VALUMICS
Food Systems Dynamics

Food consumption behaviours in Europe

Mapping drivers, trends and pathways towards sustainability

Imprint

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Acknowledgements

We would like to thank the VALUMICS partners and stakeholders for their valuable feedback, ideas and contributions to the development of this report.

This publication has been produced with funding from the European Union within the project Valumics: Food Systems Dynamics. The content of this publication is the responsibility of the authors, and cannot be taken to reflect the views of the European Union.

Nicolau, M., Esquivel, L., Schmidt, I., Fedato, C., Leimann, L., Samoggia, A., Monticone, F., Prete, D.M., Ghelfi, R., Saviolidis, M.N., Olafsdottir, G., Sigurdardottir, H., Aubert, P.M., Huber, E., Aditjandra, A., Hubbard, C., De, A., Gorton, M., Řechura, L., Bogason, G.S., Brimont, L., Odene, J. & Schamari, D. (2021). Food consumption behaviours in Europe. Mapping drivers, trends and pathways towards sustainability. VALUMICS project.

DOI: 10.5281/zenodo.5011691

Wuppertal 2021

Valumics: Food Systems Dynamics project received funding from the European Union's Horizon 2020 Research and Innovation Programme, under grant agreement no. 727243.

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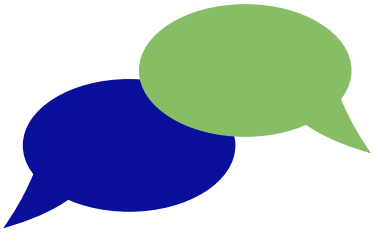
Food Systems Dynamics

Contents

Highlights

Key Insights

- Food consumption behaviours result from a combination of drivers, but it is possible to identify the drivers that seem to influence consumers the most.
- Price as a key driver of food purchasing behaviour. Behaviours do not seem to be necessarily driven by the cheapest price, but price considerations count among the main determinants of purchasing decisions.
- The social context and habits also have a considerable influence in food consumption behaviour. It stood out how the eating habits of the family or other social contexts around the individual are important in shaping food purchasing behaviour.
- Health concerns may function as a sustainability opportunity or barrier depending on the context. Health was identified as playing an increasingly important role in shaping food consumption behaviours.
- Environmental awareness exists but is not top of the list, as other factors seem to take precedence, such as price considerations, lack of time and food shopping habits. The actual sense of environmental awareness with regards to food consumption among most consumers was identified as being low or inexistent.
- Sustainability trends are developing over time, including veganism and vegetarianism, local consumption and slow food movements, but have a limited impact in the mainstream food industry. It is important to foster ways to boost their scalability.
- The structure of current food systems is not oriented towards sustainability. Most farmers and manufacturers perform for years within a “conventional” food production and consumption system, in which there are nearly no incentives for changing the direction of focus.



Experts pathways towards sustainability

The expert interviews conducted as part of this report enabled a dialogue about potential pathways towards more sustainable food consumption practices. The following suggestions were put forward by stakeholders:

Increase the role of consumers and strengthen relationship between consumers and producers in food systems: according to the interviewees, solution pathways would include fostering a stronger communication channel between producers and consumers, with the potential for increasing the resilience of food value chains.

Develop a regulatory framework for sustainable food consumption: according to the interviewees, solution pathways would entail the need for regulations and incentives that puts sustainability among the top priority of food systems.

Use behavioural insights to inform policy making on sustainable food consumption: several stakeholders consider that the public sector also has a role to play in driving sustainable consumption, including with regards to interventions targeting the demand side. In the same direction, some stakeholders also raised the importance of developing sustainable food consumption policies based on behavioural evidence rather than driven by assumptions only.

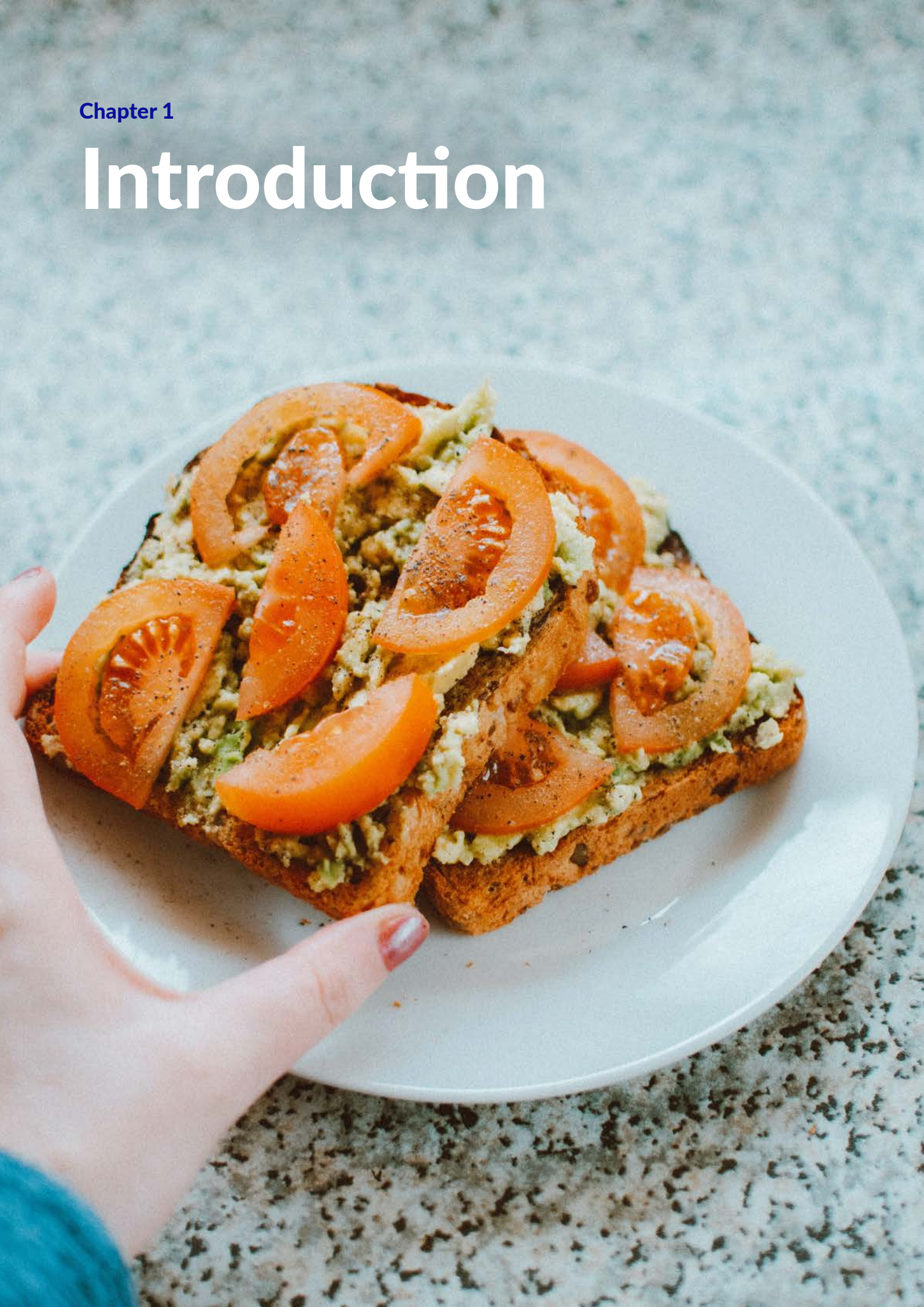
Foster business demand for sustainable food supply: according to the interviewees, retailers would also have an important role to play in the sustainability transition, due to their negotiation power in the whole food system.

Start at the local level: solution pathways for sustainable food consumption should involve local authorities as directly interested parties with potential to provide test beds for future European policies.

Enable work-life balance: experts also highlighted the need for policy and innovation to help people achieve a better work-life balance, thereby allowing individuals to have more time to plan their meals and engage meaningfully with their own food consumption.

Chapter 1

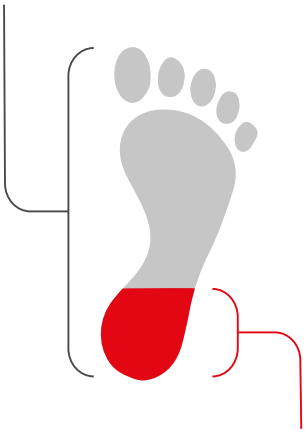
Introduction



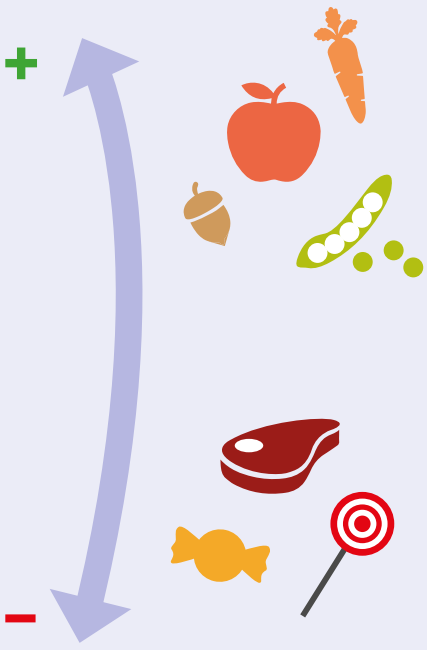
It is increasingly recognised that changes in consumption patterns and lifestyles are a critical and integral part of addressing climate change [1] and wider sustainability, including also its social challenges [2]. This is particularly true when it comes to food consumption behaviour in Europe. Eating and food purchase patterns have been known for years to account for at least 25% of the already oversized average carbon footprint of a European [3], with the consumption of meat and dairy products accounting for most of these environmental impacts [4]. There is also growing concern that current mainstream consumption patterns contribute to unfair trading practices in food value chains across European countries, an issue that is currently under the spotlight within the EU [5]. Other food consumption related impacts are equally important, such as implications for human health [6] or working conditions in food production outside Europe.

In order to achieve food consumption change, it is crucial to better understand the contexts and motivations behind consumer behaviour and how this relates to other food value chain parameters. Only on this basis can one begin to explore the design and implementation of effective interventions, policies and other strategic action plans that consider and reflect consumers actual behaviours.

Material footprint of a European person



Food consumption accounts for at least 25% of the average material footprint of a European person



VALUMICS as a project takes the EAT-Lancet Commission Summary Report [7] as a basis for understanding and defining future targets for sustainable food consumption in Europe. The report states that in order for the global population to be sustainably healthy by 2050, the global consumption of fruits, vegetables, nuts and legumes should double, and consumption of foods such as red meat and sugar should fall by more than 50%. A diet rich in plant-based foods and with fewer animal-source foods confers both improved health and environmental benefits. For a more complete picture concerning the sustainability attributes of food consumption, it is important to add a socioeconomic dimension to the health and environmental components. In this sense, sustainable food consumption also comprises consumption of food that supports fairness in food value chains (FVCs) both in Europe and beyond. Sustainable behaviour means behaviour that minimises the negative impact of one's actions on the physical, social and economic environment [6].

This is exactly the purpose of this report, namely, to support the decision makers in European food value chains to prioritise the most promising intervention points for fair and sustainable food consumption by:

- deepening the understanding of the drivers of food consumption behaviours of European consumers – in other words, why European consumers buy food the way they do
- investigating consumption patterns and trends, at the consumer level, towards more sustainable food consumption in Europe
- initiating a discussion and exchange on existing and new action plans driven by different actors in support towards more sustainable food consumption and in this light discuss related potential barriers and opportunities.

What is this report about?

Research today is increasingly focusing on food consumption in Europe generating and providing a rich overview of the factors and drivers that affect consumers' consumption decisions and patterns. Building on existing knowledge in a pragmatic and solution-oriented way, the originality and innovative contribution of our work consists in:

- **Prioritising drivers of consumption behaviours:** In light of several existing studies analysing single drivers of food consumption behaviour in specific contexts, VALUMICS has sought, on the basis of secondary and primary data collection and analysis, to distil emerging patterns and principles, and to prioritise the main drivers of food consumption behaviours in Europe within a range of countries and food product categories.

- **Conceiving the consumer in interaction with food value chain stakeholders:** Placing the consumer within food systems allows us on the one hand to investigate how consumers play a role in driving sustainability in food value chains, and how they potentially influence other actors. On the other hand, it provides a holistic and integrated view of consumer behaviour. This is a prerequisite for addressing behavioural change not by targeting the consumer in isolation, but rather by understanding that behaviours are also shaped by social norms, physical environments, opportunity and capabilities – factors in which policymakers, food producers, retailers, farmers' associations and others may well have a role to play.

- **Contributing to the empirical evidence base:** Our work in this report combines analysis of secondary data and primary data collected through consumer focus groups and multi-stakeholder expert interviews across several European countries. Accordingly, consumer focus groups and a total of 38 semi-structured expert interviews were conducted across various stakeholder groups operating in Iceland, the UK, Italy, France, Germany, and the EU, including policymakers, businesses, consumer organisations, NGOs and academia. The outcomes and insights resulting from the interviews are presented in the preceding section and in the form of quote bubbles throughout this report.

This report is the first in a series of VALUMICS outputs especially dedicated to food consumption analysis. Reports following this one look into successful interventions for sustainable food behaviour, multi-stakeholder recommendations towards more sustainable food consumption, and food retailer interventions to support this shift.

Content of this report

Chapter 2 summarises the key gathered insights on food consumption behaviours in Europe in general, collected mainly through the focus groups conducted by the project.

Chapter 3 and sub-chapters dive deeper into consumption behaviours in the context five food product categories: beef, dairy products, salmon, tomato and bread. Each thematic chapter presents the landscape or context in which food purchasing behaviour takes place, the key drivers that lie behind such behaviour, main trends and barriers identified in that area that can be linked to more sustainable lifestyle and behaviour, and a preliminary discussion on how a sustainable vision in the sector might be achieved. These chapters (in conjunction) discuss findings both at the European and selected country level with data relating to Iceland, the UK, Italy, France, Germany and Czech Republic, and also provide some further insights relating to other European countries when relevant.

The report ends with **Chapter 4** providing an overview of main outcomes of the report.

The overall goal of the VALUMICS project is to provide European decision makers with a compre- hensive suite of approaches and tools to evaluate the impact of policies and strategies for enhancing the resilience, integrity and sustainability of food value chains in Europe. Contributing to the project goal this report is the first in a series of VALUMICS outputs especially dedicated to food consumption analysis. Reports following this one look into successful interventions for sustainable food behaviour, multi-stakeholder recommendations towards more sustainable food consumption, and food retailer interventions to support this shift.

Report 3
"Behaviour change interventions for more sustainable food consumption"
coming soon

Report 4
"From intention to action"
coming soon

Chapter 2

Insights about food consumption behaviour in general

The following section provides an overview of the main results stemming from the focus groups conducted in 4 European countries, namely, the UK, Germany, France and Italy. The goal of the VALUMICS consumer focus groups was to gain further insight into food consumption behaviours. In order to go "beyond the surface", especially in view of the limited time to be spent with the participating consumers, the key topics explored in the focus groups were narrowed down to specific aspects within food consumption behaviours and to specific product categories. In this sense, we aimed at better understanding the underlying motivations, perceptions and opinions that drive behaviour in view of current food shopping patterns of participants, as well as the barriers and opportunities that hinder or support more sustainable food consumption behaviours, particularly in view of food environmental impacts and fairness issues related to food consumption.

The focus groups brought together approx. 40 consumers in each target country. Each group was relatively homogeneous in terms of household income level (with a diverse representation of income levels across groups), but diverse in terms of: types of food eaten (e.g. vegetarians/vegans and non-vegetarians/vegans), level of environmental awareness, level of health awareness, food price consciousness, age, household composition, education level and gender.

2.1. Purchasing drivers, values and bahaviour

The main reasons for concrete food purchasing behaviour were found to be very similar across all countries. For example, the **eating habits of the family** and the **person in charge of food shopping** are everywhere decisive for the purchases. **Health**, **price** and **accessibility** also play a role.

One interesting common feature was the dominant presence of two environmentally relevant topics in all countries: on the one hand, the **avoidance of plastic waste** and, on the other, the **regionality** of products. In all focus groups in all countries, plastic was an important topic of discussion and, from an ecological point of view, was often more important to consumers than organic food. What is interesting here is that consumers expect retailers to take responsibility for ecology and social issues and to make a corresponding preselection.

What is particularly interesting, however, is the subtle differences that emerged, especially in the discussions, because this is where the respective cultural focal points became clear. While in the UK family habits, price and loyalty to certain brands play a major role and therefore a combination of factors is more decisive, in France health is the all-dominant driver and determining factor for the composition of the shopping trolley. Although health plays a role in all four countries, the French stand out in this regard. In Italy, the situation is somewhat different: Italians are mainly concerned with taste as well as traditional, seasonal and regional foods, above all from their home region. Nostalgia and tradition are important keywords here. In Germany, availability and local retail structures are very important. Even if many other factors also play a role (e.g. family habits, health and price), the shops found in the residential area are are preferred for convenience reasons.

In this sense, although basic conditions such as price and habit always play a decisive role, specific national and consumer group features are decisive indicators of where interventions for a more sustainable food consumption should start where the respective consumer group can be picked up emotionally and culturally.

When it comes to actual ecological and social behaviour, VALUMICS identified also country-specific differences among countries. In France, many organically produced (labelled) products are bought, mainly for health reasons, as organic products are perceived as healthier. In Germany, possibly because of their lack of availability or high prices, these products are bought less. In Italy, a minority of consumers stated to be vegetarian or vegan, but emphasis was placed on regionality and seasonality. In the UK, ecological and social aspects hardly play a role in shopping. Here, the government is expected to take care of these issues.

2.2. Main barriers to sustainable food consumption

Among concrete obstacles to more sustainable consumption, **lack of knowledge**, excessively **high prices** and the **lack of access** to certain food products crystallize as relevant barriers in all countries.

Above all in the UK, there is also a strong fundamental **distrust** of companies and seal initiatives. In addition, all nationalities somehow distrust the supposedly ecological organic consumer, who is described either as "feels as if he was something better" (UK) or as a "fun brake" (Italy). In Germany, the sustainable shopper is considered **unrealistic** for everyday life and is accused of inconsistency (for example, when everything is bought ecologically but non-regional coconut milk is still in the shopping cart). For German focus groups participants, a strong need for freedom of consumption became apparent, for example in the refusal to cook according to the contents of a regional organic box.

How to overcome such barriers, particularly as there are people in every country who have already overcome these obstacles and are already consuming more sustainably? It is, therefore, worth taking a closer look at what is different about this group of consumers. In all countries, a strong **personal trigger** seems decisive for change, be it one's own children and the concern for their future, direct experience of animal suffering, or meeting convinced and convincing advocates of new eating habits. Some people, on the other hand, were able to overcome boundaries for reasons far removed from sustainability. For some vegans, for example, this might be their own health (e.g. in Germany). In Italy, a longer journey and other circumstances are accepted in order to obtain tasty products from the consumers' own region of origin. In France, more expensive organic products are purchased, also for health reasons.
In this context, fostering a personal trigger for behavioural change may be among the crucial factors enabling more sustainable food consumption behaviour.

2.3. Entry points to design behavioural interventions

What we can infer from these findings for the design of interventions to promote more sustainable food consumption?

- **Knowledge:** Knowledge about sustainable consumption generally seems to be too complex and too multi-layered for consumers to really consider it in their everyday shopping. For this reason, it is essential to make information available simple and directly at point of sale through a reliable and trusted source.

- **Price:** Here, too, clear relationships must be created: If more sustainable products are significantly more expensive, they lose their attractiveness. At the very least, the price difference in comparison to conventional products should not be too large. Additionally, the disclosure of true costs, in the sense of a second price tag for conventional products comprising of external costs related to the product's negative impacts, could be helpful (e.g. the price of CO2 emissions from meat).

- **Everyday compatibility:** The integration of purchasing into the tight time-frame of everyday life is an important factor. Direct availability and ease of handling (e.g. deposit glass bottles), therefore, play an important role. Why not combine local retail structures so that conventional, ecological, unpacked and regional offers can be directly addressed together?

It is also interesting to note that in all countries of study there are some strong brands that have won the trust of consumers and that also create a certain emotional bond. In France, for example, this is "C'est qui le Patron" or in Germany the Demeter label. These brands can also act as strong ambassadors and strengthen the idea of sustainability as a social norm. It is important to point out once again the dominant subliminal cultural reasons for shopping highlighted above, which can represent starting points for personal triggers of sustainable consumption. In this sense, sustainable consumption can be associated to country specificities and values, e.g.:

- In Italy, taste and the nostalgic link to local, traditional products.
- In Germany, the strong desire to have all sustainable services available in the immediate vicinity.
- In France, health.
- In the UK, the expectation that the government should start initiatives and give consumers security and credibility.

A summary: Country-specific insights on food consumption behaviours

UK

- UK focus groups participants were generally driven by family, personal health and price concerns.
- There is widespread mistrust of organic products.
- There was relatively little (if any) knowledge or consideration about fairness among participants, except for two participants – a young vegan and a new parent who thought about reasons behind veganism and children's wellbeing when shopping.
- A few were knowledgeable about "fair for farmers" initiatives, but acknowledged other factors were typically more salient (habit, family, brand quality, offers, lifestyle, etc.) when shopping.
- Participants acknowledged that they were price sensitive when shopping for food.
- Many (at a least a couple of participants from each focus group) were mistrustful of brands, corporations and supermarkets generally, regarding that they employ deceptive or manipulative practices to influence consumer behaviour.
- Fairness was associated with participants' own concerns (e.g., health, convenience, price) and locally produced food, while ecological awareness was limited to plastic packaging and food miles. Generally, it was felt that fairness and sustainability were the responsibility of the government and producers rather than consumers.
- None of the milk products labelled as organic presented to the participants was selected. The main argument was that such products were 'ripping off' consumers or 'a way of charging more'. The most common milk chosen in the selection task was standard, supermarket branded, e.g. Tesco. This product has a 'fair for farmer' label but participants did not pick the milk for this reason: their purchase was based rather on habit and convenience.
- Some participants opposed the idea of 'fair for farmer' schemes on the basis that farmers receive subsidies. However, one participant, who had previously visited farms and had a relative who worked on one, was far more positive.
- It also came across that participants generally have little knowledge regarding the environmental impact of food choices and what fair(er) shopping means or which products would be best to purchase (for both the environment and farmers).

Italy

- Sustainability as a concept, interpreted as community and social sustainability, is a key driver.
- Taste is a key driver of food consumption. Thus, sustainable food should taste as good as conventional food.
- Seasonality is a concept related to healthy diet.
- Price is a key driver of food purchasing. Consumers aim for low prices or promoted prices. Thus, sustainable food should be sold at the same price as conventional prices.
- Family food habits and preferences drive food selection.
- Trust in familiar corporate brands and retailers is a recurrent topic.
- Lack of trust in organic certification labels is apparent among Italians.
- Fairness is a multidimensional concept. There is no common agreement on what is "fairness". It mainly includes fairness of prices towards local community producers and animal welfare. Many consumers believe food products are bought from producers at a fair price. They do not think of this strictly as fairness.

France

- Health is the single most important factor driving food consumption choices, across all socio-economic and age categories. It motivates the vast majority of consumption shifts reported by participants and is the main reason expressed for purchasing organic products. Even for consumers who are insensitive to ecological concerns, health benefits therefore provide an essential gateway to promote more sustainable consumption choices.
- A majority of participants welcome the recent "democratization" of organic products through the decreasing price differential with conventional products and their presence in mainstream supermarkets. Price and accessibility are, therefore, key factors in gaining further consumer groups, especially as they help change perceptions around sustainable products. This does not mean that all sustainable products must be cheap, but that multiple product ranges (low-end to high-end) are a pertinent strategy to appeal to various consumer groups.
- Faced with a cacophony of potentially contradictory information and messages, many consumers doubt the trustworthiness/feel reticence towards organic products (and food products in general). This element of doubt can inhibit the realignment of food consumption habits. It also often limits the purchase of organic products to occasional selections ("just in case") to keep a "good conscience".
- Conversely, "fair" products are positively perceived by consumers from all socio-economic categories. The disconnect between perceptions and presence in consumers' shopping baskets is often justified by a lack of practicality/accessibility.
- Participants have divergent conceptions of "sustainable" and "ecological" consumption, both among themselves and in relation to the "expert" definitions. For example, "ecological" was often associated with a lack of plastic packaging or with local origin: the prevalence of these subjects in the general discourse indicates that it is a significant point of concern for consumers and should therefore invite a strategic response from retailers and processors.

Germany

- The German participants in the focus groups were generally quite knowledgeable about ecological and fairness issues in food supply chains. Besides food consumption patterns as such, a very dominant issue in the German focus groups was plastics packaging. Also, regionally or even locally sourced food seemed important – for ecological as well as fairness reasons.
- Participants insisted that sustainable behaviour still had to fit into their daily life routines and habits, mainly due to time pressure related to family and work. Many wanted convenient offers nearby that would make it easier for them to follow a more sustainable diet. Also, price concerns were raised and some participants showed a limited willingness to pay more than for conventional alternatives.
- When analysing the main drivers of food consumption behaviours of the German focus group participants, the following key conclusions can be distilled:
  - People valued most highly the general diet they followed and their personal tastes and habits, together with health and price.
  - They would select regional rather than organic products.
  - They would select less packaged products rather than organic products.
  - They would opt for the conventional product if the alternatives were not offered close to home or work, or any inconvenience was involved in purchasing them.
- Taste, food quality, and habit are all challenging to change – for example, a convinced meat consumer is not likely to switch to a vegetarian or vegan diet, but can perhaps be brought to reduce meat and dairy product consumption or to find more sustainably produced products. This is also a major conclusion for the design of potential interventions: The German participants tended to be very strict regarding a consistent and consequent behaviour. Either they wanted people to consume food completely sustainably or rather not, if this was not possible. Making a sustainable food consumption more fun, convenient, and open towards trial and error could therefore be a recommendable approach. Also, current windows of opportunity – such as children who demand a responsible consumption behaviour from their parents or the raising awareness of health issues – could be used as triggers for change.
- The proportion of vegetarians and vegans in the FG was surprisingly high – maybe due to the over-presence of young people (20-29 years of age) or because of a certain bias related to the topic of the study.

Chapter 3

Insights about food consumption for key product categories

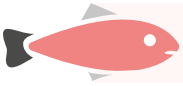
By means of an extensive research across the most relevant reviews and databases, insights on consumer food purchasing behavioural patterns as well as further contextual factors were collected for the following product categories: beef, dairy products, salmon, tomatoes and bread. With regard to the geographical scope, the work aimed at understanding behaviour at both European and national levels, the latter including Germany, the UK, France, Italy, Iceland, and the Czech Republic.

The search for relevant information focused on scientific articles published between 2000-2019 both in English and in the various national languages. Besides scientific articles and databases, the collection of secondary data included grey literature – factsheets, commercial market research, reports from national institutes, action plans, news articles, and other databases information. The reason for including grey literature was to gather as much insightful information on food consumption behaviours as possible.

A conceptual outline (please see below) was developed in close collaboration with project partners and used as a basis to analyse existing literature and guide the primary data collection conducted for this report. The outline assembles the main components used to map and understand mainstream food consumption and purchasing behaviour, namely the landscape and drivers of behaviour, emerging sustainability trends, and barriers to more sustainable food consumption.

Beef consumption → *page 23*

Dairy consumption → *page 32*



Salmon consumption → *page 41*

Tomato consumption → *page 53*

Bread consumption → *page 63*

Conceptual outline

Landscape:

Characterisation of food purchasing behaviour, through aspects such as how much is consumed over time, what are the consumption patterns of different groups, and where does the behaviour takes place.

Drivers of behaviour:

Factors / driving forces that contribute to the occurrence of a specific behaviour. The following clusters of behavioural drivers were investigated:

Food attributes: Properties and characteristics of food, including nutrients, fibre, energy values, specific substances such as sugar, its preparation/production and appearance. Drivers in this cluster include sensory perception (taste, smell, look), packaging, quality, health aspects, country of origin, convenience and sustainability attributes.

Personal factors: Psychological and relational characteristics of the individual that influence food choices. Drivers in this cluster include values, habits, education, trust, emotions, identity, lifestyles, and skills/ability.

Social context: Relationships in which people are embedded that influence food choices. Drivers in this cluster include family structure, culture and traditions, social identity and social norms.

Environment and physical context: The physical environment and ways in which people make food choices within particular environments [8]. Drivers in this cluster include place of purchase, infrastructure, space, service provision, safety, display of products and accessibility.

Economic and marketing factors: The overall process of product promotion, selling and related strategies. Drivers in this cluster include price, marketing and advertising, information, product placement, choice editing and promotions.

Policy measures: The area of public policy concerning how food is produced, processed, distributed, and purchased. Drivers in this cluster include legislation and regulations, fiscal measures, taxes, guidelines and voluntary agreements.

Trends:

New manifestation of sustained change within an industry sector, society, or human behaviour. In this context, we looked specifically into sustainability trends related to food consumption behaviours.

Barriers:

Aspects preventing more sustainable consumption behaviour in the food product categories studied. By understanding such barriers, it is also possible to better plan intervention strategies.

Snapshot of key findings and insights per product category

Beef consumption

Landscape

- Despite still eating large quantities of meat, the average European has been eating both less beef and less meat in general in the past few years, and this downward trend is expected to continue in future, with beef consumption in the EU gradually declining from 11 kg per capita in 2018 to 10.4 kg per capita in 2030.
- Beef consumption tends to vary across different consumer segments in Europe: men tend to consume more than women, higher income is often connected to a higher consumption of beef, but not in all selected countries. The influence of age on beef consumption varies from country to country.
- In Europe meat is generally sold rather cheaply and often as meat products in supermarkets and discounters.
- In order to achieve a healthy and sustainable diet for humans and the planet, beef consumption should be reduced by more than 50%, especially in developed countries, and should not exceed an average of 7g/day/cap., which accounts for a quarter of current average beef consumption in Europe.

Drivers

- The main drivers influencing beef consumption across Europe are economic and marketing factors (mainly price), food attributes (mainly health aspects, and also sensory attributes and quality) and personal factors (for example preferences, habits and socio-demographic background).

Trends & Barriers

- Various trends in meat consumption are emerging; these are expected to push fresh meat consumption further downward:
- Changing dietary patterns with a shift towards more plant-based proteins and an increasing number of flexitarians, vegetarians and vegans, especially among younger consumers.
- The increasing importance consumers attach to the origin of meat and how it is produced (i.e. organic methods, conforming to animal welfare standards), and preference for quality over quantity.
- A shift away from fresh meat towards processed meat and meat use in ready-to-eat meals and other convenience food products.

Various barriers explain consumers' unwillingness to reduce beef consumption and to switch to more sustainable or even plant-based alternatives.

- Meat consumption is perceived as healthy.
- Habitual food choice behaviours and the strong cultural and personal significance of meat are potential barriers to change.
- Willingness to pay more for products with sustainability attributes (e.g. with high animal welfare standards in the production of animal-based foods) as well as knowledge about health concerns related to the consumption of beef seem to have limited influence on actual purchasing habits.
- Cheaply priced meat can act as a barrier to reducing meat consumption, as price is still a primary consideration for many food shoppers.
- Consumers claim a lack of suitable labelling on food. More information, education and better labelling, including country of origin and how animals are reared is needed.

Reflection with expert interviews

- The influence of the social context, e.g. of social groups, family and partners, was mentioned as an important driver of meat consumption in particular and of food consumption in general in the focus groups.
- An important link was made by the interviewed experts between the identified trends (of meat alternatives and "free-from" food categories) with the needs to changing production approaches and to developing ICT solutions to enable such changes, particularly with regards to the beef value chain.

Dairy consumption

Landscape

- Fresh milk consumption is declining, while dairy products, especially those with added value (e.g. organic or protected geographical indication products) as well as cheese and dairy ingredients added to convenience foods are on the rise.
- In the EU liquid milk consumption declined between 2008 and 2018 from 58 kg to 52 kg per capita; this trend is expected to continue, leading to a consumption level of 49 kg per capita by 2030.
- Dairy products are mostly sold via supermarkets and discounters alongside other groceries. In most cases, consumers remain loyal to their usual retail market.
- Dairy products are eaten regularly and by a wide sector of the population, but consumption varies among and within the countries investigated, depending on the product, as well as on age, income and lifestyle.
- In order to achieve a healthy and sustainable diet for humans and the planet, the EAT Lancet report calculates an average consumption of 250 g of whole milk or derivative equivalents per day per capita. This would require a consumption reduction to around one third of the prospected consumption amount in 2030.

Drivers

- The main drivers influencing dairy consumption across Europe are food attributes (e.g. health aspects and quality), personal factors (e.g. preferences, habits, socio-demographic background), and economic and marketing factors (including price).

Trends & Barriers

Various trends in dairy consumption are emerging; these underline the downward trend in conventional liquid milk consumption:

- Regardless of the underlying reasons, veganism is a core trend and plant-based milk alternatives are gaining importance in the market.
- Health consciousness is another trend influencing dairy consumption.
- Consumers increasingly value the origin of dairy products and how they are produced (i.e. locally produced, organic methods, conforming to animal welfare standards, fairness to the farmer, pasture-raised quality products).

Various barriers explain consumers' unwillingness to reduce dairy consumption and to switch to more sustainable or even plant-based alternatives.

- An increasing concentration of fewer but bigger dairy farms and dairy factories and a more standardized offer in the supermarkets makes it difficult for consumers to buy locally and diversely unless they make the effort and drive to the farms with their cars.
- The high price of organic and high-quality milk, compared to conventional milk, is a powerful barrier to purchasing it. Alternatives to TetraPak packaging for plant-based drinks are also difficult to find.

Reflection with expert interviews

- Consumers tend to shop all groceries in one store that is the closest to their homes or work place. Having to make a detour to shop for more sustainable options of dairy products somewhere else was considered a barrier by consumers in some of the focus groups.
- Emphasis should be placed on circular economy solutions to addressing packaging issues, and the shift to higher quality, regional and environment-friendly dairy and dairy-alternative products was mentioned in the interviews as a market opportunity particularly for Small and Medium Sized companies (SMEs).
- Among highlighted barriers to change in consumption patterns, stakeholders identified the lack of consumer understanding about dairy value chain price distribution, as well as the lack of motivation within the industry to revisit the current functioning of the system and mainstream production patterns.

Salmon consumption

Landscape

- Salmon is a traditional food in many European diets and it is the third most consumed fish species in the EU. For consumers, salmon is a popular product that serves as an important protein source, it is perceived as tasty, healthy, with good appearance and convenient.
- In 2016, salmon consumption in the EU totalled 2.2 kg per capita (5% wild and 95% farmed), maintaining a similar amount of consumption in comparison to the previous year.
- Due to technological advances in farming practices (e.g. aquaculture), salmon production output has increased over the years and has made the product widely available for consumption in EU retail shops, supermarkets and hypermarkets. Large retail shops are taking over as main salmon points of sale for consumers.
- Salmon farming and aquaculture, however, are already known to pose important sustainability challenges, which would need to be addressed in future strategies towards more sustainable consumption of salmon.

Drivers

- The main drivers influencing salmon consumption across Europe are food attributes, such as sensorial characteristics (e.g., appearance and freshness) and origin, personal factors (e.g., convenience and traditions), economic and marketing factors (e.g., price, labelling and packaging), and policy measures (e.g., import regulations).

Trends & Barriers

Various trends in salmon consumption are emerging, which underline opportunities for the development of sustainability attributes in the sector:

- The consumption of organic fish and seafood products has been constantly increasing in Europe, but it remains unclear whether organic produce on a large scale could be considered a sustainability attitude of products.
- Blockchain technology has revolutionized fish supply chains by offering a traceability system to ensure transparency of each process in the supply chain, giving consumers the possibility to scan fish products with QR codes to gather information from the origin through to the end of the chain.

Various barriers, however, challenge the transition to more sustainable consumption with regards to salmon:

- The price of salmon is expected continue to influence consumption behaviours among EU countries, despite of parallel efforts to support consumers to behave more sustainably.
- Consumer perception of salmon as healthy, tasty and convenient raises the need for addressing consumer understanding and habits about salmon consumption.

Reflection with expert interviews

- It is importance to consider price instruments when designing strategies to address the environmental impacts of salmon consumption in Europe.
- Salmon production methods, such as aquaculture and organic, remain controversial.

Tomato consumption

Landscape

- It is estimated that, in 2018, the EU produced more than 16 million tonnes of tomatoes, out of which, approximately 40% was consumed fresh and 60% was used in the processing industry.
- Consumption of fresh tomatoes remained stable during the last decade, at around 14 kg per capita. Consumption of processed tomatoes is expected to increase from 20.5 kg per capita in 2018 to around 21 kg in 2030, driven by rising demand as an ingredient and for food products that evoke a Mediterranean lifestyle.
- Fruits and vegetables, with tomatoes included, are among the food types whose consumption is recommended to double if we are to achieve more sustainable and healthier diets by 2050, according to the EAT-LANCET report. However, the negative environmental and social impacts of tomato production would need to be addressed.

Drivers

- Main drivers influencing tomato consumption across Europe are food attributes such as sensory characteristics (e.g. texture, appearance, colour, size, freshness, taste, smell), origin of tomatoes and health factors; personal factors such as convenience and lifestyle; and economics and marketing factors such as price, packaging and labelling.

Trends & Barriers

Various trends in tomato consumption have been identified:

- It is gaining momentum the support of EU consumers to locally produced tomatoes, organic production practices and new business models (e.g. “farm boxes”).
- Consumers are also looking more and more for taste rather than the appearance of a shiny red tomato, with greater acceptance of “ugly tomatoes”.
- There is a multitude of social movements and initiatives educating individuals and reinventing behaviour patterns towards fruit and vegetable consumption.

Barriers, however, challenge the transition to more sustainable consumption with regards to tomato:

- There is uncertainty about the concept of organic, a lack of knowledge from consumers about sustainability issues, and low level of trust toward labels for products with higher or with sustainability attributes.
- Plastic packaging of tomatoes from brands and retailers impacts the environment and remains an issue.

Reflection with expert interviews

- Expert interviews generally confirmed the secondary data findings that identified price among the main drivers influencing tomato consumption in Europe, especially processed tomato products.
- Interviewed stakeholders also shared a very critical view with regards to trends such as consumption of locally produced vegetables and appreciation of slow food movements, as such trends are still very niche and face challenges to be scaled up.
- Most farmers and manufacturers are still operating on a conventional way of producing food, which highlights the structural nature of sustainability challenges. A closer relationship between producers and consumers was highlighted as the way forward towards increased resilience in food value chains.

Bread consumption

Landscape

- According to the European Commission (2018), bread consumption per capita decreased from 66 kg in 2007 to 60 kg in 2017, but bread consumption patterns are very diverse among EU countries.
- The decline of EU bread consumption is in part because EU consumers are moving out of bread to consume other food products.
- The EAT LANCET report (2019) highlights that whole grains are emphasised food for consumption if we want to achieve healthy diets within planetary boundaries, recommending a daily macronutrient intake of 232 grams of whole grains (including wheat) per day. However, production and consumption impact on sustainability would need to be addressed.

Drivers

- The main drivers influencing bread consumption in the EU mainly involves health factors (e.g. perceptions of health and wellness from bread), price and purchasing power of populations and changing lifestyles of consumers.
- EU consumers are eating less bread due to a diversification of other food products and changing behavioural patterns such as eating outside home.
- Modern lifestyles, including mobility, flexibility, cultural diversity, understanding of foreign cultures and culinary diversity are factors decreasing bread consumption.

Trends & Barriers

- Among trends, it is possible to identify new niches for bread and bakery products, customers seeking quality bread from regional and craft bakeries, new business models and innovations (e.g. 'from baker to consumer'), sustainability labelling and packaging, and organic bread consumption.
- • Barriers to more sustainable consumption of bread include lack of information in bread products with regards to its health and sustainability attributes.

Reflection with expert interviews

- Stakeholders reported a greater environmental concern also with regards to cereal production and consumption in Europe.

3.1

Beef Consumption

3.1.1 Landscape

How much is consumed

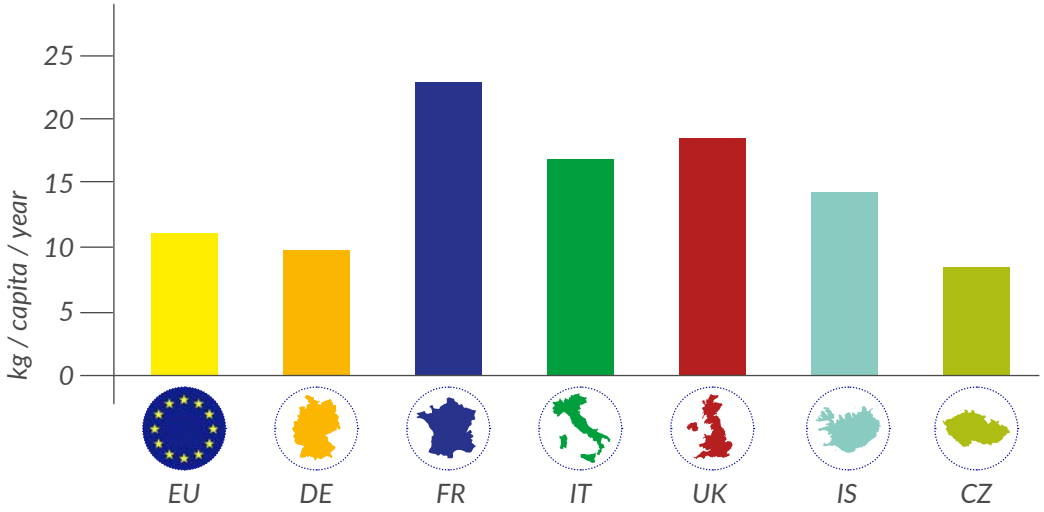
Despite still eating large quantities of meat and being one of the largest beef consuming markets in the world in absolute terms, the average European has been eating both less beef and less meat in general in the past few years. Meat is generally sold rather cheaply and in the form of meat product in supermarkets and discounters [10] [11].

This downward trend is expected to continue in future, with beef consumption in the EU gradually declining from 11 kg per capita in 2018 to 10.4 kg per capita in 2030 [12]. The ageing population (with reduced protein intake), EU social structures (migration changing meat consumption patterns), lower meat availability (high production costs), growing social and ethical concerns (animal welfare, water pollution) and environmental and climate issues (carbon footprints) are among the reasons for reduced beef consumption in Europe [12]. Figure 1 below shows the yearly average consumption of beef in the countries selected for this report.

EU in the global context	• The EU produces 11% of the global beef market supply [13]. • The EU is among the largest beef consuming markets in the world in absolute terms, behind only the US and comparable with Brazil and China [11].
EU consumption quantities	• Average beef consumption of 11 kg/capita/year in 2018 [12].
EU consumption trends	• Downward trend: beef consumption is expected to continue declining, from 11 kg/capita/year in 2018 to 10.4 kg/capita/year in 2030 [12].

Average beef consumption in selected countries

(Source: the authors according to [13] [14] 18] [268] [269] [270]



When it comes to consumption trends in the countries, between 2012 and 2018 the consumption of beef in Germany per capita per year increased by over 10%, from 9.1 to 10.1 kg [13]. In Iceland and the Czech Republic consumption has also been increasing, while it has been decreasing in France and has remained rather flat in the UK [14] [15] [16] [17]. In Italy, beef and meat consumption in general is decreasing [18].

Consumer characteristics

Beef consumption tends to vary across different consumer segments in Europe. The differences highlighted below demonstrate that strategies to address food consumption behaviours might need to vary depending on the targeted consumer segments and the most powerful consumption drivers identified.

- **Gender:** Men tend to consume more beef than women [10] [19]. Generally, more women follow a vegetarian diet than men and consume smaller portions when they do eat meat [20].
- **Income level:** Overall, it is important to distinguish consumption trends between meat and beef consumption when it comes to income level, as figures may differ. In the UK, the Czech Republic and Germany, for example, consumers with higher income tend to eat more beef than those with lower income 16. In the Czech Republic, higher income groups also buy more meat in general [21], while in Germany, higher income groups, despite eating more beef, tend to buy less meat in general [22] [23]. In the UK, limiting or reducing meat consumption is more common among affluent consumers, who also generally consume more [16] [24]. In France, low income households eat more meat, but of lower quality [25].
- **Age:** With regard to age, no conclusive differentiation can be made for Europe, whereas in Germany younger consumers eat more beef than older ones, while in Italy it is the other way around [10] [26]. In France, consumption increases until the age of 55-65 and decreases afterwards [27].
- **Personal factors:** [20] found that emotions, cognitive dissonance and sociocultural factors are the most relevant influences on meat consumption. In a German study, the personality traits of openness and friendliness, as well as conservative political and social views, coincided with a one-off variance, inasmuch as these traits were inversely related to frequency of meat consumption [28].

The motivations for beef consumption are around the '4Ns': it is generally natural, nice, normal and necessary. For male consumers, masculinity plays a role, it seems to be a matter of identity: 'in order to feel like a man, I need to eat meat'. And that's a barrier to change behaviours also in families where the husband holds the family hostage of fulfilling his masculinity needs."

Interviewed stakeholder

3.1.2 Drivers

Despite the complexity of factors shaping behaviours, VALUMICS sought to analyse and rank the drivers of beef consumption (i.e. why people consume beef the way they do) according to their significance as high, moderate or low, based on the research conducted. The following beef consumption patterns have been identified:

- The main drivers influencing beef consumption across Europe are economics and marketing (mainly price), food attributes (health aspects, sensory attributes, quality etc.), and personal factors (e.g. preferences, habits, socio-demographic background).

- The second most frequently mentioned drivers were policy measures, like the regulations and subsidies from the Common Agricultural Policy (CAP), trading contracts and labelling. This factor affects, for example, the beef price and trading practices in Europe, influencing consumption choices. The social context, including traditions, lifestyles, and family structures, are also important to beef consumption.

Food attributes

Food attributes can be clustered into sensory and nutritional attributes. The health aspect and perceived healthiness of beef is considered a core driver of its consumption [28] [29] [30]. Although the consumption of red meat has been advocated as unhealthy and damaging to the environment by various organisations in different countries [7], pro-meat health concerns still rate higher than environmental or animal welfare concerns in motivating change in dietary behaviour. But there are still differences in this respect between sociodemographic groups [28] [31] [32].

Within food attributes, another relevant driver is quality, which includes food safety, flavour, appearance, origin, freshness, convenience and transparency [29] [33] [34]. Throughout Europe, butchers and specialized shops are seen as a guarantor of quality [29]. In Italy, product quality and origin are the most important drivers of beef consumption [18]. Origin is also mentioned as a quality seal among consumers from Italy, UK, Czech Republic and Germany, who prefer beef from their own countries [34]. Convenience and usability are also important to consumers, as time is usually scarce and cooking skills and knowledge are decreasing [29].

Personal factors

Personal factors include socio-demographics, such as age and gender, which are static, but also factors that are more dynamic and develop over time, such as habits, values, attitudes, emotions, character traits, risk awareness, consciousness and openness.

Regarding meat-eating behaviour specifically, the most influential reported sociodemographic factors determining consumption are gender, age and socioeconomic status [30] [31]. [35] found that gender was the strongest predictor of levels of meat consumption. Women are more emotionally engaged, show more concern about environmental destruction and animal welfare, have less faith in technological solutions and are more willing to change [36]. Men tend to eat more meat and are less willing to consider reducing their consumption [31] [32].

Concerning age, there are significant differences across generations as to why people choose a vegetarian diet and associated lifestyles: younger vegetarians are swayed more by moral and environmental reasons to be vegetarian, while people aged 41–60 are prompted by health reasons [37]. Young people appear more open to "flexitarian" eating, with the highest proportion of non-meat eaters, potentially indicative of a generational shift in attitudes and behaviours away from meat eating [32]. Some products are chosen habitually. The vast majority feel that eating meat is normal, natural, necessary and has positive connotations [29] [38].

[20] assume that the most relevant factors influencing behaviour are emotions and cognitive dissonance (between knowledge, conflicting values and actual behaviour), as well as sociocultural factors (e.g. social norms or social identity) influenced by economic factors and the food environment. They recommend providing emotional messages or promoting new social norms (related to the social context discussed below) in order to address barriers such as cognitive dissonance.

Economics and marketing

Labelling, packaging, brands, advertising campaigns, and above all, price, were the most frequently mentioned drivers within this cluster, with varying levels of importance attributed to each of the individual drivers. Starting with price, in Germany, three-quarters of the large-scale consumers surveyed stated that they expected a low price for meat [33]. Investigation on willingness to pay shows that almost 70% of consumers would pay up to 20% more for meat and meat products from particularly animal-friendly production. Of the large-scale consumers, just about 60% considered a surcharge of 20% justified. After all, 52% of consumers would pay more for tighter security measures in production. However, consumers would only pay more for the process qualities such as "animal welfare" and "environmental friendliness" if they were guaranteed by familiar indicators [33].

When contrasting willingness to pay with actual purchasing behaviours, however, the latter did not correspond at all to the statements of the German citizens in the surveys. Only about 16% of customers purchased animal welfare articles, 11% bought organic products, and almost three quarters of the customers (73%) preferred the cheap offer. Even large information signs pointing to the animal welfare offer did not change anything [39]. As price is a powerful driver of beef consumption in both France and Germany, beef is often sold for an artificially low price by retailers as an effective strategy to attract consumers and sell other products to them as well [40].

Regarding the relationship between willingness to pay and various socio-economic variables, age had a significantly different influence in comparison to the other variables, with an increase in age leading to a decrease in willingness to pay, implying different preferences between older and younger individuals. This finding is in line with the previous meta-analysis by [41] who report a similar decrease in willingness to pay in relation to age [42].

Regarding the relationship between price and quality, the price of meat was considered of minor importance to the respondents in a German study assessing food quality and safety. It did not mean that consumers did not care about price, but rather that they did not necessarily assume that a higher price automatically meant higher quality. Price has apparently lost its function as an indicator of quality. Country of origin, place of purchase and expert trust as a sign for quality are considered more important [34].

Meat labelling is directly linked to beef and meat product attributes (discussed above) and is considered by consumers an important way of getting information about quality attributes of meat. Over 90% of

Consumers have the expectation of cheap food (so low price). People are not willing to pay too much for food as they expect it to be cheap. In addition, there is a lack of time to engage with food. 24/7 lifestyles drive consumer behaviours. People finish working, pick up the kids and end up at supermarkets to fix dinner.

Interviewed stakeholder

consumers in Germany wanted mandatory labelling of beef from cattle that were fed genetically modified (GM) crops. Consumers who are concerned about the food production process are more interested in further information about the product. This might explain in part the interest in labels of origin that permit the consumer to relate the product to a particular type of production environment [43].

It is questionable, however, to what extent such information-based tools influence consumption choices, as many consumers pay little attention to such information when shopping [44]. Although [32] feel that "the significance of strong public health messaging may be a valuable driver of reduced meat consumption", they are not confident that it will necessarily translate into changed dietary behaviour, even if people understand the message regarding the value of meat-free or meat-reduced foods. Overall, consumers generally have difficulties in forming expectations around meat quality [45], and struggle to understand the differences between food quality labels [46].

When it comes to the role of private brands and their relationship with product origin in the case of meat consumption, [43] estimated the relative importance that consumers place on private brands and origin labels in France, Germany, and the UK. Results suggest that consumers place a higher level of importance on information about the origin of a product than on private brands. In France and Germany, origin labels were rated as the most important factor in consumers' beefsteak purchasing decisions. Brands were of relatively little importance among the factors proposed in the questionnaire in Germany and the UK. Nevertheless, in Germany, brands received a high score in absolute terms. In general, French and German consumers placed a higher level of importance on both brands and origin labels than did UK consumers.

Policy measures

Since the 1960s the consumption of animal protein in Europe has increased by 80% [47]. Some studies attribute such increase in consumption to the corresponding increase in EU animal protein production, which in turn was achieved by significant technological and structural changes in livestock farming systems and by supportive agricultural and protective trade policies [48].

The Common Agricultural Policy (CAP), for example, accounts for nearly 40% of the European Union budget (€60 billion). Direct payments account for around four-fifths of CAP expenditure. While most direct payments are decoupled from production, some payments linked to production remain. The impact of the CAP on beef farming is complex, particularly in terms of its effects on productivity [49] and farmer income, which largely relies on public subsidies [50].

Social context

Since consumers buy food products not only for themselves but also for the whole family, the preferences of other family members count in food choice [29]. The presence of other people during consumption can be a barrier as well as an opportunity to more sustainable consumption [20] [51].

Social norms are also reported to play an important role in meat consumption [28] [52] [53]. Other social factors such as socially rising individual households or a decreasing willingness to cook at home are relevant causes of the slight decline in meat consumption in Europe, and these trends will be increasingly evident in coming years [26].

Other drivers

For 90% of end consumers and three-quarters of large consumers in Germany, the process qualities of **animal welfare** and **environmental friendliness** play an important role. However, such characteristics are not as important to consumers in their purchasing decision process as others. Concern for **climate change**, the **environment** and **feeding the world fairly** is currently less important as a motivator of behavioural change than other drivers such as health concerns. Awareness of meat consumption having negative impacts is low – only 28% of people agree that livestock production has significant impacts on the environment [33]. Overall, findings on meat consumption behaviour and environmental concerns are inconsistent [28].

However, some segments of European consumers are increasingly concerned about the impact of their meat consumption. In 2018, an open public consultation carried out by the European Commission showed that over 80% of respondents were willing to 'consider the impact of their food purchases on greenhouse gas emissions' and 74% would 'consider changing their diets' [54].

For a long time, we as producers had no real sustainability agenda. (…) Since this is not an issue in the education system or was not an issue, the broad mass simply is not aware of it. In the press, this is always exaggerated and upheld but, in the market, it looks very different. There is the price, the appearance of the product, the look and how it is presented in the supermarket, and perhaps the taste in the end. Everything else is irrelevant. Often something life-changing needs to happen before people wake up and change their eating habits.

Interviewed stakeholder

3.1.3 Trends & barriers

Trends

Various trends in meat consumption are expected to push fresh meat consumption on a downward trend. Key trends are highlighted below.

Vegetarian diets and plant-based foods: Recent years have witnessed a change in public awareness about the health (and, to a lesser extent, environmental) risks associated with overconsumption of meat, particularly red and processed meat, and have shown an increasing trend towards 'flexitarian' (or casual vegetarian) diets, in which meat intake is reduced in favour of plant-based sources of protein. Generally, young people eat less meat than older generations do (although there are exceptions in some countries) and other social factors such as socially rising individual households or a decreasing willingness to cook at home are relevant factors for an understanding of the decrease in meat consumption [26].

Germany currently has one of the highest proportions of vegetarians (11% of its population, eight million people) and vegans (1% of its population, 870,000 people) among western countries [55]. In Italy, vegetarianism and trends towards meat consumption reduction continued to grow in 2017, and tendencies trying to stop or reduce consumers' meat intake have become crucial factors (Euromonitor, 2018a). The UK also observes a rise in veganism and flexitarianism [56]. The plant-based industry is

expected to grow by $10 billion in the next five years [57] and the global cultured meat market might reach $20 billion in 2027 [54]. Iceland already has the highest per capita number of vegetarian restaurants in Europe, but meat consumption in the country has continued to increase in recent years, associated with tourism [58].

Widespread growth in demand for plant-based 'meat' and cultured meat among target audiences may depend on a broader shift in social and cultural norms towards the acceptance of flexitarian lifestyles and a food environment in which plant-based options are both more visible and more appealing [54]. Studies subjected to meta-analysis by [20] confirm that the dominant motivational factors for being vegetarian are personal moral values, in particular those concerning animal welfare. Those already seeking to reduce their meat consumption are the most likely group to purchase plant-based meat alternatives, while, unsurprisingly, so-called 'meat-believers' are less likely to be tempted by new meat substitute options [54].

Production methods, origin and organic beef: Over recent years, there has been a significant increase in the offer of and demand for organic products. The proportion of organic meat in retail sales increased in the UK (from 2.6% in 2012 to 5.1% in 2017), in France (from 2.4% to 3.7%), in Italy (from 0.8% to 1.7%) and in Germany (from 1.2% to 1.6%) [12]. In the last decade, the land area under organic cultivation in the European Union has doubled, while the market has increased four times [59]. In Germany the market share of organic beef was 4% in 2013 [10]. In Italy, in contrast to the reduction in traditional meat, organic options are expected to grow in tandem with consumers' rising focus on wellbeing. The growing penetration of organic meat through mainstream distribution channels is expected to help the establishment of this type of product within households and food service outlets [26].

Besides health, concerns regarding animal welfare grew over the review period, which is another important claim made by environmental entities [26]. As [60] showed, animal welfare considerations have a substantial impact on meat consumption. In Germany, only 22% of respondents believe that production is animal-friendly and 38% think production is environmentally friendly [33]. In the UK 'local' food appears to have greater resonance than other environmental and ethical food issues/options.

Shifting from fresh beef to processed convenience foods: The trend towards 'convenience' has been a major influence on food purchasing habits, encouraged by lack of time, skills or interest in cooking. The convenience food market is forecast to continue its growth, increasing by 30% between 2013 and 2018 from £35.6 billion to £46.2 billion. It is likely that ready-made meals and convenience meat consumption will also continue to rise in the UK [32].

In Italy, no change in sales of meat from packaged to unpackaged could be observed between 2013 and 2017 [26]. In the Czech Republic, consumers still prefer fresh beef. Frozen red meat accounts for less than 1% of the market volume. Regarding products that contain meat, consumers prefer as much meat and as little additives as possible [61].

Barriers

Various barriers explain consumers' unwillingness to reduce beef consumption and to switch to more sustainable or even plant-based alternatives. The main barriers identified in the work are highlighted below.

Meat perceived as healthy: Potential barriers against meat reduction are concerns that meat is essential for maintaining health, and that vegetarian diets are nutritionally inadequate. In Italy, consumers who are unsure about meat consumption have identified uncertainty about the healthiness of meat and lack of trust in hygienic standards of the product as barriers [62].

The power of habits and emotions: Habitual behaviours towards food choices and the strong cultural and personal significance of meat eating are potential barriers to change [20]. An analysis of several studies of meat consumption shows that a mechanism called cognitive dissonance, or 'meat paradox' specifically with regard to meat consumption, acts as a barrier to feeling emotionally involved and to changing meat-eating behaviour [63] [64] [65]. When reminded that their meat-eating behaviour may not match their values and attitudes, meat-eaters tend to avoid or resist information about the negative consequences of meat eating because it contradicts or threatens their basic perspectives on fairness and ethical behaviour and may give rise to strong, emotionally distressing reactions [20]. This unconscious mechanism of blocking emotional involvement is a challenge, considering that the stronger a person's emotional reaction is, the more likely that person is to adopt new behaviour [36].

If you survey at the entrance of the supermarket what the consumer would like to buy and then check what he bought at the exit, it won't match: what I think differs from what I do.

Interviewed stakeholder

Low environmental awareness and lack of knowledge: When compared to other 'food and sustainability' issues, environmental awareness is low and can be a barrier to change. Research on consumer willingness to adopt environmental food consumption behaviours showed that many consumers thought that choosing foods with less packaging would have a more positive impact on the environment than moving away from meat consumption [32]. Generally, the skills component is underestimated, but should be taken seriously [20].

Intention-action gap: The intention-action gap is often mentioned as a barrier to actual change in purchasing behaviour. German consumers are a good example when it comes to sustainable nutrition and animal welfare. In surveys, the majority say they would like to spend more money on meat if it helped the welfare of the animals. In practice, however, consumers still decide for cheap meat products at a discount price. In a representative survey for the "Nutrition Report 2008" of the Federal Ministry of Agriculture, almost half (47%) of those surveyed stated that they were "definitely" prepared to pay a higher price for food if this ensured better husbandry for the animals. Another 43% were inclined to dig deeper into their pockets for this. Only 2% of the respondents did not want to do this under any circumstances [22]. When contrasting these self-declared perceptions with actual behaviour, the discrepancy was striking: most of the consumers surveyed still bought conventional meat products.

Labelling and price: Another cited barrier to reduced or better meat consumption is the lack of suitable labelling on food (more information, education and better labelling including country of origin and how animals are reared). Two out of three people (67%) agreed it is hard to tell which meat is more environmentally friendly [32]. In Italy, consumers who are unsure about meat consumption have identified lack of transparency and lack of information about farming conditions as barriers. Czech consumers do not trust online sales of meat [66].

A cheap price can act as a barrier to reducing meat consumption, as this is still a primary consideration for many food shoppers. This is the case, for example, in Germany, where subsidies and industrial factory farming result in artificially low prices [20].

3.1.4 A sustainable vision

In terms of the impacts of consumption and individual lifestyles, often communicated in terms of 'footprint', beef is among the food consumption choices with the highest sustainability impacts. Food consumption accounts for 25% of the average material footprint of a European, mostly attributed to meat products, especially beef [3]. A recent study conducted by the Institute for Global Environmental Strategies (IGES) analysed the carbon footprint of lifestyles in different countries around the world and confirmed the high carbon intensity of beef, usually accounting for the largest food-related lifestyle impact [1]. From a production point of view, the impact of beef is also striking: producing beef uses, for example, 20 times more land and causes 20 times more emissions than growing beans, per gram of protein, and requires more than 10 times more resources than producing chicken [67]. [7] suggests that beef consumption should be reduced substantially, especially in developed countries, and should not exceed an average of 7g/day in order to achieve a healthy and sustainable diet for humans and the planet [7]. 7g/day means an average of 2.5 kg/capita/year – a quarter of current average beef consumption in Europe. Additionally, plans for future sustainable food consumption recommend an increase of some 50% in the consumption of vegetables, fruits, pulses and nuts [7]. These proposals, however, especially with regard to reduction targets, remain controversial. Besides, fair working conditions in beef production should also be factored in when transitioning towards more sustainable food consumption and production [68] [69] [70].

Lifestyle and behavioural changes are crucial if we are to deliver on future targets towards sustainability. Two important behavioural shifts can be identified:

1. Replacing beef consumption, at least partly, by a shift to plant-based alternatives. Novel, successful food start-ups are already paving the way and facilitating behavioural change by making meat substitutes from vegetable proteins more attractive. Other consumers, however, prefer products that are less processed [71].
2. Choosing beef products with higher quality and sustainability attributes, which would include e.g. fairer working conditions for the workers involved in production [68] [69] [70] or local and organic products. This would require transparent product information, as well as investment in time, interest and knowledge on the part of consumers.

3.2

Dairy Consumption

3.2.1 Landscape

How much is consumed

Dairy products range from fairly standardized goods, such as milk, butter, and non-fat dry milk powder, to multi-variety, multi-flavoured products, such as speciality cheeses, fermented drinks, and milk protein fractions used in food and beverage products. Products such as fresh milk, yogurt, and cheese are intended for direct consumption. Dairy products are also consumed indirectly as ingredients in other foods, such as pizza, snack bars, and bakery products [72].

The EU-28 average consumption of liquid milk was 53.6 kg/capita/year in 2017. The UK (90 kg/capita/year) was significantly above this average, followed by Germany (55.5 kg/capita/year) and the Czech Republic (56.5 kg/capita/year), while France (48.6 kg/capita/year), Italy (40.7 kg/capita/year) and Iceland (43.5 kg/capita/year) were below [73].

EU in the global context

- The EU was among the world five largest milk producers in 2018, with a 20% share in global production [266].
- The number of farms is significantly decreasing and a trend to move towards fewer but bigger, specialized, and industrialized farms can be observed [267].

EU consumption quantities

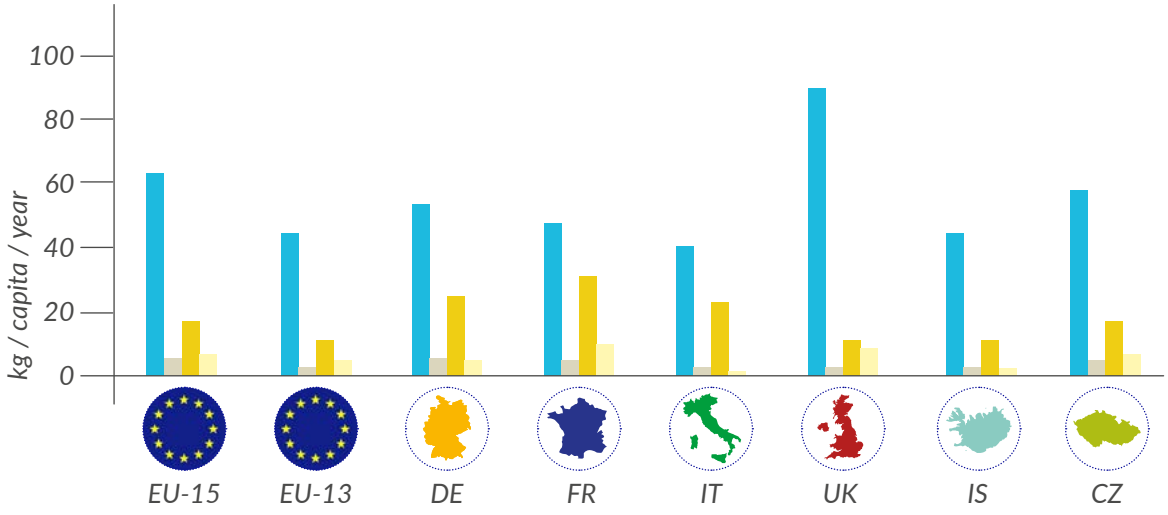
- About 3% of the European Union's milk production currently comes from organic farms, which is expected to grow further [75].

EU consumption trends

- The EU liquid milk consumption declined between 2008 and 2018 from 58 kg to 52 kg/capita/year.
- This is expected to continue, leading to a consumption level of 49 kg/capita by 2030.

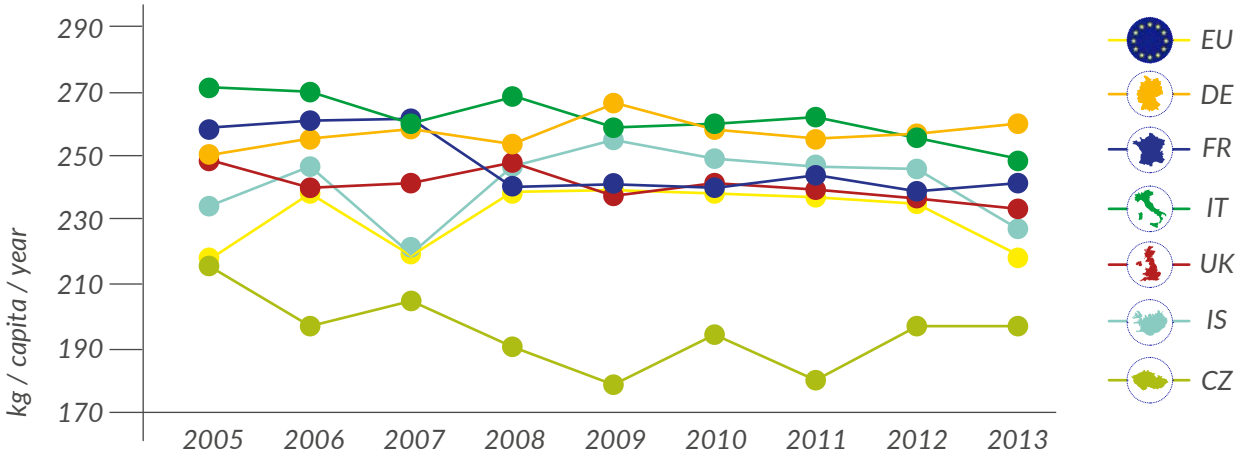
Per Capita Milk and Dairy Product consumption in selected countries

(EU-15 includes AU, BE, DK, FI, FR, DE, GR, IR, IT, LU, NL, PT, ES, SE and the UK. EU-13 includes BG, CZ, HU, PL, RO, SK, HR, CY, EE, LV, LT, MT and SI Source: [73])



Total per capita dairy consumption in selected countries, measured as milk equivalents, excluding butter

Source: the authors according to [74]



In terms of total consumption of dairy products excluding butter, measured in milk equivalents, according to figures as of 2013, Germany leads the ranking, followed by Italy, France, the European Union, UK, Iceland and the Czech Republic [74].

Fresh milk consumption is declining, while dairy products, especially those with added value (e.g. organic or protected geographical indication products) as well as cheese and dairy ingredients added to convenience foods are on the rise [75].

Between 2008 and 2018, EU liquid milk consumption declined by 6 kg per capita, from 58 kg to 52 kg. In part, this reflected switching by some consumers to alterative, plant-based "milk" options [76]. However, market expenditure on dairy products per capita increased in the EU in the same period, particularly in France, Germany, Italy and the UK [72].

The decreasing trend of EU liquid milk consumption is expected to continue between 2018-2030, leading to a consumption level of 49 kg per capita by 2030 [12]. On the other hand, the consumption of cheese and processed dairy products is expected to rise in coming years [75]. Concretely, consumption of butter and cheese is expected to further increase to 4.6 and 20 kg/capita/year, respectively, by 2030 [75]. Despite the expected decline in liquid milk consumption, the total intake of fresh dairy products should decline only slightly, to 74 kg per capita in 2030, compared with 77 kg in 2018 [75].

Milk and dairy products are typically bought alongside other groceries with supermarkets and multiple retailers dominating sales in Europe [77]. In Germany, most dairy sales are made in supermarkets, and 50% in discounters [78] (Friedrich, 2010). Similarly, in France, 98% of all liquid milk is bought in supermarkets and hypermarkets [79]. In the Czech Republic, super- and hypermarkets account for 95% and small grocery stores for 28% of sales. More often than other age groups, consumers aged 15-34 buy directly from farmers, markets and health food stores [80]. In Italy, 90% of dairy products are bought in modern grocery retailers, of which conventional stores account for 5.8%, discounters for 9.3%, hypermarkets

for 27.9% and supermarkets for 46.4%. The remaining 10% are purchased in traditional grocery retailers [81], with an increasing number of families buying milk at discounters [82].

In the UK, dairy products are purchased mainly in supermarkets and multiple retail markets (with own brands). Specifically, four major supermarkets (Tesco, Asda, Sainsbury's and Morrison's) account for 76% of all UK dairy sales [83]. Doorstep delivery of milk decreased from 45% of all milk purchases in 1995 to only 3% in 2014-15 [84].

Consumer characteristics

Dairy products are eaten regularly and by a wide sector of the population, but consumption varies among and within individual countries for reasons including socio-demographic aspects and consumer preferences. The differences highlighted below demonstrate that strategies to address dairy consumption may vary depending on the country, specific dairy product and targeted consumer groups.

- **Gender:** In France, among children, girls generally consume more dairy products than boys [85]. In German schools, the opposite has been observed: indeed, gender affects school milk demand significantly, but girls demand less school milk than boys [86]. In the Czech Republic, women consume more dairy products than men [87].
- **Income level:** Although higher incomes generally lead to higher overall consumption of dairy products, the same cannot be said of consumption of individual products. For example, in several high-income countries, consumption of cheese is increasing, but consumption of fluid milk is decreasing. Per capita consumption of yogurt is also relatively high in high-income countries, such as France and Germany, and demand growth is unabated [72]. In Italy, families with a higher income show the largest decrease in milk purchase [82]. In France, dairy product consumption is higher among wealthier households [25]. In Germany, on the other hand, the influence of net income on dairy consumption patterns seems small [88].
- **Age:** In France, 90% of children consume dairy products daily and 63% of adults more than 4 times a week [89] with milk mostly consumed for breakfast and at home. Still in France, children consume twice as much as adults, and consumption decreases with age, but increases after 65. Milk consumption is more important when there are children in the family [85]. In the Czech Republic, women consume dairy products mostly between the ages of 30-44 and least between the ages of 45-59 [87]. In Italy, purchases are more stable by older people (64+), while younger people (<35) are decreasing their consumption of dairy products, because they are more inclined towards new and trendy consumption styles and open towards trying milk alternative products [82]. The typical Italian fresh milk consumer would be somewhat older, with a not too high available income and belonging to a larger family [82]. In the UK, dairy products are consumed by 96% of the population, mostly at home, and with the highest consumption level within older (>55) and the least within younger (<35) consumers. Younger consumers are more likely to consume plant-based alternatives [76] [90]. In a survey in Germany, 64% of German respondents consumed dairy

products on a daily basis (Nutrition Report, 2019), and age difference seemed to play a limited role with regard to consumption levels [88].

- **Product preference:** France has a higher per capita consumption of soft-type cheeses than most other EU countries [72].

3.2.2 Drivers

Based on the analysis conducted by VALUMICS of existing research around food consumption behavioural drivers in Europe, organised around six driver clusters, namely food attributes, personal factors, social context, environment/physical context, economic & marketing and policy measures, the following patterns with regard to the consumption of dairy products have been identified:

- The main drivers influencing dairy consumption across Europe are food attributes (e.g. health aspects and quality), personal factors (e.g. preferences, habits and socio-demographic background), and economic and marketing factors (including price).
- The second most frequently mentioned drivers were policy measures, related to price regulation, certification and labelling of dairy products, as well as the social context and its influence on dairy product consumption.

Food Attributes

From a food attributes perspective, health concerns are the most widely mentioned influence on dairy product consumption in the literature researched [82] [91] [92]. What is perceived as healthy among consumers, however, remains controversial. While in the UK consumers have shifted from full-fat to reduced fat dairy product options and see cream as unhealthy due to its high percentage of fat, the consumption of cream has been increasing in Iceland [93] [94].The market developm[ent of plant-based milk alternatives is often attributed to health concerns such as cow milk's allergy, lactose intolerance and prevalence of hypercholesterolemia [95] (Sethi et al., 2016); however, other studies associate it with consumer preference alone [97] [98].

Food quality, country of origin and means of production are also mentioned as relevant aspects influencing the consumption of dairy products [99]. Taste, sensory attributes and fat content are seen as signs of food quality. For German consumers, the most important purchasing criteria are taste, freshness and health, as well as price [78] [91]. In Italy, premium and local products are preferred, together with organic products. Consumers will buy what they consider better quality products (Euromonitor, 2018b). For Czech consumers, the type of packaging of milk is important, especially in Prague [87].

Personal factors

For many consumers, the purchase of fresh milk is habitualised [99] and dairy purchases tend to be routine with little involvement [100]. Milk is popular and affordable, appreciated by European consumers and deeply

anchored in food habits across various countries [72]. A behavioural shift in dairy product consumption has taken place in Europe due to changes in lifestyles and promotions of lower dairy product intake for adults. Busy lifestyles with a skipped breakfast, coffee-to-go, and out of home consumption has reduced the purchase of milk and its consumption at home, where it is usually consumed. On the other hand, the growing consumption of convenience foods (e.g. ready meals, burgers, frozen baked goods) has contributed to higher consumption of dairy ingredients such as cheese, skimmed milk powder and butter [75] [101].

Economics and marketing

Income levels and the availability and cost of milk are key factors behind differences in dairy product consumption throughout Europe [72]. Although higher incomes generally lead to higher overall consumption of dairy products, the same cannot be said of consumption of individual products. For example, in several high-income countries, consumption of cheese is increasing, but consumption of fluid milk is decreasing. Per capita consumption of yogurt is also relatively high in high-income countries, such as France and Germany, and demand growth is unabated [72]. Retail dairy purchases are growing at widely different rates among the European countries in response to rising incomes and expanding urban populations [72].

Mass media promotions and new forms of retail channels are also driving consumption growth in countries where dairy products are marketed to Europe's ageing population and typically affluent senior demographic groups, which form an attractive target market for functional dairy food and drink, for example. Functional claims are helping this increase by providing consumers with access to expanded product selections and brands [72]. In France, a multimedia effort a few years ago, supported by media and health professionals, helped disseminate knowledge about the harmful health effects of high consumption of fat and sugar. This is partly the explanation why full cream milk has been largely replaced by half cream milk [102].

Specifically concerning the impact of price, when choosing milk and dairy products in stores, Czech consumers are influenced first by price (63% of respondents), then by quality (46%) [80].

The usage of raw milk products has changed across cultures significantly, there is not a consumer. However, these days it is cheap and considered a standard product. It is the price that drives the consumption. In addition, the perception of healthy products is another aspect and the people increasingly look for these kinds of products.

Interviewed stakeholder

Policy measures

Some European governments are fostering dairy product consumption by encouraging milk consumption in schools as a means to supposedly improve the diets of children [72] [103]. National food-based dietary guidelines and recommendations have also played a role in supporting the consumption of dairy products. The French National Nutrition and Health Program (PNNS), for example, recommends daily consumption of several servings of dairy products for children and adults [85].

The regulation of how the plant-based sector names its products has also recently been in the spotlight. The European Court of Justice has restricted the sector from using the terms 'milk', 'butter', 'cheese' and 'yoghurt' for their products, which should refer exclusively to animal

products [104]. Whether this will have an impact on consumer behaviours towards dairy and dairy alternative products is not yet clear. Dairy demand and export opportunities can be affected by the outcome of free trade agreements (FTA) and regional trade agreements (RTA) currently under discussion [75].

Environmental legislation can also have a strong impact on the future development of dairy production. Greenhouse gas emissions from dairy activities make up a high share of total emissions in some countries, and changes in related policies could affect dairy production. Water access and manure management are additional areas where policy changes could have an impact [75].

Social Context

Especially in the case of school milk, consumption behaviour is also affected by social environmental factors. As a German study showed, these factors include preferences of parents, consumption behaviour of teachers, teachers' attitudes, and the attitude of the school principal towards milk consumption by children [105].

In France, the presence of children in the household increases the consumption of milk in the whole family. The abandonment and shortening of breastfeeding and the shift to cow's milk instead is a general trend in industrialized countries, but is more common in low-income families [25].

These days' customers are concerned about animal welfare and ingredients as well as livestock feed. And the consumer demands towards farmers have changed. What has changed is the perception towards dairy as the major contributor for global warming. This also influences the demand for sustainable dairy products these days.

Interviewed stakeholder

Other drivers

Consumer behaviour with respect to liquid milk differs depending on the product production system and on family composition. For example, in France, demand for conventional milk fell in 2018 (by close to 4%), whereas consumption of organic drinking milk increased at a more dynamic pace (18%) [75]. In the UK the presence of babies and young children in the family is considered a key motivator towards the purchase of organic milk [100].

In Germany, consumers committed to buying organic milk tend to have a larger net income, a below average household size and just one young child up to 7 [106]. In the Czech Republic, organic milk is the most commonly bought organic commodity [107]; it is bought mainly by 30-39 year-old women with higher education [108].

In several countries (including Germany, France and Italy) concerns about environmental issues may limit milk production increase [75]. Negative publicity about animal welfare in the dairy industry has caught the attention of one third of dairy consumers, according to a UK survey [90].

3.2.3 Trends & barriers

Trends

Various trends concerning more sustainable consumption of dairy products have been identified in Europe and in the selected countries. Key trends are highlighted below.

Vegan diet and plant-based dairy alternatives: A vegan diet can have various underlying consumption drivers, like preference, taste, health concerns, animal welfare or ecological awareness. Plant-based milk alternatives are also consumed by 'flexitarians' not exclusively following a vegan diet, but avoiding dairy or milk specifically [109] [110].

In general, it is estimated that 2-6% of the European population and close to 10% of the German population follow a vegetarian or vegan diet [109] [111]. In Germany, there are approximately 7 million vegetarians and 1.2 million vegans. Furthermore, a still relatively small, but continuously growing 12% of German consumers claim to be 'flexitarians', which means that they eat meat only occasionally [109]. Iceland has a growing number of recently opened vegetarian and vegan restaurants [112].

Specifically, with regard to impacts on the dairy sector, plant-based milk alternatives have been traditionally consumed in several cultures for centuries, but demand for these products is only recently growing, and the market as well as the diversity of products is expanding rapidly [98]. The plant-based dairy alternative market in Europe is expected to witness a compound annual growth rate of around 7% between 2019 and 2024. The German dairy alternatives market has become the largest in Europe, followed by the UK, where plant-based milk sales showed an increase of 30% between 2015 and 2017 [76]. The UK, however, leads sales in chilled fresh soy milk as an alternative to fresh milk. Spanish consumers show the fastest-growing demand for non-dairy beverages [113].

Health: The connection of health with food consumption becomes most obvious when people have issues with digestion of specific foods. The most prominent cases are intolerances against gluten in cereal products and lactose, or cow's milk allergy in dairy products. These diseases occur in less than 20% of white Europeans [114]. In the UK, those that consume plant-based milk substitutes do so out of preference, rather than necessity due to an allergy [96].

Organic, fairer and quality dairy products: In 2016, about 3% of the milk produced in the EU was organic. In countries like Sweden, Austria, Latvia and Denmark, organic milk accounts for 10% or more of total milk production [115]. When pooling milk and dairy products, they represent a proportion of up to 20% of all organic products sold in many European countries. Their market share is between 5-10% in Germany [116]. In France, organic milk purchases doubled between 2007 and 2015 [117] and milk from pasture raised dairy cows is gaining popularity [118].

In France, trademarks like 'C'est qui le patron' are basing their communication on fair payment to producers [119]. In the UK some supermarket chains offer farmers' labels which guarantee a certain price for milk to farmers. Less than 10% of UK farmers, however, are on such a contract [120]. In saturated markets, like in the EU-15, opportunities lie in various "quality products" with certain special features, such as geographical indications, organic, and GMO-free etc., as well as functional dairy products, for instance tailored to meet age-based nutritional needs and sports nutrition [115]. Additionally, the environmental impacts of livestock farming are publicly communicated and recognized by a growing number of EU citizens [75].

Regional origin: 'Regional' as a marketing trend can be observed in all the countries studied by VALUMICS. A German study showed that willingness to pay for regionally marketed milk is positive in the majority of the test persons. However, it was significantly lower in the experimental study than in the survey, where respondents accepted significantly higher price premiums for regional production of organic milk than for conventionally produced milk [99]. Additionally, 75% of German consumers prefer "regional products" if they have the choice, most already buy such products on a regular basis, and 70% claim that they are even prepared to pay a premium for them [109].

Convenience: Convenience products are becoming increasingly important, in both the retail and the out-of-home sector. The increase can be observed in ready to eat dairy products as well as in products like grated cheese, which link convenience with self-cooking [121]. Packaging and portion sizes play a role, as well as the rising trend of 'on-the-go' products, which is leading to an increased demand for convenience dairy products [115].

Barriers

Various barriers still prevent reduction of dairy consumption and a switch to more sustainable or even plant-based dairy alternatives. Understanding the barriers on the way ahead is also useful when developing appropriate strategies to foster more sustainable consumption in the dairy sector. The main barriers identified by VALUMICS are highlighted below.

Availability and Accessibility: The ongoing market trend of bigger but fewer dairy farms and dairy processing companies narrows the product range on the market. Additionally, dominant retailers, namely supermarkets and discounters, tend to choose big producers and the dairy industry as their suppliers [122]. This increased concentration of dairy factories and their power makes it difficult to buy locally [123].

Farmers in some countries put up vending machines to sell local and fresh milk even after the regular opening hours of markets, with varying success. In the Czech Republic, however, the number of such dairy vending machines is decreasing, because sales of milk in this way were not profitable [124]. One potential barrier could be the accessibility and convenience of the machine: i.e. the provision of clean bottles or a functioning system to return bottles. As consumers here are devoted to their (mostly closest) retailer, the vending machine would have to be on the way to the retailer or on the way from work to home. Purchasing at local farms can be challenging in Iceland, because as two thirds of the population live in the capital it is difficult to access the farms. As local consumption exceeds local production, dairy products are, and will still be imported, which involves externalities like emissions. Additionally, uncertainty regarding the future tourist numbers in Iceland makes it potentially difficult to match supply and demand. With regard to accessibility in schools: if milk is offered in schools, alternatives like plant-based milk are usually not offered [125].

Consumption quantities: If we assume that more sustainable dairy production would need a more extensive production system based on pastureland and grass-fed animals, then a reduction in the consumption quantity of dairy products would be needed. Some experts argue that a lower level of milk consumption could have an impact on the ability of milk producers to move towards less intensive models [126]. However, those farmers would also need to have access to pastureland, and this is an issue that needs political support [127].

Information: National food-based dietary guidelines and recommendations have also played a role in supporting the consumption of dairy products. The French National Nutrition and Health Program (PNNS), for example, recommends daily consumption of several servings of dairy products for children and adults [85]. Some European governments are fostering the consumption of dairy products by encouraging milk consumption in schools as a means to supposedly improve the diets of children [72] [103].

Price: High price is the primary barrier to purchasing organic milk in some of the countries in the study, and low price is generally a primary driver in selecting products. 47% of adults questioned by Mintel reported they would buy more organic milk if it was cheaper [83]. This may also be the case for plant-based alternatives. In Germany these are often more expensive, among other reasons because there is a higher value added tax on plant-based than on dairy products [95] [98].

3.2.4 A Sustainable vision

After meat, the consumption of dairy products accounts most for the environmental impacts of lifestyles related to food and eating [128]. The actual climate change impacts of dairy product consumption depend largely on the amount and product consumed. The carbon intensity of butter, for example, is 13 times higher than that of milk, which is already high in comparison to plant-based products [1].

The EAT Lancet report [7] sets as future target an average consumption of 250 g of whole milk or derivative equivalents per day, which means 91.25 kg of liquid milk per capita/year. Meeting such a target would require the reduction of dairy product consumption to around one third of forecast consumption for 2030, which is expected to reach 74 kg of fresh milk products (including liquid milk), 4.6 kg of butter and 20 kg of cheese per person in the EU under a business-as-usual scenario [75].

As in meat consumption, shifting consumption patterns of dairy products may require both (1) replacing, to a certain extent, dairy products with plant-based alternatives [1], and (2) opting for products with higher quality and sustainability standards, often associated with products sourced by local and small-scale farming.

3.3 Salmon Consumption

3.3.1 Landscape

How much is consumed

Salmon is a traditional food in many European diets and it is the third most consumed fish species in the EU. For consumers, salmon is a popular product that serves as an important protein source, it is perceived as tasty, healthy, with good appearance, and convenient. In addition, due to technological advances in farming practices (e.g. aquaculture), salmon production output has increased over the years, which has made the product widely available for consumption in EU retail shops, supermarkets and hypermarkets.

Across the EU there are significant differences in salmon consumption, and the reasons behind the decision-making processes differ from one region to another. For example, culture, family traditions, gender, age, habits, marketing and even regulations, play a significant role in salmon consumption decision processes. Furthermore, linkages between production and consumption are relevant to understand the landscape of salmon consumption in the EU. These and other questions will be addressed in this chapter in order to provide an overview of relevant aspects about salmon consumption in Europe, how consumers' daily decisions are shaped by various influencing factors, and initial solution pathways for greater sustainability in salmon consumption in Europe.

In 2016, salmon consumption in the EU totalled 2.2 kg per capita, from which 5% is wild and 95% is farmed salmon, maintaining a similar level of consumption in comparison to the previous year [131]. Salmon is the third most consumed fish species in the EU (9%), most of it imported, behind only the consumption of tuna (11%) and cod (10%). France is the largest consumption market for salmon in the EU, with salmon becoming a central item in the regular French diet, contributing to the growth of salmon demand which, in turn, is considered to influence the increase of salmon prices [133].

EU in the global context

- In 2017, the EU remained the world's largest trader of fishery and aquaculture products. The trade volume between the EU and the rest of the world surpassed China's by more than EUR 2.3 billion [129].
- About 72% of the world's salmon harvest is farmed, mainly coming from Norway, Chile, Scotland and Canada [130].

EU consumption quantities

- EU totalled 2.19 kg per capita of salmon consumption in 2016 (5% wild and 95% farmed) [131].
- Europe consumes far more seafood than it can catch in domestic waters or produce in fish farms, and more than half the yearly demand comes from overseas [132].

EU consumption trends

- Despite a slight decrease in 2016, EU salmon consumption has shown a general increase trend between 2001 and 2017, due to increased availability and affordable prices [129].

Most salmon consumed in Europe is farmed, and salmon is the most consumed farmed species in the EU [134]. Moreover, salmon in the EU is mainly consumed fresh or smoked, with France and Poland both producing large quantities of smoked salmon.

Retailers are the main place of purchase of fish and aquaculture products in Europe, in comparison to specialised shops and fishmongers. In the EU, around 70% of the Atlantic salmon supply goes to retailers, and approximately the same share is sold fresh. Of the different products, fillets have the largest market share (45%), followed by smoked (30%) and all other value-added processed products except smoked salmon (15%) [135]. Preferences at place of purchase depend largely on the products one would like to purchase: type of product (fresh/frozen/processed), product presentation (fillets/whole), and production method (wild/farmed). Details from selected project countries are given below:

- Germany: Between 2011 and 2013, discounters' share of fish products sales slightly increased, from 39% to 40% (value). Market share of other large-scale retailers remained stable at 37%, while fishmongers saw their share slightly reduced (from 11% to 10%).
- France: Large-scale retailers are dominant, including for fresh fish. They have a smaller market share for frozen fish (50% in value) due to the strong position of retailers specialized in frozen products (31%), and they also account for a small home delivery segment (14%).
- Italy: Fish and processed seafood are increasingly sold as frozen products through large scale retailers, which account for 40% of the fish market in Italy; the market share of fishmongers has registered a parallel decrease in importance.

Consumer characteristics: Salmon consumption in Europe varies according to the characteristics of different consumer segments. The differences highlighted below demonstrate that strategies to address salmon consumption may vary depending on the targeted consumer groups and the most powerful consumption drivers.

- **National differences:** Salmon products form a traditional part of many European diets [134]. The UK is the largest consumer of fresh salmon, spending EUR 860 billion on 52.1 tonnes, accounting for 30% of the EU household consumption of this species in volume terms. The UK is followed by Spain, which accounts for 26%, and France which accounts for 12%. Together, the three countries are responsible for 68% of total EU consumption of salmon, both in value and volume [129]. Salmon products are also popular in other EU countries, such as Sweden and Denmark [136]. Salmon in the EU tends to be processed and consumed smoked, with France and Poland both producing large quantities of smoked salmon [134]. Nonetheless, fresh salmon is used in a variety of products. According to [131], in Lithuania, Portugal, Spain, Croatia and Greece, a preference for wild fish is clear. On the other hand, studies confirmed growth towards farmed fish in the Netherlands (as a possible result of the replacement of wild catches with fish from aquaculture) and in Finland (farmed salmonids dominate consumption). In Romania, 72% of consumers did not know if they were buying farmed or wild salmon.

- **Age:** Elderly and retired social groups give more relevance to wellness and health when consuming fish, while these aspects are less important for young people and students [137].
- **Convenience:** The 55-64s, as well as retired and unemployed people, tend to emphasize convenience and ease when it comes to fish consumption, while for managers, the self-employed and students these factors are less important [137].
- **Sensorial perception:** The organoleptic characteristics of fish are more relevant for the youngest non-consumers, the unemployed and students. They are less important for non-consumers of the age group 45-54 and house persons [137].

Fish and Aquaculture Product (FAPs) Consumption in EU Regions

Source: [137]

Northern EU countries

- Fish consumption is highly dependent on imports.
- Consumption is relatively low, well below EU average.
- FAPs are generally considered expensive products.
- Consumers are increasingly aware of sustainability issues.

Central EU countries

- Central EU countries form a landlocked region with quite low consumption of FAPs, albeit increasing. Locally produced carp is an important species, especially in Hungary and in the Czech Republic, and consumption is influenced by tradition.
- Availability of saltwater fish depends on imports from other regions. Growing imports increase the availability of FAPs and are changing consumer habits, although traditional habits are strong.
- Consumption and purchase are value-oriented (price sensitive).
- Urbanization increases demand for convenience products.
- The increasing focus on health benefits fish consumption.

Western EU countries

- These countries have a significant own supply both from fisheries and from aquaculture, and consumption of FAPs is an important part of their culinary traditions.
- Fish consumption is relatively high and consumption of products from aquaculture is trending upwards.
- Consumption is value-oriented (price sensitive).
- Purchases in traditional fish markets or specialized fish shops are down, while buying at super- and hypermarkets is increasingly common.
- Higher availability of fresh fish, convenience products and sushi is changing consumption habits from more traditional forms, especially among younger consumers
- Spending per capita is increasing, but consumption per capita is down in the UK.
- There is an increasing focus on health benefits and sustainability.
- Communication with consumers through social networks is increasing.

Eastern EU countries

- Internal supply is important and influences consumer habits due to traditional local/regional fisheries and FAPs' availability.
- Consumption of FAPs is low. Interest in local and traditional products is diminishing – especially among younger consumers.
- Price is an important factor for purchase, many consumers consider FAPs unaffordable. However, consumption of fresh and convenience products is increasing.
- Growing imports from other regions increase availability of FAPs, and hence evidently also consumption of FAPs.

Southern EU countries

- There is a large diversity within these countries regarding fish consumption, e.g. Croatia has a fish consumption level well below EU average, while Portugal is well above.
- All countries have major self-supply of FAPs.
- Price seems to be an important consumption driver.

3.3.2 Drivers

The following section will address the identification and analysis of main drivers that influence behavioural patterns towards salmon consumption in Europe. VALUMICS sought to analyse and rank the drivers of salmon consumption, i.e. why people consume salmon the way they do, according to their significance as high, moderate or low, based on the number of studies supporting such position and on the general assessment and experience of the VALUMICS team. The following patterns regarding the consumption of salmon have been identified:

- The main drivers influencing salmon consumption across Europe are food attributes such as sensorial characteristics (e.g., appearance and freshness) and origin, personal factors (e.g., convenience and traditions), economics & marketing factors (e.g., price, labelling and packaging), and policy measures (e.g., import regulations).
- The second most frequently mentioned drivers were aspects concerned with the social context (e.g., family preferences); the environment and physical context in which salmon consumption takes place (e.g., large retailers taking over smaller supermarkets, specialized shops and fishmongers), and personal factors such as gender.

Food attributes

Based on the analysis, sensory attributes such as appearance, taste and freshness are important qualities that trigger positive consumption behaviour towards this seafood product [138]. According to the [139], seafood appearance is the factor with the highest impact on purchasing decisions; cost and geographical origin factors follow. Sensorial characteristics such as appearance (and freshness in particular), is the most important factor in France, Greece and Spain [131].

On the other hand, food attribute preferences differ among countries. For example, Icelandic citizens prefer to consume wild rather than farmed salmon, and to consume fresh fish rather than frozen products and pre-prepared meals [140]. Also, they consider other salmon species attributes (e.g. size and texture of char salmon) more as a delicacy than Atlantic salmon and are willing to pay more for it [141]. Also, salmon is perceived as a suitable food choice for its nutritional properties (e.g. proteins).

According to [131], most reasons for fish consumption refer to health and nutritional issues. A study in the Czech Republic indicates that common salmon and fish consumers in general are people focusing on a healthy lifestyle [142] (2CAnlayitics, 2016). Fish consumption preferences in Iceland also found a tendency for the young to choose healthy produce [140]. According to [143], German consumers might associate with healthiness in itself and because it is an alternative to other products judged as unhealthy (e.g. red meat) and those who. In Italy, there is a strong desire by consumers to eat more healthily. This upward movement has been influenced by the growing avoidance of meat, because fish rarely has a bad press on the health front, and because consumers are generally encouraged to eat more fish [144]. Also, according to [145], the sustainability of the production process for farmed as well as wild

seafood has been shown to be a concern for German consumers in a number of studies. In this regard, results indicate that sustainability concerns are more important than quality concerns in driving the preference for wild versus farmed fish.

Furthermore, the geographical origin of salmon products is an attribute that relates to quality and taste among European consumers. These were the most frequently mentioned food attributes that influenced consumers to purchase salmon. According to the [146], the question of origin is more important in Germany than environmental aspects. It seems that Norwegians also mainly rely on their national regulations regarding food safety and trust products of Norwegian origin [147].

Pre-packaged salmon consumption differs from one country to another. According to the [148], French consumers find salmon pre-packaging not so appealing for the following reasons: 1. It's not the way they are used to buying salmon, 2. It doesn't inspire, 3. They don't know if the salmon fresh, 4. They don't trust the quality, 5. It doesn't look appealing.

Personal factors

Personal factors such as habits, family traditions, values, gender, convenience, socio-economic factors, sustainability, convenience and even emotions are important drivers that influence purchasing decisions with regard to food products, including salmon consumption in the EU. According to [147], the values held by consumers also have an effect on consumption behaviours.

For example, sustainability awareness supports a more suitable selection of salmon products for consumption. In this regard, conscious and voluntary pro-environmental behaviour requires motivation, which is then transformed into a concrete behavioural intention, such as buying sustainable products or the consumption of seafood. Intending to consume seafood sustainably is likely to increase the chances of this behaviour actually taking place. It is important to keep in mind, however, that awareness and intention do not always translate into behaviours as, for example, in Germany, where consumers understand environmental and sustainability issues, but other factors such as flavour, health and value for money are much more important [146].

Moreover, salmon consumption was controversial in France due to an image problem that caused high concern among French consumers with regard to quality, health and sustainability [149]. In addition, lack of knowledge about salmon production processes may influence behaviour. For example, according to [141], there is a lack of knowledge concerning environmental and sustainability issues in Iceland, which is likely due to the recent emergence of the aquaculture industry and the relative disconnection between where farming takes place (remote West and East Fjords) and where the food is consumed (mainly in the capital city of Reykjavík). Lack of knowledge and transparency about fish farming processes may influence consumption decisions.

There is evidence that women have a stronger preference for salmon sushi than men (The Norwegian Seafood Council, 2014). In the Czech Republic, a typical consumer is a woman with higher education [142]. In Iceland, fish consumption patterns are more frequently observed among

women, and there is greater emphasis on health and freshness, as well as on access and price [140]. Habits are also reported as an important factor in German seafood consumption [150].

EU consumers find fish products convenient and easy to prepare [131]. In the Czech Republic, most fish is eaten at home and it is said that knowledge of easy recipes can increase the interest of potential consumers [142]. From a different perspective, in the UK, hurried families look for quick meal solutions with emphasis on convenience and what is acceptable to children [151]. Furthermore, the [146] indicates that salmon is the most popular type of fish among Germans at home and in restaurants, it is the most preferred fish [141]; fish is generally considered expensive by elderly people; in Iceland, however, people aged 60 or above are more likely to consume such products, maybe partly due to cultural traditions.

In the Czech Republic consumers tend to buy more fish after returning from a holiday [142]. In Italy, lifestyle issues and the perception of trendy flavours increase fish consumption [152].

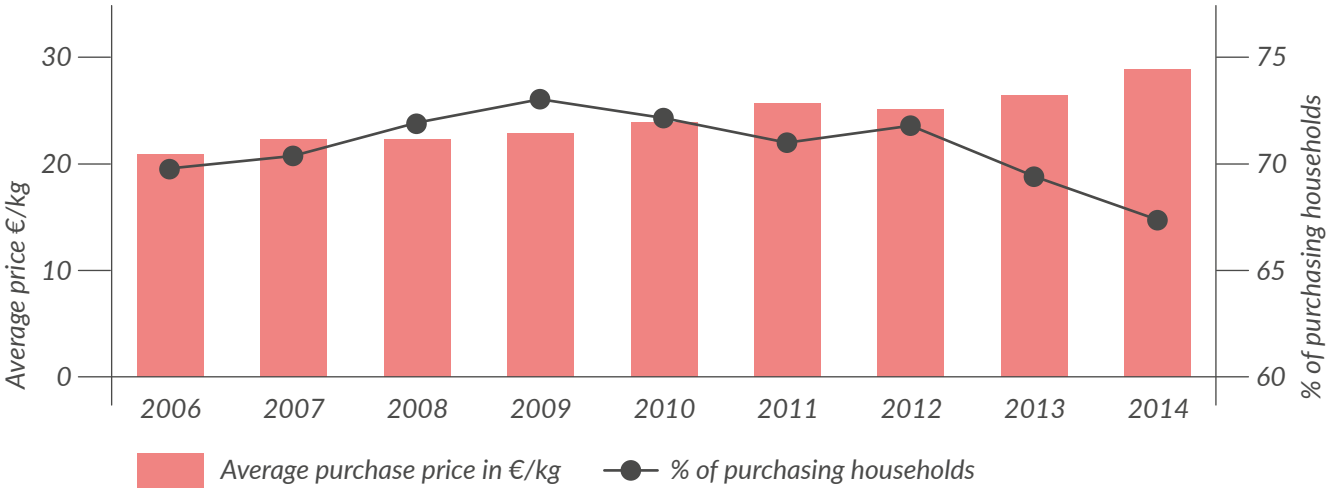
Economics & marketing

Price is one of the most important drivers of EU salmon consumption behaviours. As described above, it was clear that consumers reacted positively and consumed more salmon when prices dropped. And it was also visible that EU consumers reduced their salmon consumption when salmon prices increased. The degree of price elasticity in demand varies across consumer groups, with higher income groups less sensitive to price changes.

The increase of 1 EUR/kg in retail prices observed in 2013 (following a 30% increase in fresh whole salmon price) led to a decrease in both share and frequency in French households. This trend accentuated in 2014 with a new increase in retail price of about 2 EUR/kg.

Relation between retail price of smoked salmon and % of purchasing households

(Source: the authors according to [134]



According to the [153], 68% of consumers indicated that they would eat more fish if prices were lower. In France, according to In France, the increase in fresh salmon prices since 2013 combined with campaigns pointing out controversial rearing conditions in Norway caused important perturbations both in the market (decrease in consumer demand) and the industry (business failure and restructuring) in France and more widely in the [134]. In France, the consumption of salmon is very sensitive to the evolution of prices (of salmon itself and of other fishes) [134]. Also, in the Czech Republic, higher prices are a main reason for not consuming fish and are one of the most important risk factors in the fish protein market in Czech aquaculture [142]. Also, the level of expenditure on salmon depends on the house income [154], and Czechs prefer to consume fish in their homes, rather than in restaurants, because it is less expensive. In Iceland, high pricing was considered the main barrier for consumption of both Arctic char and salmon [141]. Moreover, according to [131], price impacts the elderly more than the EU average consumer. Price is a main reason why the EU elderly population and manual workers do not widely consume salmon products. On the other hand, the younger population, managers and the self-employed are less sensitive to price changes [131]. According to [143] in Germany, the perception that salmon provides good value for the money.

When looking into studies that investigated consumer willingness to pay for sustainability attributes of fish products, prices also seemed to play a key role. In a study on fish consumption in eight European countries (Finland, France, Germany, Ireland, Italy, Poland, Spain, and the UK), only a small fraction of consumers was willing to pay significantly higher prices for sustainably produced fish from Europe, given that trustworthy standards are applied and well communicated [155].

In addition, factors such as packaging and labelling influence consumer choice. In Germany, the use of new packaging technologies such as MAP packaging, which wraps the packaged goods in a modified protective atmosphere, has enabled new consumer groups to be gained [156]. In this regard, according to [147], third-party labelling and certification schemes such as the Marine Stewardship Council (MSC), Aquaculture Stewardship Council (ASC) or Friends of the Sea (FOS), which are awarded to fisheries and fish farms fulfilling their criteria, seem to play an important role in driving consumption decisions. For example, German consumers have preferences for sustainable seafood from certified wild fisheries prefer seafood certified to be sustainable by the MSC [145]. In Norway and Iceland, however, the market for sustainability labelled food is relatively small and receives little consumer attention. On the other hand, Icelandic consumers viewed information about origin, ingredients and production on packaging as an important factor influencing additional trust towards seafood (88%) [141]. In the Czech Republic, consumers are strongly interested in nutritional information, and tend to resort to food labels, the internet and sellers for information about fish [157].

Policy measures

Policy measures also have an important influence on salmon value and its consumption rates. Depending on international, European and national policies on salmon production and trade, consumer behaviour may change purchasing decisions towards products. As an example, which included products from the EU, Norway and other countries, entered into force in August 2014. According to [129], Norway had to find other markets for more than 100.000 tonnes of salmon intended for the Russian market. A majority of the salmon ended up on the EU market, causing downward pressure on prices in the second half of 2014 and in 2015. During this time, salmon prices changed and a diversification of salmon products occurred in the EU. According to [72], salmon has been extensively used in pet food, especially cat food: of the 13,332 total products released in the 20 surveyed EU countries over the last ten years, 3,525 were new salmon pet food products.

Furthermore, with aquaculture farming practices working as an important component of the EU Common Fisheries Policy (CFP), biological issues have appeared in Norwegian salmon farms, causing negative impacts in the environment and massive losses of farmed salmon products for export into the EU. This situation was responsible for a salmon price increase in the EU, which reduced consumption of the product. According to [158], governments need to create an "enabling" environment through appropriate policies and legal frameworks. Application of the principles of the FAO Code of Conduct for Responsible Fisheries should be encouraged and development and implementation of better management practices is seen as a priority.

Besides its influence on price and production methods, policy measures can also have an impact on the understanding and perception of healthy food consumption. In this regard, the UK government recommends eating fish twice a week for a healthy lifestyle [159], which may contribute to increased consumption of salmon.

Social context

Social contexts differ in each European country, influencing consumption behaviours in different ways. For example, salmon consumption might be traditional in some countries that have always had access to the food resource for geographical reasons. Also, family contexts and celebrations are highlighted as events where salmon is consumed.

According to [147], family preferences play a role in salmon consumption. In Iceland, attitudes towards consuming salmon are generally very positive, and most people consider the family to have the most encouraging influence on their fish consumption [140]. In the UK, fish consumption is geared to a small number of species such as salmon and cod, with generally low consumer interest and poor sense of adventure in buying/cooking different types of fish, as well as a lack of awareness regarding local and seasonal seafood and the overall provenance and traceability of seafood [160]. The review of different sources of national consumer behaviour surveys and government reports by VALUMICS partners indicated that UK family households have the potential to influence eating

habits regarding fish and salmon. According to a study from [142], consumption of fish in the Czech Republic is significantly different across regions, being traditionally high in the south of the country, e.g. in Bohemia (traditional fishing region) or in Prague. It is interesting to note, however, that in some countries where salmon consumption is not a tradition there is also a positive consumption attitude towards salmon. For example, in Italy, consumers have a strong preference for smoked salmon, which is neither traditional nor cheap [161].

In some countries, salmon has pronounced seasonal consumption: e.g. in the Czech Republic it is widely consumed over Christmas [142]. In a similar direction, according to [134], one key characteristic of the French market for smoked-salmonids is that around 30% of the annual sales are concentrated in December, associated with festive meals in the Christmas and New Year period.

Environment/physical context

The environment and physical context where consumers purchase salmon products influence salmon consumption behaviours in the EU. Place of purchase may be large retail stores, hypermarkets, supermarkets, small specialized shops, or fishmongers. As already mentioned, a [131] analysis highlights that large retailers are taking over smaller supermarkets, specialized shops and fishmongers in order to sell salmon products in the EU. In the UK, for example, Tesco is currently the largest seafood retailer, followed by Sainsbury's, Aldi, Morrisons and Asda; with Aldi, showing the largest total growth from a 1.5% share in 2008 to 9.8% in 2018 [159]. The fishery and aquaculture industry supplies fish and seafood through different sales channels: retail, which includes fishmongers, and large-scale retail; food-service, which includes catering and commercial restaurants; and institutional, which includes schools, canteens, hospitals and prisons [131]. Fish and seafood sold through retail was highest in Spain, where, in 2017, 857,700 tonnes were sold through this channel. Nonetheless, sales recorded in Spain through retail have been decreasing, dropping 14% as compared with 2013 and 5% from 2016. Italy, Germany and the UK, on the other hand, showed an upward trend. In France, 90% of fresh salmon is bought in supermarkets [162]. Moreover, according to [144], the percentage distribution of fish by format in Italy is: retail stores 79.7%, food-service 18.2% and institutional 2.1%. In the Czech Republic most consumers buy salmon in supermarkets and hypermarkets. In Italy, inland consumers prefer to buy fish in super- and hypermarkets, mainly because these places are habitual and practical, they trust the product, consider it hygienic, and it has a good price [152].

Interestingly, in the Czech Republic, poor accessibility to place of purchase has been identified as a reason for limited demand, even if product quality is perceived as high [142].

3.3.3 Trends & barriers

Trends

Climate change, population growth and scarcity of resources are major global challenges that will have a significant impact on lifestyles and global economies, including on the seafood industry. Based on this, how might EU consumers adopt more sustainable salmon consumption patterns that can ensure healthy lifestyles and demand sustainable value chains? Below the main trends towards more sustainable consumption of salmon identified across Europe are highlighted:

Organic salmon: According to [131], the consumption of organic fish and seafood products has been constantly increasing in Europe, registering a 73% increase from 2012. In absolute terms, the UK led in the consumption of organic fish in 2016, consuming more than 23,300 tonnes of organically produced products, an increase of 43% over 2015. Additionally, in absolute terms, the United Kingdom, Germany, France and Spain showed positive trends from 2012 to 2016. While still considered a niche market, the consumption of organic seafood products is constantly increasing in the EU. [131] indicates that this trend has been considered by food retail companies and fish and seafood traders (brands), by adapting their offer of organic food and, at the same time, by promoting specific organic fish and seafood product lines.

According to [163], two EU Member States are involved in the organic production of Atlantic salmon, which is the major species organically certified in the EU. The largest EU organic salmon producer is Ireland. The rest is produced in the UK: in Scotland and, to a much lesser extent, in Northern Ireland. Organic production, estimated at 12,500 tonnes in 2012 (EAS), has thus increased by 23% thanks to Irish development (+35%), while Scottish organic production decreased by half in the same period. It remains unclear, however, whether organic produce on a large scale could be considered a sustainability attitude of products.

Slow fish, product quality and certification schemes: Social movements such as "Slow Fish", promote eating in a 'slow style', savouring taste while choosing good, clean and fair fish, pushing the market through consumer choice towards responsible management of fish. Based on these consumption trends, the salmon industry must aim to transform its business model towards sustainability and transparency. [147] indicate that consumer demand for sustainable seafood has motivated an increasing number of wholesalers and brands to collaborate with certification programs. Brands are responding to sustainability demands: in Italy and Switzerland, for example, Negozio Leggero has 13 stores stocking more than 1,500 package-free products and, in France, Grandes Origines Saumon Fumé d'Ecosse (Smoked Scottish Salmon) is marketed as being selected from sites known for their water quality, heralding a new era of sourcing from unpolluted areas [164]. Furthermore, as mentioned by [145], the Aquaculture Stewardship Council (ASC) and the Marine Stewardship Council (MSC) ecolabel are important for consumption communication in regards to sustainability and quality.

Technological solutions: Blockchain technology has revolutionized fish supply chains by offering a traceability system to ensure transparency of each process in the supply chain. For example, Provenance is a company that enables consumers to scan fish products with QR codes, to gather information from the origin through to the end of the chain. This technology allows brands and retailers to replace the clutter of traditional printed communication with mobile-accessible information about producers, suppliers and procedures undergone by the product [165].

Still within the technology front, [166] indicate that cell-based seafood production offers a new option to potentially avert the sustainability challenges associated with industrial aquaculture and marine capture. The concept of producing seafood from fish cell-and-tissue cultures is emerging as an approach to address similar sustainability challenges found in industrial aquaculture systems and marine capture, by combining developments in biomedical engineering with modern aquaculture techniques [166]. In this regard, retailers, policy makers and consumers would become key stakeholders in determining the level of uptake of such cell-based salmon products in the future.

Food waste & new business models: Regarding food waste, innovative business models have been developed in recent months, such as the experiment done by the S GROUP, a Finnish retail co-operative, which sets reduced prices up to 60% for food that is close to the expiry date. For mass consumers, price is an important factor and there is a demand for these food products, including salmon. "Food that is nearly unsellable goes on sale at every one of S-market's 900 stores in Finland, with prices that are already reduced by 30% slashed to 60% off at exactly 9 p.m. It's part of a two-year campaign to reduce food waste that company executives in this famously bibulous country decided to call 'happy hour' in the hope of drawing in regulars, like any decent bar [167]."

Barriers

Strategies towards a more sustainable consumption of salmon is still hindered by various barriers, as outlined below.

Price of salmon: The salmon price is expected to continue influencing consumption behaviours among EU countries, despite parallel efforts to support consumers to behave more sustainably.

The role of policies and regulations: Policies and regulations may also be considered as barriers, since they still have to improve towards sustainability within the overall salmon value chain. This includes, for example, the opportunity for policies and regulations to boost the development and implementation of more transparent value chains, including retailers, improve sustainability standards and labelling schemes, and control greenwashing in unethical marketing and packaged products.

3.3.4 A sustainable vision

In comparison to beef and dairy products, salmon has relatively smaller carbon emission and overall sustainability impacts attributed to food consumption in Europe [1]. In addition, the European Environment Agency recognises the need for more research to fully understand the impacts of current salmon farming practices in marine environments [168].

Nevertheless, salmon farming and aquaculture is already known to pose important sustainability challenges. For example, aquaculture salmon eats fishmeal derived from wild-caught fish [169], thus increasing wild-capture. Also, it is estimated that current industrialized fishing has lowered ocean biomass content by up to 80% [170]. Such changes, coupled with the effects of global warming on oceans, threaten to decimate wild fish populations [171].

Other environmental impacts of aquaculture areas include the use of pesticides, anti-bacterials and other therapeutants in coastal aquaculture, which may lead to chemical residues appearing in the wild fauna of the local environment; sewage and wastewater discharge from fish farms, which is associated with toxic algal blooms and polluted drinking water [172]; and the fact that farmed fish often slip out of their pens and come into contact with native populations, with unknown impacts in degree and scale to the gene pool of wild fish [172].

According to the EAT Lancet Report [3], animal source foods should be substantially limited and consumption of plant-based foods doubled. In the report, fish is classified as an important protein source and it is categorised as an emphasized food, along with vegetables, legumes, fruits, whole grains and nuts. Current average consumption levels of fish in Europe [131], as well as food-based dietary guidelines for fish in the project selected countries [173] (EU Science Hub, 2018), are, however, significantly below the EAT Lancet report recommendations [7].

It is important to take a holistic view of such recommendations (i.e. beyond health concerns), and to take into consideration the impacts that fish (especially salmon) production has on the environment and society at large. This is particularly true for salmon aquaculture, which has been in the spotlight, due to its industrial and somewhat controversial farming methods that impact particularly on local ecosystems.

In this sense, addressing salmon consumption patterns may require both (1) replacing, to some extent, the consumption of salmon products with alternatives, and (2) opting for salmon products with better sustainability performance.

3.4 Tomato Consumption

3.4.1 Landscape

How much is consumed

Tomatoes are consumed in most European countries and considered as healthy, tasty, with good appearance and texture. Tomatoes were introduced in Europe from America, becoming a traditional food in many European countries such as Spain, Portugal and Italy. Fresh tomatoes can be categorised as fruits (botanically) or as vegetables (due to its low level of sugar), and are used in most European households as a fresh product to prepare meals, salads or main dishes. Today, processed tomato products have been taking over fresh tomatoes in Europe, mainly due to the increasing popularity of prepared meals sold by retailers, as well as for the increasing desire of Europeans to adopt Mediterranean lifestyles [177].

In the European Union, tomatoes hold the number one position among vegetables, with a 19% share as the largest fresh vegetable crop. It is estimated that, in 2018, the EU produced more than 16 million tonnes of tomatoes, out of which approximately 40% was consumed fresh and 60% was used in the processing industry [176]. Domestic per capita consumption of fresh tomatoes remained stable during the last decade, at around 14 kg per capita, and is expected to slightly decline by 2030 to 13.6 kg, due to the fact that consumers are switching to smaller size tomatoes [176]. On the other hand, the EU consumption of processed tomatoes is expected to increase from 20.5 kg per capita in 2018 to around 21 kg in 2030 in fresh tomato equivalent, mainly driven by increasing demand for convenience food such as prepared meals and products representing a Mediterranean lifestyle [176].

As for many EU countries, most of fresh and canned tomato purchases takes place in modern distribution channels such as supermarkets, hypermarkets, discount and specialized fruit and vegetable stores [178]. In Italy for example, the percentage of tomato purchases occur 34% in supermarkets,12% hypermarkets, 9% discount and 16% specialized fruit and vegetable stores.

EU in the global context	• The top 5 largest tomato producers are: China, EU, India, US and Turkey. They account for 70% of global production [174]. • In 2017/2018, the three leading tomato products exported by the 13 main production and exchange countries (of which 7 are part of the EU) were: tomato paste, canned tomatoes (whole or pieced, peeled or unpeeled), and tomato sauces & ketchup [175].
EU consumption quantities	• Consumption of fresh tomatoes remained stable during the last decade, at around 14 kg per capita [176].
EU consumption trends	• Consumption of fresh tomatoes is expected to slightly decline by 2030 to 13.6 kg, while consumption of processed tomatoes is expected to increase from 20.5 kg per capita in 2018 to around 21 kg in 2030 [176].

Moreover, consumers are increasingly choosing to buy tomatoes and other groceries through online stores. Between 2017 and 2018, there was a 170% increase in the online shopping of food, including tomatoes in Iceland [179] and in places such as the Czech Republic and Germany, some business models developed a system where the sales of vegetables and fruits can be done directly by an organic farmer through the so-called "from the yard" online stores, offering a delivery service of "farmer boxes" to households.

Consumer characteristics: A European study examined consumer behaviour towards fresh tomatoes and resulted in three segments of tomato consumers [180]. The study was done with Greek consumers and differentiated consumers according to their personal characteristics and perception of tomato attributes, as detailed below. As information about segmentation of tomato consumers is relatively scarce, it is interesting to consider whether the segmentation below has relevant aspects that can be generalisable for other European contexts, with the potential to support European strategies to support more sustainable consumption of tomatoes.

- **Eating habits:** consumers mostly driven by eating habits with regard to tomato consumption are those that do not eat other vegetables as salad but tomato. With regard to age, consumers in this group have the youngest profile base, with 62.1% of consumers being between 18 and 35 years old. Additionally, most of them are single, and prefer to purchase tomatoes mainly from open markets.
- **Sensorial experience and food organoleptic properties:** consumers mostly driven by sensorial experiences such as taste and smell when shopping for tomatoes prefer to purchase tomatoes mainly from open markets.
- **Health:** consumers mostly driven by health attributes and the nutritional value of tomatoes have the oldest profile base among the three groups, with 64% being older than 36 years. Health-conscious ones have a higher household income and differ significantly compared to the other segments especially when there is a presence of a working mother in the household. Also, they prefer to purchase tomatoes mainly from grocery shops.

No significant differences were found regarding gender, education, and the presence of children in the family [180].

3.4.2 Drivers

VALUMICS sought to analyse and rank the drivers of tomato consumption in general, i.e. why people consume tomato the way they consume, according to their significance among high, moderate and low, based on the number of studies supporting such position and on the general assessment and experience of the VALUMICS team. The following main drivers with regard to the consumption of tomato have been identified:

- The key drivers influencing tomato consumption across Europe are food attributes such as sensorial aspects (e.g. texture, appearance, colour, size, freshness, taste, smell), origin of tomatoes and health factors; personal factors such as convenience and lifestyle related; and economics and marketing factors such as price, packaging and labelling.
- The second most frequently mentioned drivers were environment and physical context such as modern distribution channels (e.g. supermarkets, retail).

Food Attributes

Sensorial aspects: In Italy, taste, smell, and freshness are important attributes. The preferred taste of fresh tomatoes has to be slightly sharp/bitter, juicy, gelatinous (the part with the seeds) and sweet [181]. Also, Italian preferred attributes describing freshness of tomatoes are: crunchy, firm, juicy, firm skin, natural aspect and colour. Moreover, an Italian study showed that consumers were able to distinguish the tomato crunchiness from a tomato 24 hours after being harvested and a tomato preserved in the fridge for 7 days [181]. In Germany, the share of oval shaped tomatoes increases compared to the round ones [182]. Czech consumers pay attention to the looks of tomatoes and exclude crops due to visual characteristics, thus causing a possible driver of food waste. If maintaining the same price, 61% of respondents of a survey would choose the vegetable with perfect look. However, there is a growing number of respondents who would choose the imperfect one. Still, 41% of respondents associate a worse appearance with a worse quality [183]. Czech consumers define quality of vegetables on the base of its freshness and the absence of chemical treatment during the production. For this reason, [184] indicates that Czechs find self-provisioning of vegetables as a way to have access to "own healthy food" which primarily means food grown with no or limited use of pesticides and other industrially produced chemicals. According to [185], the popularity of cherry tomatoes is growing in the Czech Republic and the small type of tomatoes has a fuller taste compared to large tomatoes. On the other hand, [186], indicates that the Czechs have a decrease of interest in "tasteless" tomatoes imported from southern European countries and from Africa.

Origin: [178] indicates that Italians have a preference toward Italian tomatoes. As for the Czech Republic, the [186] highlights that consumers are leaned to choose vegetables from local producers. In contrast to this consumption preference, imported tomatoes account for 90% of tomato consumption in the country [187]. In Germany, according to a research from [188], results indicate the existence of a relationship for German consumers between country-of-origin and the environmental characteristics of the cherry tomato.

Organic produce: EU consumers perceive organic tomatoes (with or without industrial processing) as more expensive, better for the environment, healthier, more natural and freer from chemicals than conventional produce [189]. In Italy, organic and higher quality class vegetables provide higher satisfaction to consumers [190], as 59% of consumers occasionally consume organic tomato paste [191]. [192] notes, however, that uncertainty about the concept of organic vegetables is the main barrier for their consumption, as consumers tend to display a low level of trust in organic food quality certifications [193].

Packaging and size: [178] highlight that consumers are increasingly oriented towards tomato convenience products (e.g. products that offer an extra service like packaging) in Italy. Based on the previous statement, there is an increase in sales of packaged tomatoes with a fixed weight.

Packaged tomatoes represent 37% (value) / 26% (volume) market share of the product category fresh tomatoes purchased by Italian families. [178] showed also that packaged tomato costs around 75% more compared to loosen tomatoes.

Health: In Italy, health and wellness are relevant concerns which drives sales of processed fruit and vegetables products. According to [194], there is an on-going decline in meat consumption in Italy, which has been fuelling sales of processed vegetables. According to [195], the Czech consumption of fresh fruit and vegetables is considered to be an efficient strategy in the prevention of a range of illnesses of modern society such as cancer, obesity, cardiovascular diseases and premature death.

Traceability: In Italy, consumers search for traceability. For example, some companies such as Coop Italia (retailer), guarantee that the raw material for the private label brand processed tomato products offered are 100% of Italian origin. In addition, they build close relationships with farmers of private labels to guarantee quality [196].

Sustainability: According to [188], German consumers are concern about agro-chemical residues, particularly to products consumed fresh such as tomatoes. Also in Germany, [197] mentions that consumers pay much more attention to the environment impact of the products they purchase, as the consumption of organic products is widely expanding.

Personal factors

Gender: with regard to consumer knowledge about cherry and on-vine tomatoes, 64.18% of women have recognized on-vine tomato versus 42.91% of men, although 28.36% of women and 16.75% of men actually consumed them. In the case of cherry tomato, 73.13% of women and 60.78% of men have recognized this variety but only 34.85% of the women and 22.24% of men consumed it [198]. In Czech Republic, women eat 1.7 times more vegetables than men [199] as also observed in Iceland, where women eat more vegetables than men, though education and residence are also important factors [200]. In Iceland, women shop for pleasure and stick to the brands and stores they know and have decided to suit them; also, they don't want unnecessary information about the products they buy because it confuses them [201]. Icelandic males were generally more compulsive and careless in their decision styles, however they generally believe that the price of products reflects in quality [201]. In France, women eat more processed vegetables then men [202].

Lifestyle: The EU consumption of processed tomatoes is expected to increase from 20.5 kg per capita in 2018 to around 21 kg in 2030 (in fresh tomato equivalent). This growth will be mainly driven by increasing demand for convenience food such as prepared meals and products representing a Mediterranean lifestyle. Yet the concentration of raw tomato in those products is decreasing due to the addition of other vegetables. Italian cuisine is mentioned to be very popular in Iceland as well as in

most of EU countries. In France, changing lifestyles has favoured the economy and stimulated the demand for processed vegetables [203].

If we talk about processed products (e.g. peeled tomato), I think that there is a chunk of consumers who are still anchored to the price. They talk about quality and about guarantees, but when they are in the supermarket, consumers buy what costs less or what costs a little more but with guarantees (brand, known name).

Interviewed stakeholder

Habits: In France, [202] indicates that the consumption of fresh vegetables has stabilized, despite short-term fluctuations, while the consumption of processed products seems to maintain an upward trend, for vegetables as for other food products. In Germany, according to [197] consumers will always ask for the most common varieties of tomato; those which are normally on the shelves of the supermarket but with new characteristics which better match the daily routine and preferences of consumers.

Convenience: In Italy, tomato paste is a convenience product that satisfies consumer that have little time, but he wants to cook and personalize his consumption. In this regard, tomato paste is the preferred product by consumers within the processed tomato category, where 70% of respondents consume it several times a week [191]. According to the [186], Czech consumer prefers types of vegetables that do not have to be cooked for a long time, or can be consumed immediately (e.g. tomatoes, peppers, cucumbers, radishes, lettuce). For French consumers, the first decision factor to purchase canned tomatoes is the use, then come the recipe and the size [204]. Also, for Germany, [182] indicates that the smaller tomato varieties increase the convenience as well as purchasing behaviours. Based on [180], the available time for purchases, together with factors such as involvement with food, nutrition knowledge, individual's characteristics, economics conditions, and health concerns influence the use of labels by consumers.

Sustainability impacts: According to [178], Italian consumers prefer increasingly organic tomatoes, influencing an increased production area dedicated to organic tomato production as well as an increase sale of organic tomatoes from 2015 to 2016 (+5,5% volume, +6,9% value). In the Czech Republic, there is a growing preference for vegetables grown in an integrated production system [186].

Economics and Marketing Factors

Price: consumers perceive organic tomatoes (with or without industrial processing) as more expensive, better for the environment, healthier, more natural and freer from chemicals than conventional produce [189]. In the Czech Republic, consumption of vegetables is influenced by a number of factors, such as the level of consumer prices [205]. In France, the brand and the price are secondary drivers for tomato consumption behaviour. Vegetable intake is also influenced by income, as low-income consumers display low vegetable consumption [206] for both organic [207] and the higher quality classes of vegetables (e.g. Class I vegetables in UK) [208]. This is due to the higher prices of these particular classes of vegetables compared to their lower-class counterparts (e.g. Class II vegetables in UK). A key element when examining the influence of price on consumer behaviour is the degree to which several quality cues are traded-off against price [209]. Hence, organic and higher quality class

We see a growing awareness of regional and national product demands as well as the trend towards old types of fruits and vegetables. But it is a very slow and small movement that is fighting its way up the social media. If I look at the supermarkets, then the shelf meters have moved rather to convenient food and serve the growing amount of single households. And they do not have time to cook nor do they want to spend the time cooking meals. (...) People rather go out or order something.

Interviewed stakeholder

vegetables should provide higher satisfaction to consumers [190]. Seasonality and availability: Another factor in relation to vegetable intake is the seasonal consumption [210] and whether the availability of particular types of vegetables, especially in rural areas, could influence purchases.

Packaging & Labelling: In Italy, consumers perceive unpackaged tomatoes as being fresher (e.g. for the tomato variety "San Marzano" which is preferred due to its rural look, bright but not shiny colour). Packaged tomatoes are perceived as being less fresh or assumed to contain preservatives [181]. On the other hand, consumers are increasingly oriented towards tomato convenience products that offer an extra service such as packaging. Increase in sales of packaged tomatoes with a fixed weight. Packaged tomatoes represent 37% (value) / 26% (volume) market share of the product category fresh tomatoes purchased by Italian families. Other data from [178], shows that packaged tomato cost around 75% more compared to lose tomatoes. From the packaging types for tomato paste, 87% of Italian consumers prefer glass bottle, 9% cans and 4% tetrapack. Also, 64% of consumers buy tomato paste each time they need it and 36% of consumers buy a stock of tomato paste to store at home. Share of private labels for processed tomato category is increasing. Based on [180], although the use of label improves consumers diets, there is a gap in the literature regarding the information that consumers would like to have available in food labels in general and vegetable labels in particular.

Marketing: In Italy, between May and July there is a higher share of families that buy tomato products in promotion (between the ending of the season of protected tomato production in greenhouses and the start of open-air tomato producing season). The processed tomato market in the country is basically driven by price and promotions, where companies try to gain market share by differentiation [196]. Moreover, [197] mentions that new products are created according to the requirements of large German retail chains (long shelf-life, standardisation) and addressing the needs and habits of customers. Also, in Italy there is an increase of communication & marketing of the health benefits of tomato paste [211] as well as the positioning of "Premium products" with local identity [212]. Moreover, Icelandic brands often use the Icelandic flag to emphasize the origin of products as a marketing approach with the aim of encouraging consumers to buy local tomatoes and other produce [213].

Environment & Physical Context

In Germany and Italy, large retail chains will keep on being the leader outlets in the supply of fresh tomatoes [197] In Germany, besides certification systems and labelling schemes, retail formats are therefore understood to also play a crucial role for purchasing decisions by providing credible information about product quality [214]. According to [178], Italian consumers purchased fresh tomatoes in 34% in supermarkets, 12% in hypermarkets, 9% discount and 16% specialized fruit and vegetable stores. Moreover, retail strategies for tomato focus on Italian origin and packaged products, as it is more convenient for logistics and for hygiene and safety at the point of sale. Furthermore, according to [194], store-

based large grocery retailers in Italy will continue to drive most sales of processed fruit and vegetables. Based on [215], consumers purchase 37% share of UK retail value sales of table sauces, mostly tomato ketchup and canned tomato as a sauce/dressing/condiment. Moreover, according to [216], 93% of UK adults eat ready meals or ready to cook foods that includes tomato (e.g. Pizza and Pasta). Most Czech consumers buy tomatoes in a supermarket / hypermarket and according to the [186], 76% of the vegetables were sold in a supermarket / hypermarket in 2018.

Other drivers

There is limited information about the potential impacts of **social norms** and the social context on tomato consumption in the selected countries. When looking into other countries in Europe, consumers in Denmark and Sweden are strongly affected by subjective norms in their intention to buy organic fresh tomatoes and tomato sauce. Danish and Swedish organic consumers are more aware of the social group to which they belong and are worried about the maintenance of their status quo within the group. Spanish consumers rely more on their own assessment to purchase these specific organic products [189].

In Italy, tomatoes are part of the **culture**, and fresh tomato purchases are concentrated in the Summer months. For example, according to [178], highest tomato purchasing months are August (1,14 kg) and September (1,23 kg). In addition, according to [191] tomato paste is a traditional product of Italian eating behaviour and is consumed several times a week.

With regards to **policy measures**, in Italy, according to [217], there was attempt to make obligatory to have a label of origin for tomato derivate products. According to [218], a project in the Czech Republic aims to incentive for parents to give their children more fruit and vegetables. In this regard, the family should have a primary influence on the creation of eating habits. Education of parents, however, would be necessary.

National bio-economy policies aim to improve the sustainability of local agricultural production. In France, consumption growth is much stronger for processed products, whose prices have risen much more slowly than those of fresh products. Specifically, from 1960 to 2005, consumer prices for fresh vegetables increased by 40% more than average food prices while processed vegetable prices were 40% lower than average food prices. In addition, the stagnation of vegetable consumption in France in the early 2000s, despite public campaigns to promote their consumption, attest the presence of obstacles and rigidities [203].

3.4.3 Trends & barriers

Trends

Even though tomato consumption has showed a constant production and consumption patterns over the last years, there are currently some trends that are changing the way EU citizens consume these products. In particular, new business models are appearing and attracting a new generation of consumers that are more conscious about the environment

and overall sustainability. An example of that are companies that use apps to link local organic farmers with customers, delivering more sustainable and healthy vegetables and fruits products, often called "farm boxes", to the customers' homes. This changes the game for traditional supermarket shopping and opens terrain for an alternative generation of consumers that are digitally connected. Moreover, there is a trend to look more for taste than appearance of a shiny red tomato. These consumers prefer to select an individual "ugly" tomato for its taste, instead of various plastic packaged perfect looking tomatoes. In addition, social movements are educating people and reinventing behaviour patterns towards vegetable and fruit products in general. Key trends observed in selected EU countries are described below:

The closer the relationship between producer and consumer, the stronger and more resilient the whole food chain.

Interviewed stakeholder

Prosumerism: Self-provisioning of tomatoes and growing for own needs are widespread in villages and in the vicinity of smaller towns. As a result of scandals and media cases with poor quality and health-conscious foods, some households are gradually starting to return to grow their own vegetables. The main reason for self-provisioning of vegetables is having access to "own healthy food" which primarily means food grown with no or limited use of pesticides and other industrially produced chemicals and which contain, as a result, the least possible residue of industrially produced chemicals. According to the [186], about 240 thousand households (approximately 6 % of Czech households) produce own vegetables with an average growing area of about 50 m2.

Imperfect vegetables: The number of consumers who are willing to purchase visually imperfect vegetables is growing in the Czech Republic [183].

Large-scale retailers have started to produce their own organic brands (private labels), which means that there is an ever-increasing and real interest of the food distribution system in organic products.

Interviewed stakeholder

Locally sourced tomatoes: In the Czech Republic, it is trendy among young "sustainability conscious" consumers to buy vegetables directly from farmer, with the so-called "from the yard", through so-called farmer box [186]. In Iceland, a high-quality standard is the distinctive feature of Icelandic vegetables, where proximity to the market ensures that the time between production and distribution is as short as possible [219].

Slow food and seasonal consumption: The Slow Food movement in Iceland hosted some events in collaboration with chefs to advertise Icelandic slow food. Tourism is blossoming around slow food around the country where Icelandic culture is shown through food experience and tradition, freshness and quality are key elements. Also, seasonal consumption of vegetables and fruits has become trendy in terms of sustainability. The increase of vegetarian products in the market. According to a round table discussion at Sustainable Future in Iceland, the seasonal consumption of vegetables and fruits has also become trendy in terms of sustainability [220].

New business models: Traceability certifications of tomatoes are emerging as an added value product. For example, the brand Example Pomì (brand owned by Consorzio Casalasco del Pomodoro), is the first Italian food company having received this certification, which serves as a social

map of every product of the total product range of Pomì tracing, helping to map the social imprint with focus on human resources, tracing the social impact of a product along all the main stages of the supply chain, mapping and quantifying input suppliers, ingredients and packaging, evaluates human resources in terms of numbers, working conditions, education level, equal opportunity and allowing the consumer to choose a sustainable product evaluating also the social impact [221] [222].

Other innovative business models include independent farmers producing fruits and vegetables with ecological farming systems and deliver their produce to consumers by subscription. In Germany, companies such as "Apfelbacher" sell fresh vegetables, fruits, fine herbs and healthy bread regularly on subscription, from locally owned organic cultivations [223]. In Iceland, something similar is offered by the Reko market ("beint frá býli" / "straight from the farm"), where customers can by online straight from the producers and pick up location advertised on social media in the Reykjavik area [224] [225].

In terms of business innovation, [226] has addressed plastics and packaging including the plastic from their tomatoes, and has used cardboard rather than polystyrene pizza bases. Other innovations include the selling of unpackaged products in stores (stores (e.g. unpackaged products from local produce and organic and fair-trade options). According to [227], the number of supermarkets in Europe minimising packaging is continuing to rise and initiatives like zero waste supermarkets encourage change in everyday behaviour in order to reduce the amount of waste produced across Europe.

Barriers

It is a structural problem, as most farms and manufacturers are conventional producing companies. The conversion would cost a lot of time and money, and we would not have guarantees that the market or the customers will pay for it.

Interviewed stakeholder

The main barriers of EU consumers to choose tomatoes that were produced under sustainable practices (e.g. organic) have to do with the lack of knowledge, the price and lack of trust with labels. As noted by [192] and [228], uncertainty about the concept of organic vegetables is the main barrier for their consumption, as consumers tend to display a low level of trust in organic food quality certifications. Moreover, even though consumers in Sweden have a positive perception towards organic tomatoes (e.g. good for the environment, better taste and good for health), price is a more important factor that influence tomato consumption in some countries. In contrast, other countries such as Italy, have showed an increase of organic tomato sales. Furthermore, according to [229], organic specifications or other sustainable production specifications hardly ever integrate social conditions of productions (working conditions especially), making it difficult to have a total sustainable consumption.

Another important barrier to consider is related to plastic packaging of tomatoes. The fact that brands and retailers use packaged tomatoes in supermarkets, has an influence on consumers to purchase tomatoes with this presentation, thus contributing to plastic pollution. In Iceland, it is mentioned that some barriers to sustainable consumption of tomato is related to plastic packaging for fresh produce. as well as carbon emissions derived from tomato imports. In addition, EU policies can also act as a barrier or as an enabler to sustainable tomato consumption. For example, policy pressures have been present on growing more products locally as well as with tomato production processes and their respective environmental and social impacts.

3.4.4 A sustainable vision

Fruits and vegetables, with tomatoes included, are among the food types whose consumption is recommended to double if we are to achieve more sustainable and healthier diets by 2050, according to the [7].

However, it is important to recognise that the EU tomato production, depending on the production techniques applied, is to considered to cause relevant negative environmental and social impacts. According to [230], the main environmental impacts of greenhouse tomato production are related on its majority to greenhouse gas emissions due to energy use (lightning, heating and air humidity controls) as well as the leaching of fertilizers. In addition, there is a potential health impact of tomato production mainly because workers in greenhouses are severely exposed to pesticides. According to [231], impacts of fertilizers, if not properly used, include contribution to global climate change, degradation of soil and water resources and air quality, soil-nutrient depletion and potential harm to human, animal and soil health.

From a consumption perspective, there are also issues to be addressed. According to a recently published JRC article, EU households generate about 35.3 kg of fresh fruit and vegetable waste per person per year, 14.2 kg of which is avoidable (EU Science Hub, 2018). In addition, single use plastic bags and plastic packaging are widely used in EU supermarkets for fruits or vegetables, thus enlarging the worldwide plastic issue. In this context, the transition towards more sustainable food consumption, to which the increased consumption of tomato might contribute, may require solutions towards more sustainable production and consumption of tomato, including environment-friendly production approaches, demand shift towards more sustainably sourced tomatoes and behaviour change to reduce food waste generally and specific regard to fruits and vegetables.

3.5 Bread Consumption

3.5.1 Landscape

How much is consumed

The consumption of bread and bakery products steadily increases in the world, which is mainly associated with the growing populations. At the same time, a decrease in bread consumption is observed in developed countries. From a consumption perspective, the competition of other food alternatives for breakfast and outside home are considered to be global trends that result in the decrease in bread consumption.

Overall, EU bread consumption is seen as a first high-quality staple food and per capita consumption is very diverse across European countries. According to the [176], bread consumption per capita decreased from 66 kg in 2007 to 60 kg in 2017. Based on information of the International Association of Plant Baker (AIBI), the highest consumption of bread per capital is reported in Turkey (104 kg) and Bulgaria (95 kg), while the lowest in Great Britain (32 kg). In addition, the level of EU bread consumption was relatively stable in the last years, having average of 59 kg of annual bread consumption per capita [232].

The decline of EU bread consumption is partly attributed to the observation that EU consumers are moving out of bread to consume other food products. For example, EU consumption of rice has increased from 4.7 kg in 2005 to 5.3 kg per capita in 2017, as consumers' diets have diversified away from traditional starch components such as bread, pasta or potatoes [177]. Moreover, other trends reducing bread consumption, also identified worldwide, are related to mobile and flexible employees whose modern lifestyle promotes the understanding of foreign cultures and culinary diversity [233].

Bread purchasing locations in Europe vary from one country to another, but these can be mainly referring to artisan bakeries, specialized stores, supermarkets, hypermarkets and discounters. For example, in Germany, according to the [234], artisanal bakeries including their branches in the prepayment zones were market leaders in the bread market in 2017 accounting for 46.3 % of all bread sales, followed by discounters (24.2 %) and supermarkets (22.5 %).

EU in the global context	• Global consumption of bread products is increasing, while in developed countries such as in the EU a decline in bread consumption has been observed [176].
EU consumption quantities	• The level of EU bread consumption was relatively stable in the last years, having average of 59 kg of annual bread consumption per capita [232].
EU consumption trends	• Bread consumption per capita decreased from 66 kg in 2007 to 60 kg in 2017 [176].

Consumer characteristics: According to a research in Germany by [235], consumers can be divided into four different groups: (1) traditional consumers (12.7%), (2) quality-oriented consumers (35.1%), (3) health-conscious consumers (28.0%), and (4) price-conscious consumers (24.2%).

- **Traditional consumers** intend to buy mixed wheat bread or mixed rye bread, and they are aware of products with a long durability and a low price. Their preferred purchase location is the bakery machine in the supermarket. As they do not prefer bread with any superfood ingredients or are not aware about the healthy properties of bread, a possible method to attract their attention could be to promote packaged sliced bread that is ready for them to take home. Even if they prefer a low price, they are not price conscious because of their financial situation. A higher price could be possible if the durability of the bread is improved. All in all, convenient and highly durable bread with an appropriate price is a fitting product for traditional

consumers. Furthermore, this group has the potential to extend their knowledge about food, and some of this group could develop into quality-oriented consumers.

- **Quality-oriented consumers** pay attention to regional, traditional, fresh, natural, or organically produced bread. Contrary to traditional consumers, they are open-minded towards superfood ingredients. Interestingly, this group would pay a higher price for higher quality, so there is the possibility to promote quality label strategies for bread to increase sales in this segment, particularly for organic or GMO-free bread. Moreover, this segment is knowledgeable about groceries and possesses cooking skills.
- **Health-conscious consumers** like to buy groceries that have a positive effect on their health and well-being. Because of this, they are passionate about cooking and interested in exotic, unfamiliar products.
- **Price-conscious consumers** are aware about cheap offers due to their limited financial budget for groceries.

According to a study in France [236], on the other hand, bread consumers can be categorised in 6 types of bread eaters:

- The **"selective" eaters**: bread is not essential and they eat little quantities (once or twice a day). They choose it scrupulously, with particular attention to possible health impacts. They attend more organic stores than bakeries. They consume more organic and gluten free bread (or cereals). Profile: Rather women, high income or student, under 45 years old.
- The **"snack" eaters**: Bread is primarily consumed at home, only once or twice a day. They eat rather basic breads and are very attentive to the preservation of bread, including the possibility of freezing. When it is consumed outside, it is especially in fast food restaurants or cafeterias. Profile: mostly men, low income and student, under 45 years old.
- The **"jaded" eaters**: Bread is consumed daily because it is considered essential for a balanced diet, but it is more consumed by habit and culture than pleasure. They have a low bread consumption and are not interested in the regional breads and breads of the world. Profile: unspecific
- The **"nutritionist" eaters**: For them, bread contributes to nutritional balance and health. They consume a wide variety of different breads and eat them at each meal. They are attentive to the nutritional qualities of the products, and the fact that it is organic. Profile: rather women, more than 30 years old.
- The **bread "gourmets"**: for them, bread is an important kind of food. They consume it a lot (often more than three quarters of a baguette a day), with a very qualitative vision on bread. They buy many different types of bread (often more than 10 types of bread) and are very sensitive to home-made bread, baking, varieties. This category is globally rising. Profile: rather retirees
- The **"conservative" eaters**: Bread is important and must be consumed daily, with each meal. They provide themselves especially in the independent bakeries, appreciate the cooking on the point of sale, the flours of origin France. They favour the classic baguette and farmhouse bread. Profile: rather men, retired, over 60, rural.

Additionally, according to a research analysis of [232] younger consumers tend to eat less bread, but generally eat more bread out of home. Also, men usually eat more bread than women, but women eat a wider variety of bread. Finally, the consumption of bread is observed to increase with age.

3.5.2 Drivers

As previously mentioned, EU drivers for bread consumption are diverse among countries. Although bread is seen as a staple food in most EU countries, current global and European trends are setting up a different consumption landscape of bread consumption. For example, pressure of other alternatives available for breakfast and food consumption outside the home result in the decrease in bread consumption. Concretely:

- The key drivers influencing bread consumption in the EU mainly involves health factors (e.g. perceptions of health and wellness from bread), price and purchasing power of consumers.
- The second most frequently mentioned drivers include personal and social context aspects, such as traditions, habits, family, new product developments, ageing population and packaging/information of bread products.

Food Attributes

Health: According to the International Association of plan Bakers (AIBI), National Health Authorities in Europe recommend the consumption of bread, although consumption figures remain under their recommendation level [233]. In Germany, consumers are becoming increasingly aware of the importance of health-conscious consumption of bread and bakery products [237]. Health-related characteristics are particularly important for around half of German consumers when buying baked goods [238]. According to [239], in the UK, around a third of bread consumers look for healthy qualities when buying bread products. In the UK, bread consumers generally believe that bread is good source of fibre (72%) but a similar percentage believe that it is unhealthy if eaten too often [240]. In Italy, according to [253], healthy eating trends like gluten free, superfoods and alternative grains grew +18% in the past years [232] as well as wellness characteristics such as easy to digest bread, multicereal, multivitamins, fiber rich, mineral salts and [241]. Also, Italians prefer bread types that are healthy, low fat, little salt, wholegrain. On the other hand, even though consumers are health conscious, they are not very well informed about healthiness of bread, grains, yeast. According to a research from [242], Italian consumers believe that the greater part of grain is imported and they believe quality and safety standards are bad. In the UK, indicates that bread consumption is static or in decline as consumers see it as generally unhealthy.

Taste, quality and safety: In the UK, bread consumption is seen as a basic need. The near universal purchasing of bread (97%) demonstrates the maturity of the market and bread's role as a household staple. Also, UK

consumption of white bread is higher among younger consumers who prefer a sweeter taste, as the bran in wholemeal tastes more bitter [240]. In Germany, food safety is also playing an increasing role in bread and bakery products, where consumers are increasingly well informed and critical [265]. In addition, [237] indicates that German consumers are increasingly asking for baked goods whose consumption is accompanied by a certain moment of pleasure and experience. According to [243], bread preferences in Italy aimed for organic bread, local bread bought directly from farmers, new products like gluten free and alternative flours like Kamut or spelt. In the Czech Republic, consumers are more conservative and prefer classic bread, although in the last ten years, bread specialities - bread wheatgrass, wholegrain, rye, are more pronounced in the consumer basket [244].

Organic bread: According to the [176] unlike conventional bread consumption, organic bread consumption is increasing. In addition, consumers in the EU and abroad will become more demanding towards the food they consume, giving impetus to adding value (such as local, organic or other certified products). In Italy, consumer´s interest in organic bread grew +2% [232]. Also, according to [245], organic industrial bread had a +10,2% value growth in Italy. In the UK, some consumers are concerned about sustainability, but not always reflected in consumption behaviours.

Expiry date: This is the second most important consumption factor for consumers in Latvia [233].

Origin: According to a market research by AIBI, there is an EU increase of searching for regional and local bread products. In Italy, consumers also rediscover traditional local bread types [246].

Economics and Marketing

Economic development: it is believed that the lack of dynamic growth in developed countries make household incomes stagnate and lead to an inert demand for bread and bakery products [233].

Purchasing power: bread is going to be one of the products the consumers are ready to pay more (after an economic crises), especially if the bread is made according to an original or ancient recipe or technology. For example, in France, people with low income tend to eat more bread (e.g. eat more sandwiches) [247]. Specifically, French consumers with low income tend to eat more bread as they eat more sandwiches (30g/day for low income workers compared to 10g/day for executives with higher incomes). According to Mintel (2018), UK consumers packaged sliced bread is more typically eaten daily by those who are struggling financially (47%) and families (48%), of those in households with children eating it once a day or more. UK consumers with a heathier financial situation typically have a larger repertoire of bread consumption. Moreover, according to [248], in the Czech Republic, lower-income households consume significantly more bread and wheat-flour bakery products than other households.

Price: according to an EU survey from [233] the main reason for consuming wheat bread was the price. In addition, consumers believed that an increase in bread consumption could be achieved by producing tastier breads. In this regard, according to a research from [249] in the Czech Republic, consumers say that price does not play a major role, but people especially want a good taste. The importance of the bread price in Czech consumption decisions is decreasing. Also, the quality of bread and bakery products is very important for Czech consumers, and with the increasing purchasing power of the population there is an increasing number of people willing to pay for higher quality [257]. In France, the price variations and market volatility of raw materials implies difficulties in production, bread and grain prices are rising much faster than general inflation since 1991. The increase in the price of the baguette might have had an impact in the level of bread consumption [250].

Labelling and information: due to an increased demand for organic food and internationally recognisable food products, labelling and communication will play a consumption decision factor for bread consumption. According to a study in Latvia, 76% of the respondents were interested in information available on the packaging of bread. Also, related to labelling and packaging, the brand was the third most important factor for bread consumption after the price. In the UK, 34% of consumers would like to see more bread with nutritional benefits. According to a research in German, [251] highlights that all nutrition-related data significantly increase the health perception of breads.

Packaging: in Italy packaged industrial bread (soft and dry bread) is growing as alternative to fresh bread from traditional bakeries. According to [245] trends 2018/17 were a volume growth of dry bread (+2,4), due to performance of sales in hyper and supermarkets and volume growth of soft bread (+3,4%) due to the performance of discounters. In the Czech Republic, consumers prefer a lower product weight and smaller packaging; however, 83% of Czech consumers prefer fresh, unpacked bread and bakery products, sales of packaged bread are growing [249]. Also, Czech consumers do not buy large loaves of bread, but their divided parts. There is a growing preference for bakery products of smaller weight, especially packaged or sliced [252]. In Germany, it can be assumed that when buying packaged bread, the product range tends to be looked at more briefly. According to [237] eye tracking studies show that perception times for packaging elements are extremely short and purchasing decisions are often made very quickly.

Marketing: In Italy, according to [253] online, offline marketing strategies are applied by the main players of the industrial bread sector (e.g. important investments in TV advertisement). Moreover, in the UK, according to [254], consumers like campaigns about adding flavours and textures to a meal (e.g. Tesco's "Everyday little helps" campaign, which shows the ingredients for making spaghetti Bolognese, with a side of garlic bread).

Personal factors

Gender: in France, women eat less bread than men and the consumption of bread increases with age. Women consume only 80 to 90 grams of bread per day against 140 grams for men (the equivalent of half a baguette a day for men). In Germany, white bread is eaten by about 45% of boys at least once a day [255].

Ageing population: The consumption of bread increases with age. Studies on the market of bakery products in Europe (Innovation and Market, 2009) explicitly show that in view of a bread consumption increase in the number of older individuals (aged over 65) in Europe. However, in France, there is a nuance to this general trend: young adults consume slightly less bread than their younger counterparts (15-19 years); perhaps because of the departure from the family home (young adults usually buy less bread, and not on a daily basis, compared to their parents) [247].

Changing lifestyles: in the EU other alternatives available for breakfast and food consumption outside the home are considered to be global trends that result in the decrease in bread consumption. In addition, as seen in other food product cases, EU consumption lifestyles are more mobile and tending to skip breakfast times. Also, the EU decrease in the consumption of bread could be explained by the number of mobile and flexible employees whose modern lifestyle promotes the understanding of foreign cultures and culinary diversity increases as well [233] Moreover, shopping behaviours such as "one-stop shopping" at a supermarket due to the lack of leisure time, changes consumption patterns. In the UK, out of home eating is a factor of a lower bread consumption. In the Czech Republic, bread in the diet is gradually replaced by other healthier bakery products and also cereals and muesli [256]. Furthermore, [237] highlights that in addition to the effects of the megatrend of individualisation, the consumption and purchasing behaviour of bread and bakery products as well as of foodstuffs as a whole is influenced by a general change in working and personal life. Moreover, in view of the lack of time and increasing mobility, the consumption of bread and bakery products on the move is no longer an exception for many consumers, but is increasingly becoming a habit. The demand for snack and snack products (such as ready-to-serve rolls, panini or mini pizzas) is also increasing for a certain variety of products.

Convenience: according to [245] there is a growth in Italian sales of packaged bread at retailers as alternative to traditional bread from bakeries (e.g. sliced bread sold in discounter channels). Also, as indicated by [257], convenience is highlighted as a current driver for bread consumption in the Czech Republic.

Values: in France, elder people usually appreciate/consume more artisanal bread. They prefer breads that is considered to be healthier. They often keep some bread in the freezer, not to spoil it and in order to have some bread that is always available [258].

Social Context

Family: According to a survey in Latvia, it revealed that 97% of the respondents preferred the bread they or their family members liked [233] In France, bread is mostly consumed at home during the main meals and breakfast is the most important time of consumption. The fact that French consumers take less and less time for breakfast also has an impact on bread consumption [247].

Traditions: In Italy, traditional bakeries are important to keep alive the tradition, quality, and innovation in bread production. For example, according to a market research by [259], 86,5% of Italian consumers prefer fresh bread from traditional bakeries. In Iceland, traditional baked preparation of bread and other baked products, is made from geothermal heat of the ground. These remain popular with both locals and tourists [260].

Other drivers

In recent years, when it comes to the preferred **place and environment** for bread purchase, there has been a considerable expansion in the number and type of bakeries open in the Reykjavík area. There has been a general trend towards artisan bakeries, with new and innovative bread and cake products. Partly the emergence of new bakeries has been to cater to the new tastes of Icelanders, but also it has occurred in conjunction with the tourism boom occurring in the nation. In addition, according to [261], bakeries in Reykjavík are often open from very early in the morning, making them a popular breakfast venue for tourists and Icelanders alike. In France, craft bakery represents around 50% of the consumption while industrial bread represents the other 50% (which represents a French specificity compared to other European countries, eating much more industrial bread, especially in the Northern countries). In Italy, since tradition conservation is an important factor for Italians, there are 20.677 traditional bakeries in the country [242]. In addition, several traditional bakeries have their own production and distribution. In the Czech Republic, most of the bread is purchased in small specialized stores (44%), hypermarkets (21%), supermarkets (19%), discounts (14%); and as some other EU countries, the number of customers in specialized bakery stores is growing (Retail News, 2017). Moreover, according to [252] 44% of customers in the Czech Republic shop bread in small and specialized stores. In Germany, bread consumption is purchased 46,3% from artisanal bakeries /markets, 24% discounters and 22,5% supermarkets.

Adults in **rural areas** or small towns consume significantly more bread than others [233] In **large cities** of the Czech Republic, consumers who prefer a healthy lifestyle have a growing demand for baker's superfoods and gluten-free products. (Retail News, 2017). In Germany, [238] highlight that regions within the country also play a cultural-historical role in bread consumption. In Iceland, according to [262], **climate change** is likely to increase cereal harvests in the coming years. This may reduce Iceland's reliance on imports, however, the effect is likely to be small and could easily be offset by the increased demands of a population projected to reach 400,000 in the coming two decades.

With regards to **public regulation**, the number of countries where the production, distribution and prices of bakery products are regulated by the government and most of the quantity of bread is produced by order of the central and local governments, often for distribution among the poor, is increasing [233] In France, artisan bakers experienced economic difficulties in the 1980's and 1990's, the French government, through the influence of millers who wanted to keep their commercial outlet with craft bakeries (allowing a better valuation of flour), has created a legislation to give a frame for what could be called a craft bakery and what could not, it allowed to keep artisan bakers which represent around 50% of the consumption in France. In Italy, according to an agreement between Emilia-Romagna region and main business associations of the bread industry, a project was implemented to promote "Bread with less salt" and help to prevent hypertension and heart diseases in the population. This agreement indicated that the bread will be available without changing its price, produced with local wheat, with extra-virgin olive oil and without additives [263]. In the UK, some CSR (Corporate Social Responsibility) activities support using stale bread for alternative uses to reduce food waste.

Many food manufacturers are trying to reduce their energy needs, the use of drinking water and the waste produced in the production process. The same applies to residues in corn and cereal products. All of this is much more prevalent among consumers today when it comes to food choices. It is being discussed more and more in the media. (...) This is possible by better data availability, for customers and manufacturers, and that always increases the pressure on manufacturers.

Interviewed stakeholder

3.5.3 Trends & barriers

Trends

Besides drivers influencing consumption behaviours in the EU, there are several trends and barriers which will impact the future of bread production and consumption, as further elaborated below.

Sustainability labelling: It plays an important role, especially in modern distribution channels such as retailers/supermarkets. Consumers in the EU and abroad will become more demanding towards the food they consume, giving impetus to adding value (such as local, organic or other certified products) on the one hand and shifts between food categories on the other. In addition, trends towards reduced meat, bread and sugar consumption, which is compensated by increased consumption of plant-based proteins, exemplify this consumption shift [176].

Niche bread products: New niches for bread and bakery products are sought for and found in Europe to meet the wishes of consumers. One can clearly notice a "boom" in sales of frozen bakery products, which has undergone consumer testing. In Latvia, bread producers, faced by the decreasing market demand for bread, will have to work on maintaining and enhancing the quality of the bread as well as developing diverse alternative products, thereby increasing competition [233] Since the population's health problems get worse and there is an increased need for dietary bakery products made of rough flour, a broad market niche is available in the market.

Ageing population: A global demographic change is an increase in the number of single-person households, which are also ageing. Since bread

consumption increase among older individuals (aged over 65) in Europe, services such as delivery, custom-made orders and consumer personalisation along with the choice of bakery products will be crucial for this consumer group; besides, not only the quality of the product but also its association with the particular site, bakery and local brand would be important [233].

Organic: Unlike conventional bread consumption, organic bread consumption is increasing in the EU [176].

Barriers

Price & availability: Organic breads are currently still marginal in total bread consumption. The high price and the lack of availability in traditional bakeries are the most significant factors which limit the consumption of organic bread [264].

3.5.4 A sustainable vision

Willet et al. [7] highlights that whole grains are emphasised food for consumption if we want to achieve healthy diets within planetary boundaries. Moreover, healthy diets have an optimal calorie intake and consist largely of a diversity of plant-based foods, low quantities of animal source foods, contain unsaturated rather than saturated fats, and limited quantities of refined grains, highly processed foods and added sugars. In this sense, the report recommends a daily macronutrient intake of 232 grams of whole grains (including wheat) per day.

Similar to tomato consumption, as emphasised above, the transition to more sustainable food consumption in the future, of which the increased consumption of bread might be part, would require addressing consumption and production related sustainability impacts, which may include production processes, fairness of the chain, and waste reduction.

Chapter 4

Main learning and outcomes

Food consumption behaviours result from a combination of drivers

From the data collection and analysis conducted for this report, it became clear that food consumption behaviours are complex and influenced by a combination of drivers, not being possible to identify one single reason behind food purchases. It was possible, however, to identify the drivers that seem to influence consumers the most. Additionally, drivers of food consumption vary with lesser or greater degree across different food product categories, consumer segments and national / local / concrete contexts.

Price as a key driver of food purchasing behaviour

Throughout all the sources of information feeding into this report, namely secondary data collection, consumer focus groups and expert interviews, price was mentioned as a key driver influencing food purchasing behaviour. Behaviours do not seem to be necessarily driven by the cheapest price, but price considerations count among the main determinants of purchasing decisions. This may suggest that monetary and economic instruments have a role to play in making behavioural shifts towards sustainable food consumption more attractive or in demotivating consumption patterns considered unsustainable.

The social context and habits have a considerable influence in food consumption behaviour

Particularly through the consumer focus groups, it stood out that the eating habits of the family or other social contexts around the individual are important in shaping food purchasing behaviour. Related to perceptions of normative behaviour by socially connected peers, social norms can function as a barrier but also as an opportunity for fostering sustainable behaviour change concerning food consumption behaviour.

Health concerns as a driver, a trend and a sustainability barrier

Health was identified as playing an increasingly important role in shaping food consumption behaviours. The type of influence of health, however, largely depends on the product category of focus, as demonstrated particularly by the secondary data analysis. As beef consumption is still largely perceived as healthy, in this case health consists of an important driver of beef consumption. In the case of dairy products, on the other hand, there is a divide, with dairy consumption being considered by some as healthy, and by others as the source of health issues leading consumers to look for plant-based alternatives. From the consumer focus groups and the expert interviews, health was identified as a cross-cutting vector

of food trends. Some stakeholders highlighted that health appears as a cross-cutting motivation which overrides all other considerations. Health is in fact the primary vector for many current food trends, including the consumption of organic products and the demand for "free-from" products (free from added sugar, additives, etc.). More generally, today's food trends mainly stem from consumers' fears which transpire from a series of health concerns (e.g. mad cow effect) (P33).

Environmental awareness exists but is not top of the list

Environmental concerns related to food consumption are increasingly in the agenda of individuals and organisations, and the consumer demand for solutions to improve the sustainability performance of food value chains has increased. Awareness and appreciation of sustainable values, however, does not seem to result necessarily in environment-friendly behaviours when it comes to food consumption, as other factors seem to take precedence, such as price considerations, lack of time and food shopping habits. From some of the stakeholder interviews and some of the consumer focus groups, the actual sense of environmental awareness with regards to food consumption among most consumers seemed low or inexistent.

Sustainability trends are developing but still consist of a niche

Particularly through the expert interviews, it became clear that sustainability trends and attributes related to food consumption, including veganism and vegetarianism, local consumption and slow food movements are there but have a limited impact in the mainstream food industry.

The structure of current food systems is not oriented towards sustainability

From the expert interviews, it became clear that a key barrier to address food consumption behaviours today lie on the foundation and structure of current food systems. Most farmers and manufacturers perform for years within a "conventional" food production and consumption system, in which there are nearly no incentives for changing the direction of focus. In the focus groups, the consumers also reported various challenges to behave more sustainably, including lack of affordability of products, lack of access to alternatives and lack of time to engage with new food consumption patterns.

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