to pay for foods with environmental sustainability labels.

- Based on a meta-analysis again of 23 studies, Scapin et al. (2021) concluded that health warning messages, graphics showing sugar content in teaspoons, and warning signs all steer consumers towards products with lower sugar content.

- **Front-of-pack labels:**
  - Based on a meta-analysis of only 6 studies, Agarwal et al. (2021) found that energy and fat content labelling had the intended effect of reducing the consumption of energy and fat.
  - In a systematic literature review of 15 studies, An et al. (2021) found that front-of-pack labels such as traffic lights, health star ratings, daily intake guides, health warnings and high sugar symbol labels prove effective in around half of the studies, but ineffective in the other half.
  - In a meta-analysis of 14 studies on front-of-pack labels on prepackaged food, Croker et al. (2020) concluded that front-of-pack labels encourage healthy food purchasing.
  - Ikonen et al. (2020) generalised the findings of 114 articles in a meta-analysis and found that front-of-pack labels have only a limited effect on steering consumers towards healthier choices. Warning labels have the strongest impact on consumers' choice of healthier food, while front-of-pack labels have little impact on food consumption. Importantly, front-of-pack labels may have the negative side effect of improving health perceptions of so-called 'vice products'. (those that provide immediate pleasurable experience, but contribute to negative long-term health outcomes).
  - Based on a meta-analysis of 13 studies, Song et al. (2021) concluded that traffic light labels, nutrient information and health warnings steered consumers towards healthy products, while Nutri-Score and warning labels were effective in making consumers avoid unhealthier options. Colour-coded labels were better able to steer consumers towards healthier choices, while warning labels were more likely to discourage unhealthy choices.
  - Based on a meta-analysis of 14 randomised controlled trials (three alcohol, eleven food), Clarke et al. (2021) established that health warning labels (either text-only or pictorial) make participants 26% less likely to choose the product.
  - In a meta-analysis of 15 randomised controlled studies, Daley et al. (2020) concluded that physical activity calorie equivalent labels displaying the physical activity calorie equivalent of food reduced the number of calories selected and consumed compared with other types of food labelling and the absence of labels.
  - Based on 60 studies, Shangguan et al. (2019) concluded that food labelling decreased consumer intake of energy by 6.6% and total fat by 10.6%. Furthermore, vegetable intake increased by 13.5%. Interestingly, they also identified industry responses to such labelling schemes, in that products contained 8.9% less sodium and 64.3% less artificial trans-fat.

- **Nutrition labels in out-of-home consumption:**
  - Based on a meta-analysis of 22 studies among college students, Christoph and An (2018) found that nutrition labels had a moderate, yet positive effect on college students' diets.
  - Based on a meta-analysis of 28 studies, Crockett et al. (2018) concluded that nutritional labelling on menus in an out-of-home consumption setting may reduce the number of calories purchased. However, they rated the quality of the evidence on which their meta-analysis was based as low, did do not provide any estimates for vending machines and supermarkets because they found the evidence on these to be too low-quality. Based on a separate meta-analysis of three randomised controlled trials, they concluded that calories per meal were reduced by 47 kcal (7.8%) when energy labelling on menus in restaurants was applied. Interestingly, they do not find any evidence for the often-cited 'dark side' of nutritional labels, that they increase instead of reducing calories purchased or consumed (see 'Negative side-effects of labels', p. 105).
  - Sinclair et al. (2014) meta-analysed 17 studies and found that menu labelling with calories alone did not decrease calories selected or consumed, but the addition of contextual or interpretive nutritional information did have this effect.

Based on these reviews and meta-analyses, we can conclude that there are some effects of nutritional labelling and health warning messages on the food consumers purchase, but effects seem to be moderate and/or limited. Health warning labels seem to be comparatively effective, but also trigger negative reactions. Furthermore, in many studies, warning labels about a product's sugar content may prove effective because of the availability of sugar-free alternatives in many categories: switching from regular Coke to Coke Zero demands less changes from a consumer than adapting one's diet.

We also note several limitations in this stream of research. Firstly, the current body of literature only includes a limited number of real-world studies. In the meta-analysis of Song et al. (2021), for instance, 95% of the studies were laboratory studies. This is likely to overestimate the impact of nutritional labels and health messages on consumer choice, given that customers pay attention to many more stimuli in a real-world environment, besides the nutritional content of food. Secondly, publication bias may play a role here, as studies that show significant results may be more likely to be published. Some, but not all, meta-analyses try to account for this.

Sustainability labels and information

Sustainability labels such as organic, animal welfare and fair trade labels have proven to be an effective tool for reaching consumers who are motivated and interested in food that supports these types of production standards. Sustainability labels enable consumers to recognise and identify respective foods which were produced according to a defined

set of sustainability standards. However, it should be noted that 'sustainability' is a so-called 'credence attribute', meaning that consumers cannot verify whether the respective production standards were met.

Potter et al. (2021) provide a review of the effect of sustainability labels. Overall, they are found to be associated with the selection and purchase of sustainable food products. Sustainability labels and claims are only successful if consumers find them trustworthy (Nagy et al., 2022), in particular regarding two aspects (Janssen & Hamm, 2012). First, consumers need to have a positive view of the underlying standards; if they are not perceived as offering substantial improvements compared to the status quo, the label risks being accused of greenwashing by consumers (as has happened with the Marine Stewardship Council label for wild fish, for instance; Ponte, 2012; Wijen & Chiroleu-Assouline, 2019). Second, consumers need to trust that the product fulfils the promised standards. Third-party certification and labelling schemes are a mechanism to overcome the information asymmetry between producers and consumers and raise consumer trust (Jahn et al., 2005).

Interestingly, sustainability labels seem to influence consumer perceptions also beyond the domain of the label itself. For instance, organic foods are viewed as healthier, and the same 'health halo' effect has been found for fair trade food (Nadricka et al., 2020; Tobi et al., 2019).

Regarding the impact of environmental sustainability labels on consumer behaviour, a recent meta-analysis (Bastounis et al., 2021) establishes that consumers are willing to pay a price premium of 3.79 purchasing power parity dollars per kilogram (95%CI 2.7, 4.89; based on 35 studies) for eco-labelled food. There was some variation in this effect, in particular for meat and dairy products, where the effect was stronger than other product categories. Consumers were also willing to pay more for food carrying an organic label than other environmental sustainability labels (for example, CO_2 emissions, water, land, pesticide use, and biodiversity loss). The authors note sizable heterogeneity between consumer segments. In particular, women and younger consumers were willing to pay more for food with an environmental sustainability label. Counterintuitively, this also holds for consumers with lower education levels, although this may be an artefact of many samples being biased towards respondents with a higher level of education. According to another study (Wägeli et al., 2016), consumers are willing to pay more for products from animal-friendly husbandry systems, where outdoor access, stocking density and floor type are viewed as important determinants of animal welfare.

Potter et al. (2021) show in their systematic review that ecolabels have a positive effect on the selection, purchase and consumption of more environmentally sustainable food and drink products. Heterogeneous responses show that labels were more effective among women and higher income or education consumers. While this systematic review

highlights the risk of bias present in many studies, it also shows that the studies with a high risk of bias do not favour interventions compared to studies with a low risk of bias.

However, while there are comparatively many meta-analyses examining reactions to health-related and nutrition labels, only a few review studies cover reactions to sustainability and environmental labels, such as willingness to buy or willingness to pay. More efforts are needed to systemise this literature. Moreover, studies based on hypothetical experiments and surveys show a positive consumer response but are potentially biased, overestimating the effects of sustainability labels on actual behaviour.

The limited evidence on the effectiveness of sustainability labels from field experiments suggests that sustainability labels have a significant but small effect (e.g., Elofsson et al., 2016). Market data, for example, for organic food, suggest that sustainability labels (combined with certification, where appropriate) are an important prerequisite for successful market penetration, but not sufficient for reaching consumers who are not already highly motivated to buy sustainably produced foods, especially if sustainable foods are perceived as involving extra effort such as higher prices, inconvenience, limited selection.

Mandatory vs voluntary labelling schemes

The question of mandatory versus voluntary labelling schemes is an important topic in relation to sustainable and healthy food consumption. While nutritional facts panels have been mandatory in the EU for decades, front-of-pack nutrition labelling is voluntary, and there is no mandatory labelling relating to sustainability (climate impact, environmental impact, animal welfare).

While mandatory disclosure of information has proven to be an effective tool in the area of energy efficiency in the EU, steering consumers towards home appliances with higher energy efficiency and incentivising producers to change their products,[47] scholars argue that there is sufficient scientific evidence to recommend the implementation of mandatory front-of-pack nutrition labelling to improve population health (Roberto et al., 2021; Song et al., 2021), nor mandatory sustainability labels (for animal welfare, see Wägeli et al., 2016).

Negative side-effects of labels

There are also 'dark sides' to labels that can act as a barrier in steering consumers to a more sustainable and healthier eating pattern. Healthy foods may suffer from consumer inferences that they are less tasty and more expensive. Sustainable food labels may trigger inferences that the food is inferior in quality and taste. In some product categories,

47 https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/about_en

a sustainability label can make consumers infer that the product is not strong enough, or that quality was sacrificed for sustainability in the product development phase. Such negative inferences likely explain findings in literature that a sustainable label harms rather than boosts sales of new food products (Luchs et al., 2010; Newman et al., 2014; van Doorn et al., 2021; van Doorn & Verhoef, 2011). It is therefore important to design healthy and sustainable food that overcomes the 'unhealthy=tasty' intuition, and to build taste preferences for healthy options (Briers et al., 2020).

Labels and their effects on socioeconomic groups

Information campaigns and food labels are regulatory tools that can lead to efficient outcomes when information is costly and consumers have perfect recall and understanding. To lead to fully efficient outcomes, consumers would also need to fully internalise externalities in their actions, which is not likely. Therefore, it is unlikely that the sustainability of food choices can be fully achieved based on information alone. Also, when consumers do not pay attention, information tools such as labels have to be supported by other instruments such as taxes and subsidies (Roosen & Marette, 2011).

Overall, the effect of labels and other information will have varying impact on different socioeconomic groups. They are often considered to be most effective among the educated. Kenkel (1991) noted that better schooling may lead to better health knowledge, and could therefore explain the tendency for better health behaviour among the better educated. However, even when accounting for differences in knowledge, it was found that differences in health behaviour by education level remain; more educated people may also have a higher preference for healthy behaviour, or beliefs that motivate a greater response to labels (Nayga, 2000).

The differential impact of environmental interventions on consumption and resulting health outcomes triggers the concern that information interventions mostly favour middle-income and high-income parts of society, leading to greater health inequities. Evidence suggests that many interventions in the food environment have reached disadvantaged consumer groups to a lesser extent (von Philipsborn et al., 2019). However, information on the equity impact of many interventions is limited, not only because the necessary information on diversity dimensions[48] is not collected, but also because disadvantaged groups are less likely to participate in studies (Waters et al., 2011).

The equity effects for sustainability labels may be different. In this context too, more affluent and better-educated people respond to labels more than people from lower socioeconomic strata of society. However, as discussed in Barkemeyer et al. (2023) they also tend to consume more unsustainably by consuming more. Eco-labelling schemes

48 Disadvantage can be identified in terms of place of residence, race or ethnicity, occupation, gender, religion, education, socioeconomic position and social capital, known as the PROGRESS acronym.

are more prominent in societies that consume more at a general level, and the propensity to use products with eco-labels is higher among consumers with a larger resource footprint. Sustainability labels may hence lead to a rebound effect.

Advertising restrictions

Another tool to address the information environment is the use of advertising restrictions, which often tale the form of voluntary industry pledges. Such an approach was evaluated by Landwehr and Hartmann (2020), where major food companies reduced their advertisements to children across the EU. Studying the change in advertising content on children's channels in Germany, the study showed that the voluntary pledge was limited in effect in reducing exposure to advertisements, partly because of its focus on children's programmes and partly due to lenient nutritional criteria.

A few studies go further to assess the effect of advertising regulation on consumption behaviour. Silva et al. (2015) looked at regulation in the UK. While television advertising regulation led to a reduction in expenditures on foods high in fat, sugar or salt, the study also observed a reallocation of advertising budgets of firms from television to other media. Dubois et al. (2017) furthermore show that an advertising ban on junk food may be countered by companies with increased price competition, limiting the effectiveness of the policy.

More recent evidence from the UK is encouraging. In early 2019, advertising restrictions on food and drinks high in fat, sugar and salt were introduced in the UK across the Transport for London network. Recent evaluations at population level, examining household purchasing patterns up to 10 months after the restrictions were introduced, demonstrated relative reductions in purchasing of these products in the intervention area compared with an area in the north of England where there were no restrictions (Yau et al., 2022). An accompanying economic modelling study of the impact of the changes in purchasing patterns on health at the individual level demonstrated a reduction of 4.8% in the proportion of individuals with obesity (equivalent to approximately 95 000 cases), with reduced incidence of diabetes and cardiovascular disease three years post-intervention (Thomas et al., 2022). The model suggested that there would be greater benefits over time for more disadvantaged groups in terms of quality of life.

Written and oral injunctions steering consumers towards healthier choices (for example, "have a tossed salad for lunch") have been found to have some effect, as have approaches which position the healthy option as hedonically more attractive, e.g. "dynamite beets" (Cadario & Chandon, 2020). The Veganuary campaign, a social media campaign for a vegan January, may have increased demand for plant-based alternatives but did not lead to a reduction in meat demand (Trewern et al., 2022).

Boyland et al. (2022) provide a systemic review of the effect of policies to restrict marketing of foods and non-alcoholic beverages to children. Outcome measures were exposure to marketing messages and their persuasive power, as well as dietary intake, choice preference, and purchasing. They found marketing policies may result in reduced purchases of unhealthy food, but stressed that results of individual studies are mixed, notably also in the way in which outcomes are measured. Therefore, it seems important that advertisement regulations state clear goals. For example, if a reduction in exposure of advertising to children is an aim, is this based on placement in children's programmes, or on advertisements generally designed to appeal to children? The authors favoured a mandatory implementation of the policy aligned with WHO recommendations.

Oke and Tan (2022) provided a review of the effectiveness of healthy food advertising in school settings to increase fruit and vegetable consumption. Only 8 studies could be included in the review. While advertisement was shown to be effective, the authors criticised the weak evidence because of non-cohesive study designs.

Food apps

The emergence of the digital food environment (see p. 39) has consequences for food choice, dietary intake and eating behaviour. Various apps exist that aim to support healthy and sustainable food purchasing and consumption. Targeted at individual consumers, these app-based solutions are typically either dietary tracking, monitoring and interventions apps to facilitate nutritiously balanced food consumption (for example, Yuka, see Soutjis, 2020), or ethical consumption apps that seek to inform consumers about the eco-score ranking of their food choice (for example, Weber, 2021), how they can 'save food' (for example, TooGoodToGo, see Fragapane & Mortara, 2022), or how to buycott or boycott certain foods (for example, Buycott, see Eli et al., 2016; Hawkins & Horst, 2020).

To date, several systematic reviews have reviewed the effectiveness of dietary tracking and intervention apps to support healthy food purchasing and consumption (DiFilippo et al., 2015; Lim et al., 2021), their impact on increasing daily fruit and vegetable consumption (Mandracchia et al., 2019), and their impact on improving diet quality (Kankanhalli et al., 2019; Rodríguez-González et al., 2023; Scarry et al., 2022). Lim et al. (2021) found "modest evidence for the efficacy of app interventions to improve healthy food purchasing and food consumption". They highlighted the advantages of apps compared to other media such as text messaging, websites, paper journals, email, face-to-face counselling and group sessions. They state that apps are effective tools for eaters seeking convenient, cost and resource saving interventions.

Mandracchia et al. (2019) found that interventions described in six of the eight studies they reviewed were effective in increasing fruit or vegetable intake. Scarry et al. (2022) found that

60% of the studies reviewed showed improved diet quality due to the use of mobile apps.[49]

Evidence from field experiments shows that personalised feedback is effective in changing behaviour into the desired direction.[50] A study with restaurants in the United States tested the effect of personalised recommendations to switch from unhealthy to healthier items displayed on the receipts. This measure shifted the mix of items purchased toward the healthier alternatives (Bedard & Kuhn, 2015). A study by Armitage and Conner (2001) found that personalised feedback on fat consumption significantly reduced fat intake. Mohr et al. (2019) and VanEpps et al. (2021) evaluated the effect of real-time aggregation of the calorie content of meals to provide dynamic feedback using traffic light symbols, and found that dynamic feedback reduces calories in food orders. Similarly, Livingstone et al. (2021) confirmed that personalised nutrition advice reduced intake of discretionary foods and beverages.

Importantly, there is some evidence that dietary tracking apps might be linked to disordered eating (Hahn et al., 2022; Kent, 2020; Messer et al., 2021). Food delivery apps may also play a role in disordered eating urges (Portingale et al., 2023). As no systematic review of studies on this topic exists at the moment, the evidence is limited to individual studies that at times also focus on selected groups of users (for instance, emerging adults), but should not be ignored. As Messer et al. (2021) show, prior app users reported higher levels of thinness-oriented and muscularity-oriented disordered eating than non-users in the studies they reviewed. Users who employed the app to lose weight, or control weight or their body shape, were more likely to report that the app use contributed to disordered eating. Relatedly, social media such as TikTok play a potential role by predominantly espousing weight-normative messaging (Minadeo & Pope, 2022). In practice, it is very difficult to disentangle the different digital media stimuli that influence eaters' practices and may lead to disordered eating.

Personalised feedback tools have proven to be effective in inducing healthier food choices (Bedard & Kuhn, 2015), but there is a lack of research on the effectiveness of

49 It is important to state that the systematic reviews referred to above mention important limitations. Lim et al. (2021) highlight that their review was limited to English language-based studies and is likely to have a publication bias. They also point out that interventions mentioned in studies older than 2013 differ from more recent ones: "Technology apps with older interventions may not be as effective as newer apps with advanced technology such as food photo recognition and personalised real-time feedback." (Lim et al. 2021, p.17). Further limitations include the different methods used to calculate nutritionally healthy and balanced diets in the reviewed studies, the inclusion of studies with non-significant findings, the amount of studies included in the reviews, the length of the intervention studies, and the targeted intervention group (often younger aged persons and women). Händel et al. (2019) also criticise the lack of rigour in systematic reviews and meta-analysis when selecting studies.

50 From the area of residential home energy consumption, it is known that peer feedback reports (informing customers how much energy they use and how much energy their neighbours consume) have the potential to decrease energy consumption (Jachimowicz et al. 2018; Ayres et al., 2013).

personalised feedback on environmentally sustainable food choices. Retailers have started to implement personalised feedback tools to induce environmentally sustainable food choices; for instance, the Norwegian online supermarket Oda[51] provides customers with an overview of their past purchases and the approximate CO_2 emissions, with the goal to steer customers towards food categories with lower greenhouse gas emissions. As indicated in section 1.4, p. 39, the appearance of food delivery apps may replace home cooking with delivered food, which is often more calorie dense. Alternatively, apps can also help consumers in food purchase and meal planning, thereby reducing food waste.

4.5. Social environment

When the consequences of our behaviours are distant or opaque, one decision-making strategy is to refer to others in our social environment (Sparkman et al., 2021). Social environments exert powerful influence on consumers' behaviour, and unhealthy and unsustainable dietary choices are often the norm. However, social norms can also be part of the solution (Nyborg et al., 2016). Many studies have suggested that descriptive norms, which communicate a desired behaviour for others, such as posters of people eating vegetables with lunch in the workplace, can be effective (Taufik et al., 2019). When a certain behaviour is not yet widely adopted, or when consumers already perform better than the descriptive norm, then injunctive norms (i.e., what individuals perceive as acceptable behaviour, what ought to be) are more effective at motivating behaviour change (Davis et al., 2018). Even minorities can change social norms on a societal level, and some studies pinpoint the existence of certain tipping points to overturn societal norms (for example, Centola et al., 2018). In addition to social norms, studies have shown the influence social support exerts on dietary-related behaviours, in general and in a situation (for example, Brug, 2008; Perino & Schwirplies, 2022).

While 'social support' in general is defined as the availability of resources, information, emotion or motivation by family or peers, for example, 'social support in the situation' is defined as the supporting or thwarting nature of individuals accompanying an individual at the point of decision (see for example, Inauen et al., 2017; McSpadden et al., 2016).

In a systematic review of reviews, Wright and Bragge (2018) found that associating a person's identity with a social group that is perceived to eat healthily, i.e., a positive positioning of social identity, is related to how much food is consumed when dining out. Chung et al. (2021) analysed peer influence on healthy eating among adolescents via social media and found significant influence on healthy eating behaviours (fruit and vegetable intake) and unhealthy ones (fast food consumption). Instagram and Facebook

51 https://sustainability.oda.com/klimaavtrykk-for-matvarer

were among the most popular social media platforms. In a review of 160 experimental interventions, Byerly et al. (2018) found some evidence that social influence and social norms can encourage reduced meat consumption. In a meta-review, Grundy et al. (2022) found that emphasising social norms is promising to reduce meat consumption. Yee et al. (2017) investigated parental influence on child food consumption and found that parental active guidance and education, psychosocial mediators and parental styles all influence child food consumption.

4.6. Combinations of tools

Increasingly, intervention studies for healthy diets focus on a combination of tools. The review of interventions in a school setting has shown that interventions that combine placement, information and education tools are particularly promising. A review by Mah et al. (2019) on retail food environment interventions similarly shows retail interventions can combine elements of geographic access with classical marketing tools in the area of price, promotion, place and product (the 'four Ps'). Programmes in schools also often combine different elements, such as providing fruit and vegetables with nutrition education elements. Furthermore, Reisch et al. (2021) show that a single intervention is used in 14% of the studies analysing climate change mitigation interventions at the consumer level, while 43% use two interventions and 34% use three simultaneously. The authors of the review conclude that a comparable share of studies evaluating multi-component interventions as compared to single component interventions had mixed or null effects on measures of health outcomes.

Regulations intervening in the close food environment often face issues that firms' action and market outcomes can strengthen or weaken policy outcomes (Hobbs & Roosen, 2022). Economic studies have turned to these dynamic interactions between policy levers. This includes reactions to labelling policies and strategic use of alternative labelling options (Villas-Boas et al., 2020), opposing pricing strategies (Dubois et al., 2017), and manipulation of ingredients or nutrients to enable front-of-pack claims. Therefore, it is important that regulatory interventions keep an eye on possible unintended consequences. For example, Kleis et al. (2020) show a ban on trans-fatty acids in Denmark has led to a replacement of these by saturated fatty acids, hence limiting effectiveness of the policy in improving dietary quality.

In addition, the release of new dietary guidelines may change consumer demand and influence the offering of and demand for specific product types. For example, Mancino et al. (2008) analysed the effect of the 2005 US Dietary Guidelines on the consumption of whole grain products. The 2005 Dietary Guidelines made its previous recommendation that encouraged the consumption of whole grains more specific, in that at least half of a

person's daily grain intake should come from whole grains. The guidelines have spurred competition among food manufacturers to introduce new products to expand the availability of whole grain foods, to certify their products as whole grain, and to use this certification in marketing communication on the food package.

In a review, Vandevijvere and Vanderlee (2019) find evidence that reformulation of food products also interacts with labelling and taxation policies, and that the effect of these policies is not limited to its effect on consumer behaviour but also creates incentives to firms to reformulate. In a more recent study, Allais et al. (2020) analyse the effect of sugar taxes on food reformulation in a simulation study. They estimate consumer preferences and, considering the cost of reformulation, the impact of a sugar tax is estimated. Hence, sugar taxes do not only influence demand and consumption directly, but can also further reduce sugar consumption by reformulating existing product ranges. Furthermore, Fernandez and Raine (2019) argue that sugar taxes should be combined with interventions that increase access to healthier beverages, to increase access to education about healthier drinks and to monitor the intended and unintended effects if sugar taxes are meant to be a viable anti-obesity policy.

Given the strategic response of food companies to various instruments that influence the proximate food environment, good monitoring tools are essential. This does not only require the regular implementation of dietary intake studies, but also the assessment of the nutrient content of food over time. In addition, given the limited effect of individual interventions and countervailing action by supply chain members, a combination of instruments is necessary to assure a substantial shift towards healthy and sustainable diets (Hawkes et al., 2015).

Box 8. Preference for food consumption change with policy choices

In the language of economics, it is not only the context in the moment of a decision that influences consumers. Instead, preferences, which economics assumes to be the basis for decisions, are shaped by cultural background and mental models of the individuals and hence are malleable by societal choices (Hoff & Stiglitz, 2016).

Across the social sciences studying diets, it is widely accepted that healthy preferences for food consumption can be learned and guided by society and policy (Birch, 1999; Hawkes et al., 2015). One important implication in assessing the evidence for policies is that price interventions can change preferences and lead to unintended outcomes: there is the risk that those price changes which are needed to deliver the required change in diets (see p. 85) might decrease intrinsic motivation to save the environment (a "preference change": see Bowles, 2016). Therefore, a price signal leading towards healthier and more sustainable choices should also be accompanied by behavioural interventions and informing citizens. That can lead to increased intrinsic motivation reinforcing the regulatory objective (Bowles, 2016; Gravert & Shreedhar, 2022). As an example, Lanz et al. (2018) find that in a field experiment with British supermarket shoppers, a carbon price of £19/tCO_2 on food decreases intrinsic motivation. Compensating for this effect requires the carbon price to rise by as much as £48/tCO_2. However, in certain circumstances, relative price changes can increase intrinsic motivation to eat more sustainably. In particular, the "meat paradox" — people hate to harm animals, but still eat meat from factory farming — is often explained by cognitive dissonance (Buttlar & Walther, 2018; Gradidge et al., 2021) and can be understood as a case of endogenous beliefs (Hestermann et al., 2020). A tax on sugar-sweetened beverages may crowd-in intrinsic motivation for healthy drinking, at least if individuals are aware that such a tax exists (Álvarez-Sánchez et al., 2018), although whether such effects exist may depend on relevant geographies (Ahn & Lusk, 2021).

Such findings indicate that price signals will need to be guided by behavioural and informational instruments and by careful explanation of the policy to the public (see Chapter 5, p. 116) as part of policy packages (Mattauch et al., 2022).

4.7. Key messages

- People are most likely to respond to incentives, monetary or otherwise. For the EU to meet objectives on healthy and sustainable food consumption, unhealthy and unsustainable diets need to be more expensive, especially animal products and products high in sugar. Evidence from sugar taxes, in particular from Mexico and the UK, show that they are effective in reducing sugar intake and can help reduce obesity. Making the price of animal products reflect the social cost of the associated environmental damages is economically efficient, including levying carbon pricing on greenhouse-gas emissions from agriculture. In view of high monitoring costs, substitution effects and food imports, consumption taxes on animal products are also effective in reducing the environmental impacts from these products. Importantly, increasing prices on red and processed meat correctly is a key lever for delivering on both healthy and sustainable diets.

- Equity effects of pricing animal products and sugary products are mild and can be made progressive by returning the tax proceeds to citizens appropriately, for example via lump-sum or targeted transfers. Increasing the prices on products high in sugar leads to comparatively higher health benefits for lower-income households and younger generations. Targeted food subsidies for low-income suburban households in poorer EU countries can help overcome poverty as an obstacle to unhealthy diets, but will need to be complemented by social policy addressing poverty in general.

- The prominent placing of healthy and sustainable food options in the food environment can help to improve the consumers' food choices. The removal of unhealthy options from prominent places also has a positive effect. This applies to grocery shop settings as well as other food environments such as schools and canteens.

- The wider food environment has been studied in terms of accessibility of healthy food stores and fast-food restaurants. Results show the expected effects, but only for some subgroups of the populations. Literature shows that inequality in consumers' food environment is more pronounced in the US compared to other higher-income and middle-income countries. Recently, studies have begun to compare the food environment in urban vs rural settings, but overall more study of regional effects is needed.

- Improving the healthiness of the overall food environment and enhancing opportunities for healthy product choice can also be achieved through reformulating food products (reducing fat, salt or sugar). The introduction of plant-based alternatives helps to widen the choice faced by consumers to replace meat

products. Silent reformulation can help to overcome barriers to adoption, but policy experiences in the past have shown that reformulation based on voluntary agreements have a limited effect. The comprehensive or mandatory inclusion of the food industry, and clear targets, make this policy instrument more effective.

- To a large extent, policy has focused on information provision to consumers. A large variety of public and private labels and symbols exist, aimed at steering consumers towards healthier or more sustainable food choices. In general, the literature shows the effectiveness of health labels, but the impact is low to moderate. The literature also shows that only some consumers, not all, attend to labels. Warning labels, as introduced in Chile, show a comparatively better effect.

- For sustainability labels, the evidence is mixed. Consumers need to be interested and motivated to use these labels. Trust in label standards plays a prominent role in determining whether consumers adopt labels for guiding their purchase decision. Given the blossoming of new sustainability labels, a coherent approach to developing and establishing label schemes is key to building trust and avoiding confusion.

- The digital food environment offers new possibilities for personalised and dynamic feedback, enabling food 'swaps' where choices are replaced healthier or more sustainable options at checkout. Initial studies show promising results. However, it must be observed how sellers (retailers and restaurants) use these tools, and whether they help consumers to make equally cost-efficient choices.

- The social environment exerts a powerful influence on consumer choices. Past policy examples, such as the regulation of the tobacco industry, show that social norms can be shifted by using a multitude of policy instruments, from taxes and advertisement restrictions to smoking bans in public spaces. In the food environment, the effect of peer influence has been shown to be successful in improving fruit and vegetable intake and limiting fast food consumption. There is evidence that influence and social norms lead to reduced meat consumption.

- A key message of this review is that interventions can have dynamic effects. They do not lead only to consumer responses, but also to reactions by other actors in the food environment, such as processors and retailers. Food labels, advertisement bans and taxes may lead to reformulations or competitive pricing strategies that can enhance or limit the desired outcomes in consumer reactions. Therefore, the development of any intervention package must consider possible reactions.

Chapter 5. Selected examples of policies to promote healthy and sustainable food consumption

Policies aimed at improving healthy and sustainable food consumption apply one or a set of policy instruments intended to change the behaviour of individual consumers, or collective consumers such as public institutions. Essentially, policies aim to create healthy and sustainable diets, by providing information or economic incentives for sustainable and healthy food consumption, or creating or removing barriers. Hence, public policies relate to the M (motivation) and O (opportunity) components of the COM-B framework (see 'Theoretical framework to identify barriers in sustainable and healthy food consumption', p. 69). For instance, by changing the price relations between sustainable and unsustainable food products, public policies can motivate consumers to choose the sustainable options by creating economic incentives and disincentives.

The selection and combination of policy instruments play an important role in relation to whether or not policy will succeed. According to May (2003), public policies "set forth courses of action for addressing problems or for providing goods and services to segments of society". Policies can come in different forms, but they "typically contain a set of intentions or goals, a mix of instruments or means for accomplishing the intentions, a designation of governmental or nongovernmental entities charged with carrying out the intentions, and an allocation of resources for the requisite tasks" (May, 2003). While goals can independently have an influence on the behaviour of the intended target groups if clearly formulated and considered legitimate within those groups, they are often problematic as steering tools. Though ideally policy goals should be clearly defined and set a clear direction, this is often not how the world of politics works. To enable the formation of a majority coalition to adopt policies, goals can be vaguely formulated to paper over disagreements on policy focus, have mainly symbolic meaning, suffer from inconsistency, or blur hidden agendas.

Hence, to assess policy's impact on behaviour, the analytical focus is usually directed at policy instruments. Policy instruments can be defined as "the set of techniques by which governmental authorities wield their power in attempting to ensure support and effect or prevent social changes" (Vedung, 1998, p. 21). While this definition is fairly broad, it does include the essentials of policy instruments and can encompass policy pursued by governments as well as private bodies.

Hood's classic policy instrument typology is useful to consider the instruments that governing bodies can use to affect the behaviour of more or less well-defined target groups. His typology distinguishes between (Hood, 1983):

- instruments based upon information (informative instruments)
- instruments that use authority (regulatory or administrative instruments)
- instruments that are associated with treasure (economic instruments)
- organisation

The distinction between different instruments is based on the motivational mechanisms that each instrument uses to induce individuals or organisations to change behaviour in the desired direction or maintain an already existing and valued behaviour which could potentially change if people are not motivated to maintain it. The four basic types of instruments use different motivational mechanisms. Informative instruments apply learning or persuasion to motivate people to change or maintain behaviour. Regulatory instruments use rules to bring about compliance, backed by authority to apply force if necessary. Economic instruments use monetary incentives to motivate people to behave in a particular way by rewarding desired behaviour or increasing the cost of undesired behaviour. Finally, organisation uses 'architecture', i.e., building or shaping organisations in a way that induces people to behave in particular ways (Hood, 1983; Vedung, 1998). Organisation is often associated with the use of one or more of the other instrument types. For instance, implementing an organic certification and labelling scheme requires an organisation to certify and monitor compliance with the standards. This policy instrument typology has proved impressively robust over forty years and continues to be well used (Hood & Margetts, 2007; Howlett et al., 2020). Although a more fine-grained categorisation of policy instruments can often be useful in empirical research, it is exactly the parsimoniousness and simplicity of the typology which has made it attractive for many policy analysts over time.

Policies can rely on a single instrument or a combination of instruments. While there is a tendency in the academic literature to focus on single instruments, in practice many policies use a combination of policy instruments. The instrument mix can be deliberately designed when policymakers have doubts that a single instrument is sufficiently effective at bringing about a desired impact. However, often instrument mixes are the result of an evolutionary process in which instruments have been added to existing instruments to address new concerns. In such situations, policy tends to evolve without having a unifying overall logic or design principle (Howlett & Rayner, 2007; Kern & Howlett, 2009).

This chapter reviews policies adopted (or under consideration) by national governments to address three of the four key impact areas highlighted in section 3.2, p. 70. These are:

- reducing consumption of unhealthy foods, focusing on sugar (below)

- reducing consumption of meat and animal products (p. 123)
- increasing the consumption of organic food (p. 127)

The policy reviews in the following sections address the barriers to policy intervention, which instruments have been or can be selected for the policy mix, how the instruments have been used and with what effect, as well as the conditions under which they were implemented, where this is relevant for understanding implementation of the policy mixes.

5.1. Sugar reduction policies

The World Health Organization (WHO) has formulated recommendations to reduce free sugars intake throughout the life course. In both adults and children, WHO recommends reducing intake of free sugars to less than 10% of total energy intake, and less than 5% as a conditional recommendation.[52] A high intake of free sugars is of concern because of its association with poor dietary quality, obesity and risk of noncommunicable diseases (WHO, 1990, 2003).

The majority of national food consumption surveys conducted among European populations provide information on intake of added sugars, rather than free sugars (Rippin et al., 2017). Of the European countries that reported adult daily sugar intake, all reported exceeding 5% of total energy intake, although only Estonian and Finnish women were over the 10% recommendation (Rippin et al., 2017). Regarding children and adolescents, in European countries where data on sugar intake were available, most children, particularly those aged 10 years or over, consumed more than 10% of their total energy intake from added sugars (Rippin et al., 2019). Beverages and sweet products, including confectionery, chocolates, cakes and biscuits make the most significant contribution to sugar intake across these age groups (Azaïs-Braesco et al., 2017; Graffe et al., 2020).

The WHO best-buys action plan lists the most cost-effective policies that can contribute to reducing free sugars intake and prevent diet-related noncommunicable diseases. These include economic instruments such as effective taxation on sugar-sweetened beverages (SSBs), informative instruments such as food labelling, and regulatory instruments such as marketing restrictions, all aimed at reducing intake of nutrients of concern, including sugars (WHO, 2017).

52 https://www.who.int/news/item/04-03-2015-who-calls-on-countries-to-reduce-sugars-intake-among-adults-and-children

A recent literature review presents a framework, illustrating various types of policies that have been used to reduce sugar and in particular SSB consumption. It categorises policies into four categories (Krieger et al., 2021):

- **Financial policies** increase the price of SSBs relative to healthier beverages and include taxes, restrictions on price and volume promotions (for example, buy-one-get-one-free offers), and incentives for the purchase of unsweetened beverages.
- **Information policies** aim to reduce the public's exposure, especially that of children, to marketing of SSBs or to increase awareness of the health risks that they pose. These policies include front-of-pack and advertising warning labels and marketing restrictions (for example, no advertising during children's television programming).
- **Default policies** make the choice of a healthy beverage easier, such as requiring a healthy drink in children's meals in restaurants.
- **Availability policies** decrease access to SSBs, or reduce portion sizes or sugar content in products. They include beverage procurement (for example, purchase or placement of beverages within various settings) and healthy checkout aisle policies (for example, lanes in grocery shops that display healthier options) (Krieger et al., 2021).

Below, we focus on both economic instruments and informative and regulatory instruments to reduce sugar intake for which most evidence is available to date. While food reformulation has been shown to be successful for salt and trans-fatty acids reduction (meaning that people usually accept, buy and consume reformulated products, resulting in an overall improvement in the nutritional composition of food purchases), similar evidence is not yet available for energy and sugar. Note that mandatory standards are generally more effective than voluntary actions, and that multi-component strategies that include food reformulation are more promising for improving population diets than reformulation alone (Gressier et al., 2021).

Economic instruments

Most fiscal policies to date related to sugar reduction have focused on SSBs. To date, over 45 countries and other jurisdictions (i.e. cities) have introduced SSB taxes, ranging from small taxes (3%–5%) to impactful taxes (50%–75%). There are generally two types of SSB taxes to consider:

- a **sales tax** is levied on consumers, based on the price of an SSB
- an **excise tax** is a tax levied further up the supply chain, meaning that manufacturers, distributors, or retailers are the taxed entities, instead of consumers. The impact of this on the consumer price will depend on how much of the tax is passed through to the consumer

Selected examples of policies

SSB taxes can also take different forms, as:

- a **volumetric tax**, which is levied on each litre of sugary beverages sold, regardless of sugar content
- a **sugar content tax**, which is levied on each gram of sugar over a minimum threshold
- a **tiered tax**, which sorts sugary drinks into different tiers according to their sugar concentrations and taxes products with high sugar concentrations at a higher rate

SSB taxes may vary in additional characteristics such as the definition of an SSB, the tax rate, and the allocation of revenues.

In their paper, Popkin and Ng (2022) show that taxes focused on sugar content have a stronger impact on the sugar content available in beverages, because they encourage reformulation. This has been seen in the UK's tiered soft drink levy based on sugar content per 100 millilitres of beverage, and in South Africa with the health promotion levy (Bandy et al., 2020; Essman et al., 2021; Scarborough et al., 2020; Stacey et al., 2021). Volume-based taxes can provide greater tax revenues, but are less likely to encourage reformulation.

In general, lower-income households and individuals are more likely to reduce their purchases in response to a tax, and therefore stand to gain more long-term health and monetary benefits (Barrientos-Gutierrez et al., 2017; Basto-Abreu et al., 2018; Sánchez-Romero et al., 2016; Torres-Álvarez et al., 2020). This was the case in evaluations of the Mexican nonessential food and SSB taxes (Batis et al., 2016; Colchero et al., 2016; Hernández-F et al., 2019; Ng et al., 2019; Sánchez-Romero et al., 2016) as well as South Africa's sugary drink levy (Essman et al., 2021). Assessing the health impact of SSB taxes is more difficult due to the long lag between tax implementation and potential health effects, and the multiple factors that contribute to health conditions associated with SSBs. However, microsimulation models predict significant reductions in obesity and cardiovascular diseases (Long, Gortmaker, et al., 2015; Peñalvo et al., 2017; Sánchez-Romero et al., 2016). A recent study suggests that the UK's soft drinks levy was associated with decreased prevalence of obesity in girls aged 10–11, 19 months after implementation, with the greatest differences in those living in deprived areas (Rogers et al., 2023). For further evidence from assessments in applied economics on taxes on SSB, see section 4.1, p. 85.

In the European context, the taxes in France, Hungary, Ireland, Latvia, Norway, Portugal and the United Kingdom were explicitly designed to reduce consumption of SSBs and/or sugar. Furthermore, taxes were designed to achieve an explicit objective of reformulation, through differential tax rates with thresholds based on sugar content, in Hungary, Latvia, the United Kingdom, Finland and France (WHO Regional Office for Europe, 2022c). Several WHO documents are available to support member states in implementing fiscal policies (WHO, 2022; WHO Regional Office for Europe, 2022b).

The most common barrier to the implementation of well-designed health taxes to reduce sugar intake in Europe is the opposition of the food industry (Campbell et al., 2020; Lauber et al., 2022; Tselengidis & Östergren, 2019).

Informative and regulatory instruments

Popkin and Ng (2022) point to clear evidence that that industry self-regulation of marketing to children has not been effective (Chambers et al., 2015; Galbraith-Emami & Lobstein, 2013). They present the Chilean example, where the government introduced a marketing ban on children-focused marketing of warning labelled foods during children's television shows, and subsequently on all marketing of those foods between the times of 6:00 and 22:00. Evaluations of these bans showed a decrease of ads for foods high in energy, saturated fat, sugar, or sodium, from 41.9% of all ads before the regulations to 14.8% after implementation. During the first year of the law, this resulted in a 44.0% decrease in exposure to 'high-in' food advertisements for children, and a 58.0% decrease for adolescents (Correa et al., 2020).

In London, since February 2019, all advertising for high fat, sugar and salt products has been banned across the London transport network. A recent evaluation found an association between the implementation of restrictions on outdoor advertising of such products and relative reductions in energy, sugar, and fat from these products. Relative reductions in purchases of sugar (80.7 g, 95% CI 41.4 to 120.1) from these products were also observed (Yau et al., 2022). A process evaluation of the design and implementation of this local policy highlighted some practical and policy challenges, such as translating the concept of 'junk food' into operational policy, reported uneven impacts across industry stakeholders, balancing health and financial impacts and the perceived influence of political motivations (Meiksin et al., 2022; see section 4.4, p. 100, for detailed discussion of the evidence).

In general, policies addressing unhealthy food marketing need to be strengthened in many ways in order to be more effective (Sing & Backholer, 2023):

- increasing the definition of a child to 18 years
- broadening the focus from 'child-directed' marketing to all marketing that children are exposed to
- including multiple settings, media and techniques within regulations
- using evidence-based food classification systems
- strengthening monitoring and enforcement systems

The following discussion focuses on SSB reduction policies, and is largely based on Krieger et al. (2021).

Selected examples of policies

SSB warning labels on outdoor advertising or on beverage cans can incentivise the industry to reformulate products and provide easy-to-understand information to consumers. There are two main types of warning labels: nutrient warnings (that indicate a high amount of sugar) and health warnings (that describe health harms of SSBs). One study that simulated a mandatory SSB health warning policy in the US concluded that such a policy would reduce the average SSB intake by 25.3 calories per day and the total energy intake by 31.2 calories per day, thus reducing obesity prevalence by 3.1%age points over 5 years. This study also found that this would particularly benefit racial and ethnic minority adults and lower-income adults (Grummon et al., 2019).

A real-world evaluation of a warning label policy became possible in 2012 in Chile, when the country adopted a food labelling and marketing law which mandated warnings for products high in sugar, saturated fats, sodium or energy, based on nutrient threshold values. This was the first national policy to regulate front-of-pack warning labels, to restrict child-directed marketing, and to ban sales of foods and beverages high in added sugars, sodium, or saturated fats in schools. The law states that prepackaged foods with at least one warning label cannot be promoted to children under 14 years, cannot be sold in schools and nurseries, and cannot be provided in school and nursery food programmes. The warning label was developed based on quantitative and qualitative studies conducted with different groups in the population. The warning label performed the best among a set of labels in terms of visibility, understanding and intention to purchase (Reyes et al., 2019). One year after the implementation of this law, purchases with such labels fell by nearly 24%. Importantly, households where the head of household was lower-educated heads showed similar absolute reductions in sugary drinks with warning labels to households where the head of household was more highly educated, demonstrating that these warning labels were understood and did not widen disparities (Taillie et al., 2020). In addition, manufacturers reformulated their products substantially in response to the implementation of the policy (Reyes et al., 2020).

A recent study evaluated changes in the calorie and sugar content of food and beverage purchases after the first phase of implementation of this law (Taillie et al., 2021). Compared with the counterfactual scenario, overall calories purchased declined by 3.5%, or 16.4 kcal per person per day (95% CI -27.3 to -5.6; p=0.0031). Overall sugar declined by 10.2%, or 11.5 kcal per person per day (-14.6 to -8.4; p<0.0001). Among purchases of products with a warning label, relative to the counterfactual scenario, there were substantial declines of 23.8% or -49.4 kcal purchased per person per day (95% CI -55.1 to -43.7; p<0.0001) and 26.7% or -20.7 kcal purchased per person per day (-23.4 to -18.1; p<0.0001). Greater changes might reasonably be anticipated after the implementation of the second and third phases of the law (Taillie et al., 2021).

Generally, in countries that have adopted front-of-pack nutrition labels to date, the main implementation challenges have included identification of covered products, trade

considerations, and the time needed by industry to change packaging and reformulate products (Corvalán et al., 2019). The involvement of civil society organisations was found vital to provide support when higher limits or restrictions on the label thresholds were proposed, as well as when opposing lower limits or less strict requirements (FAO & PAHO, 2017; WCRF, 2019).

Some evidence is now also emerging on industries' attempts to influence policy areas that they perceive as detrimental to their interests. This includes misrepresenting scientific evidence; developing public relations campaigns; mounting front organisations; lobbying; shifting the blame away from their products; and highlighting positive corporate actions (Collin & Hill, 2019; Lauber et al., 2021). However, the number of sugar reduction policies has increased and success factors have started to emerge. Successful campaigns have:

> increased public awareness of the health and equity issues associated with SSBs, built strong multisector coalitions, fielded effective grassroots initiatives, launched effective communications strategies to control the framing of the policy debate early on, articulated clearly the purpose of the policy and who will benefit, secured the support of elected officials, and arranged adequate funding
>
> *(Krieger et al., 2021)*

In a review, von Philipsborn et al. (2019) study the effect of environmental interventions excluding taxation aimed at reducing the consumption of SSBs. As successful, they identify easily understood labels such as traffic lights; limiting availability of SSBs in schools; children's menus including healthier beverages by default; promoting healthier beverages in supermarkets; community campaigns focused on SSBs; and measures that improve the availability of low-calorie beverages at home.

No single policy will reduce sugar and sugary drinks consumption to recommended levels. Therefore, multiple policies at different levels, such as Chile's food labelling and marketing law, along with public awareness campaigns, should be integrated to leverage synergies, reinforce healthy norms, and maximise impact.

5.2. Meat reduction policies

Meaningful reductions of animal product consumption required to meet environmental goals of the EU are not to be expected without significant policy intervention (see Chapter 4, p. 83). Following the key messages in Chapter 2, p. 52, this section focuses on red and processed meat (but not dairy) consumption. However, there are so far very few real-world policy examples of specifically targeting the reduction of meat consumption (WBAE, 2020). This section first collects the reasons why significant policy interventions to reduce the consumption of animal products are absent in industrialised countries. Second, it highlights a number of examples of implemented or discussed

policies targeting the reduction of meat consumption from relevant jurisdictions. Third, it summarises findings on options for raising public support for effective meat reduction policies. Reducing meat consumption to achieve more sustainable and healthy diets relates more to lack of motivation and lack of opportunity, but less to lack of capability (see section 3.3, p. 80).

As much meat consumption is in fact habitual and due to preference learning (Hawkes et al., 2015), this section looks especially into price interventions (economic instruments), public procurement (organisation) and public discourse (informative instruments) to shift behaviour. It looks at meat consumption of median consumers in EU nations; the specific role of the share of low-meat consumers is beyond scope. Unintended side-effects especially of price interventions, such as a reduction of red and processed meat leading to more consumption of poultry and its effect on animal welfare, are discussed in section 4.1, p. 85.

Barriers for policies reducing meat consumption

There are several political barriers to reducing meat consumption. Governance challenges to decrease red and processed meat consumption include industry lobbying, shaping the public discourse, market power, government-industry dependence and trade policy conflicts (Sievert et al., 2021). As one example, in 2019, only four out of the 35 largest meat and dairy companies stated that they have an explicit commitment to net zero greenhouse gas emissions by 2050 (Lazarus et al., 2021). In accordance with the focus of the report, this section focuses on the role of the consumers and the public in establishing political feasibility despite these barriers.

Notably, there is evidence that meat industry representative bodies have obstructed public discourse on the negative impacts from meat consumption in rich countries (Clare et al., 2022; Sievert, Lawrence, Parker, Russell, et al., 2022). Parallels have been observed between tactics used by major players in the meat sector (evidenced by documents from meat industry representative bodies) and the strategies of other politically powerful industries on which regulation was imposed due to desirable social transitions, such as the tobacco industry (Brownell & Warner, 2009) and the fossil fuel industry (Clare et al., 2022).

Clare et al. (2022) find three main strategies used by meat industry interest groups to shape public debates in the UK:

- They emphasise the consumer's free choice, in particular with respect to health effects. This can also come with framing the reduction of meat consumption as an elitist "vegan agenda" (Sievert, Lawrence, Parker, Russell, et al., 2022) in UK, USA, Australia and New Zealand.

- They portray the industry as part of the solution, rather than the problem. This emphasises voluntary self-regulation, the (limited) possibilities for better practices within the production processes, and (alleged) positive side effects regarding carbon sequestration and biodiversity preservation of some of the sector's activities.
- They influence public discussion by deflecting attention from the need to reduce animal products by consistently using the following four main framings: "[harmfulness of meat consumption is] still open for debate", "most people need not worry" (only a small subgroup of consumers are threatened by health risks), "keep eating meat to be healthy", "no need to cut down to be green" (Clare et al., 2022).

Discourse analysis of reactions to proposals to reduce meat consumption reveals that populist and anti-elitist sentiments are also barriers to the adoption of low-meat diets (Michielsen & van der Horst, 2022), and that discourse on meat reduction among the public is more polarised than among food system stakeholders (Sievert, Lawrence, Parker, & Baker, 2022). Even though there are more 'flexitarians' in EU populations than in the past, the (erroneous) lay beliefs that eating lots of meat is natural and plant-based meals are unenjoyable still constitute a significant barrier (Perez-Cueto et al., 2022). Moreover, sociological and cultural studies have identified a connection between norms of masculinity and meat consumption (Nath, 2010; Rozin et al., 2012). This may contribute to vegetarianism being more widespread amongst females (Räty & Carlsson-Kanyama, 2010; Rosenfeld & Tomiyama, 2021). However, there may be potential in EU countries for the younger generation to be especially receptive to publicly support meat reduction. Schulze et al. (2022) find that, among young Germans (15–29 years), opinion leaders have high approval for policy interventions promoting sustainable diets.

Examples of meat consumption regulation

Despite the efforts of industry interest groups to obstruct animal product regulation, there is nevertheless a number of prominent discussions about policies for reducing meat consumption in an EU context. In Germany and the Netherlands, forms of taxes on meat are current government proposals, notably in Germany as an 'animal welfare levy' (redistributing the tax proceeds to farmers to increase rearing standards in Germany). New Zealand is introducing some form of emissions pricing on agricultural products from 2025, as the sector is responsible for 50% of the country's greenhouse gas emissions.[53] The price will apply to manufacturers rather than individual farmers and is opposed by the farming lobby. At the time of writing, the level of the tax has not yet been decided.

Between 2011 and 2013, Denmark had a tax on saturated fat tax which reduced consumption of processed beef and cream (Jensen et al., 2016). The tax was repealed due to political pressure from stakeholders in Danish society. While public health

53 https://environment.govt.nz/publications/aotearoa-new-zealands-first-emissions-reduction-plan/

research was considered in the introduction of the tax (as part of a broader tax reform), it played no role in the discussion leading to its repeal (Jensen & Smed, 2018).

Changes to relative prices reducing meat consumption to some extent can also be brought about via differentiating the rate of value-added taxes (VAT). In Italy and Spain, basic foods such as fruits, vegetables and dairy, but not meat, are taxed at the very low VAT rate of 4%. To counteract inflation, Spain has currently reduced the VAT on basic products to 0%, but this does not include meat. Early results shows high pass-through of this tax reduction to consumers (De Amores Hernandez et al., 2023). In the EU, it has been possible for member states to reduce VAT on fruits and vegetables to zero since 2022. This option is currently under discussion in a number of EU member states including Belgium, Germany and the Netherlands, and very low VAT rates on vegetables also apply in Cyprus, Latvia and Luxembourg and Poland.

There are many legislative efforts across EU countries to curtail meat consumption at the local level. Predominantly vegetarian-only or vegetarian default meals in public canteens (sometimes on specific days) have been legislated by municipal governments, with examples including Gent, Freiburg, Grenoble and Helsinki (De Keyzer et al., 2012; Lombardini & Lankoski, 2013). There is also a meat advertisement ban in Haarlem (Netherlands).[54] France enacted a mandatory vegetarian option.[55] Conversely, livestock-related targets in public procurement schemes are so far omitted at national or EU levels (over other goals such as switching to organic produce; see section 5.3, p. 127), although decreasing meat consumption would actually be a primary objective for improved public health and environmental goals.

Green public procurement schemes in the EU have so far predominantly focused on the production of food packaging, and only to a lesser extent on goals for meal composition (Neto & Gama Caldas, 2018). However, the emissions-reduction potential of switching towards more plant-based diets is far greater than that of a switch to organic foods (see Chapter 2 and section 4.1, p. 85). For example, in a modelling study for Italian school meals (based on life-cycle analysis), the emissions reductions potential of procuring 100% organic foods is in the order of 11%–15%, while a switch to vegetarian meals results in a 20%–32% decrease (Cerutti et al., 2018). Selected case studies across the EU (for example, for school canteens) also show that reduction in meat can further balance out the higher cost of procuring a larger share of organic products (European Commission, 2014; European Committee of the Regions & Soldi, 2018). Reisch et al. (2013) therefore suggest that the lever of sustainable public procurement is underutilised, due to the frequent omission of concrete goals for reducing meat consumption.

Finally, a limited nascent number of policy initiatives seek to make meat replacement products more competitive by subsidising learning technology (Treich, 2021). In Israel and the Netherlands

54 https://haarlem.nl/haarlem-wil-geen-reclame-meer-voor-vleesproducten

55 https://agriculture.gouv.fr/egalim-depuis-le-1er-novembre-2019-un-menu-vegetarien-par-semaine-dans-toutes-les-cantines

as of 2022, government funding sponsors companies, research institutes and research foundations for the scaling up and education on cultured meat.

Options for raising public support for effective meat reduction policies

On overcoming some of the political barriers to regulation for reduction of meat consumption, we focus on the consumer side.

An important and especially policy-relevant barrier for tools to reduce meat consumption is their support from the public. A recent body of literature studies how policies can be designed to reduce meat consumption while at the same time increasing public support (Fesenfeld et al., 2021; Pechey et al., 2022; Perino & Schwickert, 2023). Fesenfeld et al. (2021) conclude that strategic framing alone is not sufficient to increase support for ambitious environmental policies which come at a cost to citizens, such as price increases on meat. Nevertheless, Perino and Schwickert (2023) show that, in Germany, animal welfare is a more popular reason for raising prices on meat than climate change. Fesenfeld et al. (2020) show that policy packaging (i.e. combining various food policies) can increase public support, while revenue recycling is not as effective in the food sector as it may be for carbon taxation in other sectors (Klenert et al., 2018). Instead, combining environmental taxes with other policy instruments perceived as beneficial has greater effects on support, including raising animal welfare standards and reducing agricultural subsidies (Fesenfeld et al., 2020). Furthermore, naming policies can sometimes matter: on meat replacement products, consumers prefer to name it 'cultured' over 'lab-grown' or 'artificial' (Asioli et al., 2022).

5.3. Promoting organic food consumption

Under Pillar II of the EU Common Agricultural Policy, support for organic agriculture is one of the activities which member states are responsible for designing. The way in which EU member states have shaped national organic agriculture policies varies, and policy impact has been very different. Some member states have converted a considerable share of their farmland to organic production, while others have been less successful in this regard.

The standard organic policy model across most European countries is to provide farm subsidies to encourage farmers to convert to and maintain organic farming. The assumption on which this policy model is based is that increased supply will create its own demand and this will lead to a growing organic food market. A more advanced policy model, the active market-development policy model, combines a variety of policy instruments to stimulate supply and demand for organic food products simultaneously (Daugbjerg & Sønderskov, 2012; Halpin et al., 2011). Policy instruments to increase organic

production already exist in the form of conversion subsidies to compensate farmers for the costs during the two-year transition period, as well as various subsidies to maintain organic farming. These can be combined with informative instruments aimed at encouraging farmers to farm organically.

When stimulating demand for organic food, governments can use all four types of instruments (Daugbjerg & Sønderskov, 2012; see also p. 116). Though governments can concentrate on the use of one instrument, a significant policy impact is more likely if several instruments are applied in combination:

- **Informative instruments** can be used to create awareness among consumers of the availability of organic food and persuade them to buy organic.
- **Regulatory instruments** can also be used. The EU has adopted baseline standards that producers are required to meet in order to market their food as organic. Furthermore, though there are no examples in practice, governments could potentially require that food services in the public sector must, as a minimum, ensure that a certain share of the food served is organic.
- **Economic instruments** can be used to subsidise organic marketing campaigns or other activities related to these, subsidise various training activities for kitchen staff or lower taxes on organic food.
- **Organisation** can also be used as an instrument to stimulate demand for organic food indirectly. For instance, public procurement services for advising kitchen managers and procurement bodies in the public sector on how to procure organic food can be established.

Ideally, the instruments should be combined in a way that will mutually reinforce each other.

Several countries have local, regional or national experiences with using sustainability criteria, including organic food products, in their public food procurement programmes (Molin et al., 2021; Neto & Gama Caldas, 2018). However, while overview articles identify organic food as an environmental sustainability criteria in procurement programmes, they do not describe best practices. What is missing are studies of national policy programmes to promote consumption of organic food.

The policy studies literature has called for more studies on policy success to learn how governments may succeed in addressing various types of policy challenges. Considering that studies of policy failure are disproportionately represented in the policy studies literature, the argument of the recent policy success literature is that there are lessons to be learned from studying policy successes that have hitherto been missed (Compton & 't Hart, 2019; de la Porte et al., 2022; Douglas et al., 2021; McConnell, 2010). In particular, four countries in the EU have been successful in promoting organic food consumption:

Denmark, Austria, Sweden and Luxembourg. In relation to the share of food retail sales that are organic, Denmark has consistently topped the list of countries since the mid-1990s when comparable international sales data became available (Willer & Yussefi, 2000). By 2020, Denmark was still leading, with 13% of the food sold by retailers and online outlets being organic. With 26.5% of agricultural land being farmed organically (Schlatter et al., 2022), Austria is often highlighted as the organic forerunner in the EU in terms of land conversion. On the consumption side, Austria is also doing well, reaching 11.3% in 2020. Luxembourg reached 9.1%. Sweden was a slow starter but has caught up and now ranks fourth in the EU with 8.7% (Schlatter et al., 2022). It should be noted, however, that much of the organic production in Sweden is livestock production: approximately 90% of the organic land area is devoted to feed production (Cederberg et al., 2011). Considering the need to switch to more plant-based diets, for organic production to be a part of the solution these systems must also deliver legumes, cereals, fruits and vegetables.

Austria initially relied on civil society and private retailers to provide outlets for organic produce. Producer-consumer collaboration was initiated to help organic farmers market their produce and to connect to consumer segments. Later, food retailers started marketing organic food products and are now the dominant outlet. The Austrian government's role was to support farm conversion and reframing the role of Austrian agriculture from a provider of cheap food to a provider of quality food (Schermer, 2015).

Denmark and Sweden have intervened more directly to promote organic consumption. Governments in Denmark and Sweden have launched policy initiatives directly to promote organic food consumption. In addition to encouraging the supply of organic produce, it was realised in both countries that to expand the organic agricultural sector, it was necessary to stimulate demand for organic food. However, the timing of the demand side initiatives in the two countries was quite different. Further, while both countries have achieved comparatively high levels of organic consumption, they arrived there through different policy strategies. Policy initiatives directed at increasing household consumption has been the main policy strategy in Denmark. It was later supplemented with a public procurement programme. Increasing organic food procurement in public sector institutions has been the key driver in Sweden.

Policy instruments to increase household demand for organic food in Denmark

Starting with the initial phases in the late 1980s, the Danish organic food and farming policy took shape as an active market-development policy (Schvartzman, 2012). The then Ministry of Agriculture argued that it was necessary to develop organic farming to cater for consumers with preferences for sustainable food (Daugbjerg & Møller, 2010; Schvartzman, 2012). Therefore, consumer demand was seen as a driver for the

development of the organic food sector. As was stated in 1999 by the Organic Food Council, established under the Ministry of Agriculture and including a number of stakeholders: "The underlying logic is that the organic farming sector can best be developed in accordance with the market which is created by the demand for organic produce. Thus, conversion is based on voluntary action and positive motivation" (Strukturdirektoratet, 1999, p. 16, author's translation). This resulted in a policy design in which demand-side instruments played an important role. The government used an economic instrument, by providing funding to promote market development such as subsidising product development, developing sales concepts and implementing marketing campaigns (Schvartzman, 2012).

Implementing the instrument of subsidised marketing required that capacities in organic marketing were developed. While government has administrative capacity to implement organic support schemes directed at farmers, or can relatively easily develop it, it is likely to lack expertise and experience in working with retailers on marketing. Furthermore, competition law may prevent government agencies from engaging directly with retailers in marketing efforts. Therefore, implementing demand-side policy instruments to increase private organic consumption, in particular those requiring collaboration with retailers, may require partnership with private bodies. Recognising this early on, the Swedish government encouraged the organic association to develop capacity in organic food marketing.

Most demand-side measures were initially implemented by a private body, the Organic Service Centre, which later merged with the association for organic farming and became Organic Denmark. The implementation of marketing measures required coordination between processors and distributors and direct engagement with retailers in sales campaigns focused on specific organic products. These strong coordination activities were a significant factor in promoting sales of organic products on a large scale. Importantly, they brought together and created trust amongst market actors who were essential for expanding the organic market (Daugbjerg & Schvartzman, 2022; Schvartzman, 2012). While the end target group at which policy was aimed were consumers, the policy worked through private intermediaries with Organic Denmark in a coordinating role and the food retail sector in an indirect role as facilitator of promoting organic food.

Using public procurement to promote consumption of organic food in Denmark and Sweden

In government efforts to promote organic food consumption through public procurement, the target group is public sector institutions rather than individual citizens. While increased public sector procurement has a direct positive impact on organic food consumption, there can be a multiplier effect if people having positive experiences with

eating organic meals in the public sector feel inspired to consume more organic food in their households. A key challenge in promoting public procurement is to develop policy mixes that motivate kitchens in the public sector to introduce and increase their use of organic food products in the meals that they serve. There are few examples of national organic food procurement programmes and very few studies analysing best policy practices in this field (Lindström et al., 2022).

An important barrier to public procurement of organic food is the financial cost increase caused by higher prices for organic food. The higher the share of organic food procured, the higher the potential cost increase (Lindström et al., 2022; Nuutila et al., 2019). However, menu planning can address this issue by substituting some meat with vegetables without compromising the nutritional quality of the food (Risku-Norja & Løes, 2017). Nonetheless, a high organic procurement share may result in some cost increase (Lindström et al., 2022). Availability of organic food products for institutional kitchens is another practical barrier (Risku-Norja & Løes, 2017). As will be shown below, this barrier has to a large extent been overcome in Denmark and Sweden by engaging food wholesalers and including requirements to offer a range of organic food products in procurement contracts. Further, there may be a lack of legal knowledge at local or kitchen level on how to create a procurement contract for organic food and how much flexibility they involve for both parties (Krogh et al., 2013). The policy effort to promote organic food sales in the private sector in Denmark was supplemented by a public procurement programme for organic food in 2012 that was in force until 2014 (Ministeriet for Fødevarer, 2012). The programme was revived in 2022 and will run until 2025. This time it is administered by the semi-public Foundation for Organic Agriculture. Apart from broadening the programme to additionally cover canteens in private companies, it is a copy of the previous programme. The original programme relied on economic instruments backed by informative instruments, whereas the current programme is based purely on economic instruments. Based on assessment of applications for specific kitchen conversion projects, the previous and the current programme offer economic subsidies for training of and advisory services for kitchen staff. Furthermore, both programmes encourage the kitchens to become certified under the government's organic cuisine label, though this is not a mandatory requirement (Daugbjerg, 2022).

The original programme produced a significant impact. The kitchens participating in the original procurement programme increased their procurement of organic food products by 24% over a two-and-a-half year period and certification under the organic cuisine level increased significantly. Prior to participating in the procurement programme, 57% of kitchens qualified for certification under the organic cuisine label (but not all of them were certified). By 2015, the share of kitchens qualifying for certification under the label had increased to 90% (Sørensen et al., 2016). Though public procurement has remained a secondary measure in the Danish demand-side policy strategy, it did boost the public sector's demand for organic food products and increased the organic certification of

kitchens in public-sector institutions. In 2021, 29% of the food procured by Danish public sector institutions was organic (data from Statistics Denmark, provided by the Danish Veterinary and Food Administration, 2022).

Similarly to the programme aimed at household consumption of organic food, the public procurement programme relied on partnering up with private actors. It was led by the Danish Veterinary and Food Administration, with the Agricultural Agency administering the funds. It was centrally governed, with national government agencies collaborating closely with mainly national private associations, most notably Organic Denmark, in designing and implementing the policy instruments. Organic Denmark represents the organic industry, including farmers, consumers, retailers and food processors. Further, actors with specific expertise in organic food procurement and kitchen management, most notably, the Copenhagen House of Food,[56] also took part in relevant parts of the process (Daugbjerg, 2022).

Engaging food wholesalers was identified as an important key to the success of the procurement programme. It was essential that they offered a range of organic products (Fødevarestyrelsen, 2012). Organic Denmark played an important role in activating wholesalers. It organised short courses aimed at sales agents and managers to motivate and assist them in developing strategies for offering organic products. The effort to engage food wholesalers proved successful, as it was possible for kitchens to source all necessary organic food products from wholesalers already in early 2013 (Daugbjerg, 2022).

The timing and the way in which organic food consumption has been promoted by government policy was quite different in Sweden. Whilst Danish policy has mainly concentrated on promoting household consumption from the initial phases of the organic food policy in the late 1980s, it was not until 2006 that the Swedish government directed attention to the demand-side, by adopting an organic consumption goal for the public sector. Up until then, the organic farming policy was focused on reaching the goal to convert 20% of farmland to organic farming (Jordbruksdepartementet, 2006), which it has achieved (Schlatter et al., 2022).

At national level, the Swedish procurement programme for organic food is essentially limited to a statement of a goal. This has remained the main national measure to increase consumption of organic food. Policy instruments supporting the goal are few and very modest in terms of funding (Burman et al., 2020; Miljö — och jordbruksutskottet, 2010). The original goal stated that organic food procurement in the public sector should increase from around 6% in 2006 to 25% by 2010 (Jordbruksdepartementet, 2006). Though procurement increased, the 25% goal was not reached until 2013 (Koch et al., 2018). In 2017, it was decided that by 2030, 60% of the food procured in the public sector

56 https://kbh-madhus.webflow.io/english/aboutus

should be certified organic (Näringsdepartementet, 2017). The Swedish programme for procurement of organic food has been successful despite few and very modestly funded national policy instruments to back the goal. In 2021, 38% of the food procured by Swedish public sector institutions was organic, which was slightly lower than the 39% in the pre-corona year 2019 (Ekomatcentrum, 2022b).

Reaching the goal relied on local and regional governments introducing their own consumption goals and measures to increase organic food procurement within their kitchens and canteens. It was voluntary to set local/regional goals. Local and regional government found the national goals helpful in increasing organic food procurement (Miljö — och jordbruksutskottet, 2010) 85% of the Swedish municipalities had adopted goals for organic consumption by 2013 (Riksrevisjonen, 2016). The share peaked with 88% in 2017 but decreased to 67% in 2020. The Organic Food Centre (Ekomatcentrum) argues that the main reason for this decline was an increased procurement focus on local — and Swedish-produced food (Ekomatcentrum, 2022a). Lindström and associates have analysed municipal consumption data for the period 2003 — 2016 and showed that the adoption of local consumption goals has had a positive impact on the share of organic food purchases (Lindström et al., 2022). While the national consumption goals were voluntary for local and regional government, it had what has been described as a catapult effect in setting local and regional ambitions and creating encouragement amongst local procurement officers and kitchen managers (Daugbjerg, 2023). A report produced by the Organic Food Centre highlighted the adoption of local and regional procurement goals as a key factor: 'the national goals have resulted in municipalities and regions formulating and adopting their own local organic goals. It is these local goals that in turn have driven the increased purchases of organic food in the country's municipalities and regions' (Ekomatcentrum, 2022a, pp. 6-7, author's translation).

As in Denmark, food wholesalers were important to the success of the procurement programme. But unlike in Denmark, the effort to motivate them was driven by requirements in local procurement contracts that resulted in a wide range of organic food products being offered (Daugbjerg, 2023).

Denmark and Sweden have introduced organic cuisine labels under which private and public kitchens can be certified. Both labelling schemes distinguish between three levels of organic kitchen certification. The Danish label was introduced in 2009. The bronze label can be obtained when 30-60% of the food products used are organic, the silver label when the organic share is between 60 and 90%, and the gold label when it is between 90 and 100%. Sørensen et al. (2020) found that kitchen certification under the label was likely to maintain or even increase the share of organic food procurement. The organic cuisine label in Sweden was introduced in 1997 by the private organic certifier KRAV. Under the KRAV label, kitchens can achieve the one-star label if at least 25% of the food purchased

is organic (alternatively at least 15 organic products), the two-star label is awarded if the share is at least 50%, and three stars can be achieved if the share is 90% or above.

The Danish and Swedish cases demonstrate that demand-side instruments can be effective in creating demand for sustainable food and that such instruments can indeed be integrated in a coherent organic food policy that also promotes organic food production. Policy innovation requires an outlook which goes beyond directing policy at farmers. Retailers, food services and consumers are key actors in the European food system and therefore policy should also aim at changing their behaviour to demand more sustainable food. In turn, this will be an encouragement for farmers to adopt sustainable farming practices and produce sustainable food for which there will be a growing demand. A concern could be that the implementation of public procurement programmes may abruptly increase demand for organic food and cause price increases. However, this is unlikely to happen. Public procurement is likely to increase gradually as there will be a process of trial-and-error in individual kitchens. This enables supply to catch up.

While the Danish strategy to promote household consumption of organic food requires partnership with private organisations and development of new expertise in organic marketing, a green public procurement strategy is less demanding in terms of policy capacity. The EU's action plan for organic farming recognises the need to stimulate demand for organic food but has few suggestions for applying demands-side policy instruments. It does, however, highlight public procurement as an available tool to stimulate demand (European Commission, 2021), but remains rather unspecific in terms of outlining policy initiatives. An opinion from the European Committee of the Regions (2022) highlights the need to develop policy capacities for public procurement of organic food. Denmark and Sweden have exhibited a high degree of policy innovation in organic food procurement in public sector institutions that can serve as inspiration for other countries. Though it is unlikely that the two countries' procurement programmes for organic food are transferable to other countries in their entirety, components may be relevant to introduce elsewhere.

5.4. Key messages

- The selected policy examples demonstrate that governments use several policy instruments to promote sustainable and healthy food consumption and are considering new instruments. While there are examples of governments using a combination of policy instruments, current policy debates indicate that there is potential for expanded use of such packages of instruments.
- In order to effectively reduce sugar consumption, a comprehensive policy package is needed covering fiscal policies targeting high sugar foods and drinks, as well as restrictions on advertising and health-related food labelling policies, among others. One of the biggest barriers to designing and implementing such policies are the sugar and beverage industries' attempts to influence policies they consider harmful to their interests.
- Despite barriers to implementation such as industry lobbying, shaping of the public discourse, market power and government-industry dependence, notable policy initiatives exist to reduce meat consumption. For example, an 'animal welfare levy' is a government proposal in Germany, and New Zealand has scheduled implementation of a price for greenhouse gas emissions from agriculture. Local initiatives across European cities indicate that public procurement of more plant-based and less animal products is viable and effective and could be rolled out at the national or EU level.
- Policies to reduce meat consumption can be designed so that they garner sufficient public support. Strategic framing alone and strategically spending tax proceeds for political buy-in are insufficient. However, combining various food policies that include forms of meat pricing can increase public support to win majority approval, especially when motivated by animal welfare concerns.
- Policy innovation in promoting the consumption of organic food requires an outlook that goes beyond directing policy at farmers. Government should actively attempt to stimulate demand for organic food. Experiences from Denmark and Sweden demonstrate that such policies can be successfully implemented through public procurement and campaigns directed at households. In both instances, it is important to collaborate with private partners.

Chapter 6. Evidence-based policy elements

Policies steering nutritional and environmental outcomes are fragmented across multiple policy levels ranging from municipalities to regions, countries and ultimately the EU. Historically, EU-level policies have been stronger in the environmental domain than the nutritional domain, while some policies affecting food environments operate mainly at local level (for example, urban development and zoning laws). In addition, member states differ in how they organise their welfare systems, which affects factors like school procurement.

However, the challenge to shift towards healthy and sustainable diets requires integrated and coherent approaches at a systems level, both horizontally (that is, across different domains at a given policy level) and vertically (across different policy levels). This is necessary to achieve synergetic effects, deal with trade-offs in outcomes, and address possible reactions that counteract the intended effects. Several examples discussed in Chapter 5 show that such an approach is possible and desirable. This is why it is important to have a legislative framework for sustainable food systems that lays down the guiding principles to enable effective and efficient actions at multiple policy levels in a coherent and systemic way.[57]

Both the legislative framework and the actions taken should not only consider the various barriers that consumers face in overcoming a shift towards healthy and sustainable diets; they should also acknowledge and take advantage of the food system as a whole, including non-market, informal and increasingly digital elements of the food system.

Rather than listing a set of policy options, we present here a varied set of policy elements that can be combined into policy mixes. Sections 6.1, p. 137, and 6.2, p. 138, list a set of elements that are important in enabling the right policy mixes: 6.2 calls attention for policy elements that capture the systemic nature of food environments and food systems in which consumer behaviour is embedded, while 6.3 summarises the main elements that form the policy objectives, namely healthy and sustainable diets. Section 6.3, p. 139, then provides elements that can be combined into policy instruments that constitute the right policy mixes.

57 https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy/legislative-framework_en

6.1. The systemic nature of food systems and environments in which consumption is embedded

Changing food consumption is a key lever to achieve the objectives of the EU's Green Deal and Farm-to-Fork Strategy. Shifting to more sustainable and healthy food choices is a complex process, as it entails changing diets, choosing foods produced using more sustainable production and distribution methods, and reducing food waste. Changing consumption practices requires consumers to reconsider trade-offs between various aspects, such as cost, health, taste, impact and time.

Current policy practices at different levels primarily focus on providing information and education to stimulate behavioural change. In the same vein, the actions proposed by the Farm-to-Fork Strategy mainly build on the premise that a well-informed consumer will make 'rational' choices, i.e. choices that are better for their own health and the planet. Such an approach relies on consumers' intentionality and knowledge about the effects of their choices. It also assumes consumers have agency to make these better choices, once armed with knowledge. This is problematic, as it assumes "that people need to be shown the consequences of their actions in order to be motivated to change behaviour, to take responsibility, to become more caring for the world around them" (Barnett & Land, 2007, p. 1070). The implication of this understanding would be that people do not care for the world and do not act responsibly unless they are exposed to educational campaigns (Sovová et al., 2021). This is patently not the case, as there is increasing recognition of different types of barriers hindering consumers to make such choices.

Therefore, the main question that this report addresses is:

> What tools could be used at EU level, in addition to those mentioned in the 2020 Farm-to-Fork Strategy, to overcome the barriers preventing consumers to adopt sustainable and healthy diets, fostering the necessary change towards sustainability in the food environment? The Group's advice should be based on an analysis that identifies the elements refraining consumers from making healthy and sustainable choices.

This report acknowledges the role of personal factors (such as the cognitive processes underlying choices) that influence consumer behaviour, and the barriers to healthy and sustainable diets that consumers need to overcome. There is increasing evidence that consumer behaviour in everyday life is less deliberative and reflective and more automatic, emotion-driven and the outcome of habituation. Consumers tend to eat in a partially-distracted way (or semi-automatic way) and these features should be increasingly taken into account in sustainable food consumption policy.

This report has also established the crucial role of the food environment in shaping consumer choices, concerns and priorities, and how companies in turn are influencing food environments in ways that are not conducive to fostering healthy and sustainable

diets. Consumer behaviour models should draw on systemic, integrative and interdisciplinary knowledge and include the relations between social, material and digital contexts; cultural conventions, social norms and values; meanings, beliefs and motivations; mental and physical/body features; emotions and feelings; know-how, skills and competences.

Finally, this report situates food environments in the larger context of food systems that are affected by multiple drivers, such as demographic changes, globalisation and geopolitical developments.

We have called attention to two important features of food systems dynamics. First, it is important to acknowledge the diversity of food systems in Europe and to account for both formal and informal food provisioning systems, not only market but crucially non-market based relations of exchange (for example, gift economy, donations and food redistribution). They not only continue to have importance in eastern and southern European countries as legacies of their recent rural histories, but are also gaining track everywhere in Europe as places of social innovation and experimentation to mitigate the effects of economic, climate, energy, food and sanitary crises. Many Europeans in their daily lives navigate and move seamlessly across various combinations of these systems. Second, digitalisation has become a key driver of change of food environments. Increasingly, digital infrastructures and technologies mediate how people seek, share and interpret food and eating-related information and practices. The effects of the digital food environment on (un)sustainable and (un)healthy food consumption are mixed and interrelated, and there is a risk of 'technological determinism' in the debate.

Finally, it should be mentioned that shifting consumer diets also creates business opportunities, by creating positive feedback loops to the sector. Innovations addressing consumer concerns such as unhealthy ingredients in meat substitutes are needed to accelerate the shift to healthy and sustainable diets (Aschemann-Witzel et al., 2021).

6.2. Direction of change: high-impact behaviours reducing negative environmental and health outcomes related to food systems

Dietary patterns and food consumption vary considerably from region to region in Europe, but also over time. There is a broad consensus in the recommended dietary pattern across countries: to predominantly eat a plant-based diet, rich in vegetables, fruits, whole grains, pulses and fish and seafood sourced from sustainably managed stocks, with moderate amounts of low-fat dairy products, and limited amounts of red and processed meat, salt, added sugar and high-fat animal products. These recommendations are

primarily based on personal health considerations, reducing the incidence of overweight, obesity and chronic diseases.

Overall, these recommendations also support environmental outcomes, as food systems are major drivers of environmental impacts, especially in terms of biodiversity loss, eutrophication, water stress, land degradation and climate change. Animal-sourced foods in general have substantially higher environmental impacts compared to plant-based foods, especially in terms of climate change, both per kilogram of food and in total. Hence, there is a broad consensus consensus that limiting the consumption of meat and dairy, especially in affluent settings where consumption is high, is a crucial strategy to mitigate climate change, stop biodiversity loss, halt obesity and fight chronic non-transmissible diseases. In addition, ruminant animals such as cattle and sheep cause higher greenhouse gas emissions per kilogram of meat than pigs and poultry, but at the same time, ruminants are not dependent on human edible crops like cereals and grain legumes as pigs and poultry are. Meanwhile, organic production has benefits such as the avoidance of synthetic pesticides with positive impact on biodiversity, but has similar climate impacts per kilogram of produce as conventional production. This means that organic production without demand-side changes (reduced consumption of animal products and reduced waste) is not a climate mitigation strategy. Savings of greenhouse gas emissions from choosing local foods are minor due to the relatively small contribution from transport to overall emissions from the food system, but local food systems can have other (social) benefits depending on the indicators used to compare local and global supply chains.

Supporting this direction of change requires the development of metrics and other indicators describing the nutritional and environmental impacts of food consumption. Therefore, an important precondition is the development of monitoring schemes using harmonised methodologies calculating nutritional and environmental outcomes.

6.3. Overcoming barriers to more sustainable and healthy food consumption

Behavioural change can be conceptualised as the result of the interaction of motivation, capability and opportunity. In other words, to change their behaviour, consumers need to be motivated, dispose of the necessary resources and have the opportunity to make healthy and sustainable choices. As a result, consumers may face a large number of barriers when trying to change their behaviour, many of which are beyond their control.

The large magnitude and variety of barriers to sustainable and healthy food consumption calls for a broad set of policy interventions and tools to be implemented. Such a policy mix needs to take into account the type of barrier, the nature of the target behaviour,

the target group and potential unintended side effects. Most existing public policy interventions use cognitive barriers and lack of personal capabilities as the entry point for behaviour change and try to build capacity through information provision and — to a lesser extent — aim to provide financial (dis)incentives. Target group-specific public policy interventions and the use of personalised feedback tools are rare. The current approach neglects the fact that food-related behaviour is often dominated by (semi-)automatic decision-making and affective processes.

Given that habits, routines, semi-autonomous processes and affective processes are important determinants of food choice, policy measures need to address these. In this regard, interdisciplinary approaches are important, including insights from sociology, anthropology, human geography and other interpretive social sciences. Disruptive measures that alter the context of food-related behaviour, such as taxes, bans, and mandatory reformulations, can alter routines and semi-autonomous processes, especially when they influence the physical food environment. Such approaches are important in creating a food environment that favours healthy and sustainable choices without the need for high agency at consumer level, and a powerful way of reducing dietary inequalities given the strong evidence that people from disadvantaged backgrounds have diets of poorer quality. In summary, policies should aim to make healthy and sustainable meals the easiest, most convenient and reasonable choice for all EU citizens.

Policy interventions should also keep an eye on possible unintended consequences. Regulations that intervene in the close food environment are often less effective, because the action of firms and the outcomes of markets may complement or frustrate policy outcomes (Hobbs & Roosen, 2022). This includes reactions to labelling policies and strategic use of alternative labelling options (Villas-Boas et al., 2020), opposing pricing strategies (Dubois et al., 2017) and manipulation of ingredients and nutrients to enable front-of-pack claims. In addition, policymakers should be aware of the multiple ways industry may operationalise its power to influence and slow down policy implementation through lobbying, finance, marketing, science, supply chains and waste, labour and employment, and reputational management. Therefore, rules on conflicts of interest, competition policy and lobbying should be scrutinised in order to mitigate industry action.

This report summarises the available empirical evidence on the impact of interventions in the food environment on behavioural change. Based on this evidence, we put forward the following policy elements, emphasising that these options should be taken in combination with each other to increase efficiency and effectiveness:

The economic environment and fiscal food policies

Taxes on less healthy and less sustainable foods, and subsidies or reduced taxes (like VAT) for more healthy and sustainable foods, tend to be effective, efficient and

have limited distributional effects. Relatively high prices need to be levied for change to account for the negative environmental outcomes related to meat consumption. Nevertheless, food subsidies supporting healthy diets targeted at low-income households are shown to be effective.

Theoretically, taxing inputs into agricultural production (such as feedstuffs, fertilisers or pesticides) leads to even higher efficiency. However, reaching higher efficiency depends on the abatement potential of production (i.e. the potential of greenhouse gas reduction), which may be limited. It may require a carbon tariff on imported carbon-intensive products, through border adjustment mechanisms.

Physical availability

Modest effectiveness for increasing health outcomes has been shown for improving the availability and placement of fruit and vegetables, while decreasing that of foods and beverages rich in added sugar, salt and fat, in all food environment settings ranging from specific points of purchase (retail, schools, restaurants & canteens) to neighbourhood environments. Similar results are to be expected for environmental outcomes and for the shift from meat to more plant-based foods, but evidence is limited, as too few studies have investigated these relationships. Informal and non-market food systems like urban gardens are shown to have positive health outcomes.

Governments may also directly influence physical availability through public procurement. The Farm-to-Fork Strategy proposes mandatory minimum sustainability criteria in public procurement, which may be expanded to also include mandatory minimum criteria for healthy diets. More attention should be paid to best procurement practices for healthy and sustainable food and their potential for transfer to other settings.

Food composition

The reformulation of product recipes can help improve dietary quality, but this positive effect depends on the degree to which the consumer substitutes reformulated products with other, less healthy products, and whether the reformulation is mandatory or voluntary for industry. Effective policies would require the EU to set mandatory reformulation targets for salt, added sugar and saturated fat for foods and meals sold in retail outlets, catering and restaurants. This can also be part of public procurement criteria.

The information environment

As mentioned in the introduction to this report, the Farm-to-Fork Strategy contains a lot of proposals related to the information environment. Evidence generally supports a moderate impact of nutrition labelling on (un)healthy consumption in different contexts

(retail, out-of-home). Sustainability oriented labels tend to reach those who are already motivated and interested, and they strongly depend on the trustworthiness of labels, given that sustainability cannot be directly observed by consumers. However, there is much less research devoted to sustainability labelling in comparison to nutritional labelling. To conclude, shaping the information environment through labelling is necessary but not sufficient to advance healthy and sustainable diets.

Advertisements form an important part of consumers' information environment. Most voluntary agreements on advertisement restrictions tend to focus on advertisement restrictions to children. They tend to have only moderate effects due to their narrow focus (for example, only children's programmes on TV) and due to counteracting measures (for example, lowering prices).

A recent but promising set of instruments are food apps supporting healthy and sustainable food choices in various ways. Evidence shows positive but moderate effects on fruit and vegetable consumption and diet quality. Food apps tend to work better for certain groups of consumers seeking convenience. Personalised feedback also tends to be effective in the desired direction both in relation to health and environmental outcomes. Attention can be given to non-commercial digital platforms and apps run by volunteers or non-profit organisations aimed at non-monetised sharing of food (that is not framed as potential food waste or a source of food for food banks).

The social environment

The social environment exerts a powerful influence on consumer choices and past policy examples, for example the regulation of the tobacco industry, has shown that social norms can be shifted by using a multitude of policy instruments, from taxes and advertisement restrictions to smoking bans in public spaces. In the food environment, the effect of peer influence has been shown to be successful in improving fruit and vegetable intake and limiting fast food consumption. There is evidence that influence and social norms lead to reduced meat consumption.

To conclude, given the complexity of the food system, available scientific evidence confirms that a policy mix of hard and soft measures will be needed to overcome the barriers preventing consumers from adopting sustainable and healthy diets. The current policy focus on the provision of information and education is not effective enough, and must be mixed with a range of other policy elements. Harder measures such as taxes or bans stand out as a very powerful tool to change behaviours across the food system. However, they must be combined with the policy elements presented above. Taken separately, these may seem to have moderate effects, but they offer promising outcomes if they are deployed jointly and in a coordinated manner, and monitored.

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Annex 1. Responsibilities and working structure within the Scientific Advice Mechanism

- **The Group of Chief Scientific Advisors** is responsible for developing the Scientific Opinion, which contains evidence-based policy recommendations. Four members of the Group were involved with the project (Eric Lambin, Nicole Grobert, Nebojsa Nakicenovic, and Eva Zažímalová), as well as former members Janusz Bujnicki and Carina Keskitalo. Eric Lambin was appointed as lead scientific advisor for the topic.
- **The Science Policy, Advice and Ethics Unit at DG RTD** assists the GCSA in the development of the Scientific Opinion. Lucia Selfa Aspiroz, Nicola Magnani and Leonard Engels coordinated the project.
- **SAPEA** is responsible for independently producing the evidence review report that informs the Scientific Opinion. Within SAPEA, ALLEA served as lead academy network for the topic. Céline Tschirhart, ALLEA Scientific Policy Officer, coordinated the report's development, with the support of the SAPEA team of scientific policy officers: Marie Franquin (Euro-CASE), Louise Edwards (Academia Europaea), Rafael Carrascosa Marzo (Academia Europaea), and Rúben Castro (FEAM).

To jointly coordinate the project between the three parts of the SAM, regular coordination meetings took place in different configurations. From SAPEA, the chair of the SAPEA working group, the president of the network leading on the topic, and members of staff supporting the project participated.

Annex 2. Selection of experts

Following our Quality Assurance Guidelines, we set up an interdisciplinary working group with 17 members from 11 European countries, chaired by Erik Mathijs.

The chair of the working group was proposed by the lead academy network, ALLEA, and approved by the SAPEA board after his Declaration of Interest form was assessed.

We issued a call for nominations describing the scope, timeline and expertise required. The areas of expertise were previously discussed with the working group chair, in coordination with the GCSA and the Unit. The call for nominations was sent via the academy networks to their member academies, who were invited to nominate experts. Experts were also identified through desk research by the academy networks.

The selection committee for the working group met on 8 September 2022. Following our Quality Assurance Guidelines, the Selection Committee comprised:

- the working group chair (Erik Mathijs, KU Leuven)
- the president of the lead academy network, ALLEA (Antonio Loprieno)
- the president of another academy network, FEAM (Stefan Constantinescu)
- a second subject expert (Peter Jackson, University of Sheffield, former SAPEA working group chair on sustainable food systems)

We received a total of 70 nominations for the working group. The experts were selected on the basis of scientific excellence and disciplinary requirements as a priority, taking into account commitment and time availability, the criteria set out in our Strategy of Diversity and Inclusiveness, and other requirements communicated to the committee in advance:

- inter- and multidisciplinarity
- involvement in the wider scientific community, i.e. not Fellows of academies;
- inclusion of early- and mid-career researchers
- gender balance
- wide geographical coverage, including from Widening countries

In the final working group, 70% of selected experts were female and 53% were early- or mid-career researchers. 11 European countries are represented in the group, with 1 member from central/eastern Europe, 3 from southern Europe, 4 from northern Europe and 9 from Western Europe.

The composition of the working group was approved by the SAPEA board. All working group members were required to fill out the Standard Declaration of Interest Form of the European Commission, in accordance with SAPEA's Quality Guidelines. In the assessment, no conflicts of interests were detected.

Annex 3. Evidence review process

We compiled this evidence review report based on input from the experts and their in-depth knowledge of the field, together with literature reviews conducted systematically on specific topics for chapter writing teams (see Annex 5, p. 189). A mapping of the EU policy landscape was also carried out to inform the work (see Annex 4, p. 188). In terms of data management, we commit to Open Science and FAIR principles.

The evidence necessary to respond to the question in the Scoping Paper was discussed, debated and assessed by the Working Group members at Working Group meetings, and was written up in iterative drafts of the Report. Chapter contributors also reviewed the relevant literature based on explicit methodological criteria, detailed in the relevant chapters. The literature reviewed for this report was not systematically checked for sponsorship or authors' conflict of interest statements. The authors acknowledge that systematic reviews may yield ambiguous results or more favourable outcomes in studies that were sponsored by industry or where authors reported conflict of interest than in studies where this was not the case (Bes-Rastrollo et al., 2013; Mandrioli et al., 2016).

The first consolidated draft was reviewed by external experts during an Expert Workshop, and the final draft underwent a double-blind peer review.

Timeline

September 2022	Final formation of working group
October 2022	Working group meeting
November 2022	Working group meeting
December 2022	Working group meeting
January 2023	Production of first draft
February 2023	Expert workshop
March 2023	Production of second draft Report sent to peer reviewers
April 2023	Working group addresses peer reviewers' comments Production of final draft
May 2023	SAPEA endorsement
June 2023	Publication of scientific opinion and evidence review report

Requested literature reviews

A Literature Review Team was formed, comprising the director of the Specialist Unit for Review Evidence, the manager of the European Information Service at Cardiff University, and SAPEA staff. The European Information Service was also responsible for developing an EU policy mapping, especially related to the Farm-to-Fork Strategy, to support the work (Annex 4, p. 188).

To complement their knowledge, the working group made individual requests for literature searches on:

- the Farm-to-Fork Strategy
- the role of the food environment for sustainable food choices
- drivers and interventions on household and consumer food waste
- labelling and consumer behaviour
- field experiments in supermarkets and canteens/restaurants regarding interventions to foster sustainable food choices
- political dimensions of meat consumption reduction
- organic food procurement

The search strategies can be found in Annex 5, p. 189.

The reviews were conducted systematically, based on a template completed by the working group member requesting the search. Protocols were recorded and submitted alongside the screened results, and EndNote files were retained with all the extracted results. Scopus and Web of Science were used in the literature searches, alongside further screening of grey literature and using EUR-LEX, the EU Publications Office catalogue and other databases, such as Overton and European Sources Online. The inclusion/exclusion criteria were discussed with appropriate members of the Working Group (when necessary), as well as other members of the Literature Review Team.

Expert workshop

In line with our Quality Assurance Guidelines, we organised an expert workshop on 3 February 2023 in Brussels and online (hybrid format) to discuss and review the evidence, especially:

- to tackle potential blind spots or biases of the working group
- to ensure that the scope and the scale of the evidence and the way it is provided covers the actual discussions in the stakeholder scene
- to discuss the practical applicability of the options proposed in the ERR

- to perform a critical appraisal of the evidence.

This workshop took place before the peer review process.

In order to select experts to participate, SAPEA Scientific Policy Officers compiled a list of experts that was based on previous academy and network nominations; on new suggestions by the Group of Chief Scientific Advisors. the SAM Unit and the working group; and further desk research. Experts were prioritised based on the selection criteria below and with the help of the working group chair. The list of potential experts was discussed and approved by the selection committee for the working group, and finally by the SAPEA board.

The criteria for the selection of experts for the expert workshop were:

- scientific background with applied or policy context knowledge in the field of sustainable food consumption
- complementarity of backgrounds, expertise and interests to cover topics covered in the ERR
- inclusion of early- and mid-career experts
- gender balance
- wide geographical coverage, including from Widening countries
- commitment and availability

In the final selection, 13 scientists or experts with applied knowledge in the field were invited to comment on the draft report. 62% of selected experts were female, and 23% were early- or mid-career researchers. 9 European countries were represented in the group, with 1 member from eastern Europe, 1 from southern Europe, 2 from northern Europe and 9 from western Europe.

Other participants included members of the working group, as well as a group of observers composed of SAPEA representatives, members of the Group of Chief Scientific Advisors, and staff of the European Commission.

The expert workshop followed an established format with the Chatham House rule applied to the entire workshop. Participants had received a draft confidential copy of the report in advance of the workshop. After a general introduction to the report, a keynote speaker presented an overall assessment of the report, with initial observations on strengths, possible limitations and gaps. Each of the main chapters was then introduced, followed by feedback from an invited discussant and then an opportunity for open discussion. The discussions helped to refine the draft evidence-based policy options in the report, to ensure they have practical implications for real-world scenarios on timescales that are relevant for EU policy development.

After the workshop, members of the working group considered the feedback and agreed on the actions that should be taken to address it. The draft evidence review report was then revised prior to undergoing formal peer review.

The expert workshop report is published separately, as a companion document to this report, and is available on the SAPEA website.[1]

Peer review

In line with our Quality Assurance Guidelines, we followed a double-blind peer review process. ALLEA, the lead network for this report, established the areas of expertise needed for peer reviewers based on the draft report, namely trade and economy, health, social sciences, and consumer behaviour.

The partner network Euro-CASE compiled a list of experts based on previous academy and network nominations, on new suggestions by the Group of Chief Scientific Advisors and the SAM Unit, and further desk research. Euro-CASE suggested a list of experts to the SAPEA noard based on the areas of expertise defined by ALLEA, complementarity of expertise, expertise that included a broad overview of the field rather than indepth knowledge in a narrow field, taking into account gender and geographical balance, and inclusion of early and mid-career experts. Euro-CASE performed an internet screening for major conflicts of interests from the potential peer-reviewers. The SAPEA board, excluding ALLEA, gave the final approval for the list of peer reviewers to be invited.

Following these directions, three reviewers accepted the invitation. Of these reviewers, 2 are female, 1 is an early- or mid-career researcher. 2 are from northern Europe and 1 from north America.

Responses were received in March 2023, anonymised by Euro-CASE and then shared with ALLEA and the working group. Members of the working group reviewed the responses and agreed on the actions that should be taken to address them. The draft evidence review report was then revised.

Revisions following peer review

Peer reviewer comments were overall positive. They found that the report satisfactorily addressed the questions posed in the scoping paper, that the literature cited was up-to-date (and several additional literature sources suggested by peer reviewer were incorporated into the text by the working group), that arguments advanced in the report showed the requisite degree of analytical rigour, that conclusions and policy options were

1 https://sapea.info/topic/food-consumption/

well supported by the scientific evidence, and that there were no signs of biases or undue influence from individuals or interest groups.

Overall, peer reviewers highlighted two points that may be strengthened:

- the socio-cultural dimensions of food consumption
- the power dynamics and interests within the food system that influence food consumption

In response, the working group strengthened these aspects in the text where relevant, to better reflect the relation between policies, norms and conventions, and adding scientific evidence on the effects of power dynamics on food consumption. The working group also acknowledged that given the timeframe for the report, some aspects cannot be dealt with in too much depth.

Additional adaptations following peer review comments included:

- emphasising the reasons for the choice of the COM-B model
- adding information on the roles of industry, both in the potential positive feedback loop with innovation resulting from changing consumer diet, and in the capacity of industries to slow down policy implementation
- adding a note that the reviews carried out for the report were not systematically checked for sponsorship or authors' conflict of interest statements

Further comments from reviewers suggested minor changes. In response, information was provided by the working group to the following areas:

- systemic violence as a driver of food insecurity
- digitalisation (apps and potential impact on sustainability)
- commercial determinants of health
- out-of-home consumption
- the case of Chile
- organic meat and meat policy interventions
- policy instruments for organic production
- the food and nutrition security dimensions in relation to food system outcomes

After the reviewers' comments were addressed by the working group, the peer reviewers' responses, the working groups' rebuttals and actions were sent to the SAPEA board which approved the outcome of the peer review process.

Plagiarism check

In accordance with the Quality Assurance Guidelines, a plagiarism check on the main report was run by Cardiff University using Turnitin software.

Publication

This evidence review report will be handed over to the Group of Chief Scientific Advisors on ~date. At the time of writing, it is planned to publish in June 2023, along with the Advisors' scientific opinion.

The main report will be accompanied by two parallel documents: one expert workshop report, and one policy landscape mapping. All documents can be accessed on the SAPEA website.[2]

2 https://sapea.info/topic/food-consumption/

Annex 4. Policy landscape summary

A separate policy landscape document was developed for the working group and the Group of Chief Scientific Advisors. It provides an overview of some of the main areas of action at EU level regarding sustainable food consumption. The main aim is to identify legal acts and preparatory documents relevant to understanding policy development. It also seeks to highlight some of the trends and challenges found in the policy documents over the years.

This document shows how legislation on foodstuffs emerged from the need to harmonise national rules to establish an internal market and free movement of products. Concerns over product safety, public health and consumer protection were apparent from an early stage. In this context, consumer information became particularly relevant in legislative initiatives adopted over the years. Wider trends of EU integration also influenced relevant legislation. At the turn of the 21st century, legislative consolidation and simplification was a clear focus of the European Commission, as were new topics such as sustainable development. The intersection of foodstuffs legislation with environmental considerations became more frequent and explicit over the last few years. The European Green Deal, adopted by the European Commission in December 2019, sought to embed environmental and climate action across all policy fields, in an attempt to create synergies.

The backbone of this policy landscape is therefore the Farm-to-Fork Strategy and associated actions. This approach was informed by the scoping paper and additional guidance provided by the European Commission's SAM Unit. The drafting of this document also took into account the work carried out by the working group and some of the main aspects of the evidence review report. While the core of this narrative developed around the actions put forward by the Farm-to-Form Strategy, other action plans and policies are still mentioned in passing whenever mentioned explicitly by the main policy documents or otherwise deemed relevant.

The narrative developed from text analysis of legal acts and preparatory documents published by the co-legislators of the European Union. Particular focus was provided to preparatory documents made available by the European Commission, as the sole institution with the power of legislative initiative. Research was carried out using the EUR-LEX database, the EU's main official resource of legislative information. Policy texts were screened for context and hints to other relevant policy documents. Search terms used for other literature reviewing work in the framework of the evidence review report were used to search in the text. EuroVoc keywords were also used to search the database.

The full document can be found on the SAPEA website.[3]

3 https://sapea.info/topic/food-consumption/

Annex 5. Literature search strategies

SAPEA supports open and transparent science practices. The following search strategies were designed in response to requests for literature reviews made by members of the working group. The strategies show the date of the search, sources searched, keywords and date limits (if applicable). 'N' shows the number of potentially relevant results that were scanned. Where multiple sources have been searched, a deduplication process has taken place.

Farm-to-Fork Strategy

Nature of search: An initial search on the policy landscape relating to the Farm-to-Fork Strategy, subsequently updated (see Annex 4, p. 188)

Date: 2020 – October 2022

Sources: Scopus and Web of Science

TITLE-ABS-KEY ("farm to fork" AND strateg* AND europe*)

Number relevant = 85

The role of the food environment for sustainable food choices

Nature of search: The role of food environment for sustainable food choices, in the context of neighbourhoods, retail outlets, food deserts

Date: 1999 - November 2022

Source: Scopus

TITLE (food AND (environment OR desert OR equal* OR outlet*) AND (neighbo* OR loca* OR rural OR urban* OR swamp*)) AND PUBYEAR > 1999 AND (LIMIT-TO (DOCTYPE , "re")

Number retrieved = Not reported
Number relevant = 35

TITLE (food AND (environment OR desert OR swamp* OR equal* OR outlet*) AND (neighbo* OR loca* OR rural OR urban*) AND review*) AND PUBYEAR > 1999 AND PUBYEAR > 1999

Number relevant = 21

Source: Web of Science

food AND (environment OR desert OR equal* OR outlet*) AND (neighbo* OR loca* OR rural OR urban* OR swamp*)

Title Search + Reviews

Number relevant = 26

Source: healthevidence.org

food AND (environment OR neighbourhood OR outlet* OR desert* OR swamp*) AND (diet* OR choice OR consum*)

Date: 2018 - November 2022

Number relevant = 6

Date: 2000-2017

Number relevant = 3

Source: Epistemonikos.org/Scopus/Web of Science

food AND (environment OR neighbourhood OR outlet* OR desert* OR swamp*) AND (diet* OR choice OR consum*) AND ("meta-analysis" OR "meta analysis" OR "systematic review")

Date: 2018 - November 2022

Number relevant = Epistemoikos 40; Scopus 14; Web of Science 12

Date: 2000-2017

Number relevant = Epistemoikos 13; Scopus 5; Web of Science 2

Source: Medline/PubMed

Food AND (environment OR neighbourhood OR outlet* OR desert* OR swamp*) AND (diet* OR choice OR consum*) AND (meta-analysis OR meta analysis OR systematic review)

Limited to title [also AND meta-analysis.pt in Medline]

Date: 2018 - November 2022

Number relevant = 11

Date: 2000-2017

Number relevant = 4

Nature of search: Drivers of consumer and household food waste, and interventions and other levers to mitigate it

Date: [Start date not reported] - 18 November 2022

Source: Scopus

TITLE (("food waste" OR "food loss" AND (house* OR home* OR domestic OR consum* AND (LIMIT-TO (DOCTYPE , "re"))

Number relevant = 30

Source: Epistemonikos

Number relevant: 1

Labelling and consumer behaviour

Nature of search: To what extent food labelling and certification impacts consumption behaviour.

Date of searches: 2018 - November 2022

Source: healthevidence.org

((food OR nutrition) AND (label* OR certificat* OR "health warning"))

Number relevant = 22

Source: Epistemonikos.org

((food OR nutrition) AND (label* OR certificat* OR "health warning")) AND ("meta-analysis" OR "meta analysis" OR "systematic review")

Number relevant = 6

Source: Scopus

((food OR nutrition) AND (label* OR certificat* OR "health warning")) AND ("meta-analysis" OR "meta analysis" OR "systematic review"). Limited to title only.

Number relevant = 15

Source: Medline

((food OR nutrition) AND (label* OR certificat* OR "health warning")) AND (("meta-analysis" OR "meta analysis" or "systematic review").tw OR meta-analysis.pt)) Limited to title other than meta-analysis.pt.

Number relevant = 15

Source: Scopus

TITLE-ABS-KEY (consum* AND behavio* AND (label* OR certifi*) AND food AND (organi* OR nutri* OR "animal welfare" OR "fair trade" OR "traffic lights"))

Reviews only

Number relevant = 38

Merged and deduplicated results set from the searches above = 54 potentially relevant reviews

Field experiments in supermarkets and canteens/restaurants regarding interventions to foster sustainable food choices

Nature of search: Evidence from field experiments in supermarkets and canteens/restaurants regarding interventions to foster sustainable food choices

Date: 2002 - December 2022

Sources: Scopus & Web of Science

Title + Abstract

food AND (field OR experimen* OR observ* OR test* OR investiga*) AND (supermarket* OR canteen* OR restaurant*) AND (interven* OR instrument* OR nudg* OR pric* OR label*) AND (sustainab* OR climate OR organic* OR biodivers* OR water OR "animal welfare" OR climate)

Number relevant = 67

Political dimensions of meat consumption reduction

Nature of search: What worked or could work politically to reduce meat consumption

Date: 2013 - January 2023

Source: Scopus & Web of Science

Title only

meat AND (consum* OR reduc* OR curtail*) AND (stakeholder* OR government* OR polic* OR politic* OR regulat*).

Number relevant = 14

Organic food procurement

Nature of search: Organic food and public procurement

Date: 2010 - February 2023

Source: Scopus & Web of Science

Title only

(Organic [within two words of*] (food OR procurement OR kitchen* OR catering OR agriculture) AND (policy OR "action plan" OR strateg* OR guideline* OR legislat* OR "public kitchen" OR "public sector"))

Number relevant = 13

[Search syntax for 'within two words of' for Scopus is W/2 and for Web of Science is NEAR/2]

Annex 6. Acknowledgements

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Working group

The names of the working group members who wrote this report are on p. 8.

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- Leonard Engels

SAPEA is part of the European Commission's Scientific Advice Mechanism, which provides independent, interdisciplinary, and evidence-based scientific advice on policy issues to the European Commission.

This Evidence Review Report informs the Group of Chief Scientific Advisors' Scientific Opinion on the topic.

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