



Macro-analysis of systemic drivers influencing food systems

Deliverable D2.1





DELIVERABLE PLAN'EAT – D2.1

Macro-analysis of systemic drivers influencing food systems



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Nature of the deliverable		
R	Document, report (excluding the periodic and final reports)	X
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DEC	Websites, patents filing, press & media actions, videos, etc.	
DATA	Data sets, microdata, etc.	
DMP	Data management plan	
ETHICS	Deliverables related to ethics issues.	
SECURITY	Deliverables related to security issues	
OTHER	Software, technical diagram, algorithms, models, etc.	

Dissemination level		
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SEN	Sensitive, limited under the conditions of the Grant Agreement	
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Abbreviations

Terms	Definition
GDP	Gross Domestic Product
NCDs	Non-communicable diseases
SES	Socio-economic status
TCA	True cost accounting

Executive summary

While the unsustainability of the food system requires the promotion of sustainable and healthy food consumption in the EU, its complexity poses an important challenge to developing solutions, because several loosely coupled subsystems interact through a large quantity of drivers that together produce societal outcomes. The macro-analysis of systemic factors that influence the food system focused on mapping these complex interrelated factors in the EU food system as a means of pinpointing promising places for policy intervention, which we call leverage points. To identify leverage points in food systems requires the development of a systems map of the food system that allows for capturing the main dynamics at a relatively high level of abstraction. For this, we have developed a basic stylized food systems map based on a state-of-the-art conceptualisation of food systems in five steps: (1) identification of food system trends, (2) description of mechanisms behind EU food system trends based on literature review, (3) development of a first systems map, (4) first adaptation of the systems map based on expert interviews and (5) second adaptation of the systems map and identification of leverage points through focus groups.

Based on a combination of literature review, theoretical reasoning, expert interviews and focus groups, we identified a pattern that captures the main functioning of the current food system. Food system activities are strongly driven by economic motivations, but insufficiently take into consideration their adverse social, environmental and health-related impacts. In addition, food system actors seek new opportunities to fuel this economic engine addressing and creating demand that goes beyond basic needs, but that may result in more adverse outcomes for health and the environment. Innovation and liberalisation tend to amplify this pattern, while at the same time also more disruptive innovations are emerging. And finally policies may also amplify some of these mechanisms or create opportunities for developing solutions driven by rising public concerns.

The focus groups identified five solutions, namely true cost accounting, financial incentives to foster ecosystem services, broad re-valuing of food, alternative proteins and community-based initiatives to address the socio-economic and environmental problems of the food system. The groups then identified specific leverage points to implement these solutions in the food system. Implementing the identified solutions and leverage points to change food environments and consumer behaviour to foster healthier and more sustainable diets requires careful consideration of social equity and gender issues. Policies need to take into account the financial constraints of people, particularly when interventions make food more expensive or involve other types of barriers for vulnerable people.

1. Introduction

This deliverable reports on the activities of Task 2.2 which is situated within WP2 that aims “to better identify, understand and influence mechanisms underlying dietary behaviours with high positive environmental, socio-economic and health impacts and the broader food environments and food systems in which these are embedded. Key leverage points for behaviour change within LLs food systems will be defined”. For this, WP2 is subdivided into a macro-task (task 2.2), a meso-task (task 2.3) and a micro-task (2.4). Task 2.5 synthesizes all findings of WP2. Task 2.2 analyses the underlying drivers that affect the European food system and identifies leverage points that can change these systems. This was done by using systems mapping underpinned by literature review, expert interviews and focus groups. The ensuing results constitute a basis to design macro-level interventions in WP4.

There is a general consensus that a systemic approach is needed to address agri-food system challenges. Not taking a systemic approach risks of proposing interventions that insufficiently consider the complexity of systems, such as unintended side-effects, resistance, delays, etc. As a result, proposed interventions may not work or may create effects elsewhere. Any quantitative, qualitative or mixed-method approach that addresses system complexity faces the challenge of balancing between manageability and comprehensiveness.

To define the macro-level to be analysed, we used the conceptualisation of food environments as embedded in the food system provided by Downs et al. (2020), as depicted in Figure 1. Thus, the micro-level refers to diets and how they are shaped by individual factors. The meso-level refers to the surrounding social and physical food environment. The macro-level refers the system at large, including sectors of influence, the socio-cultural and political environment and ecosystems.

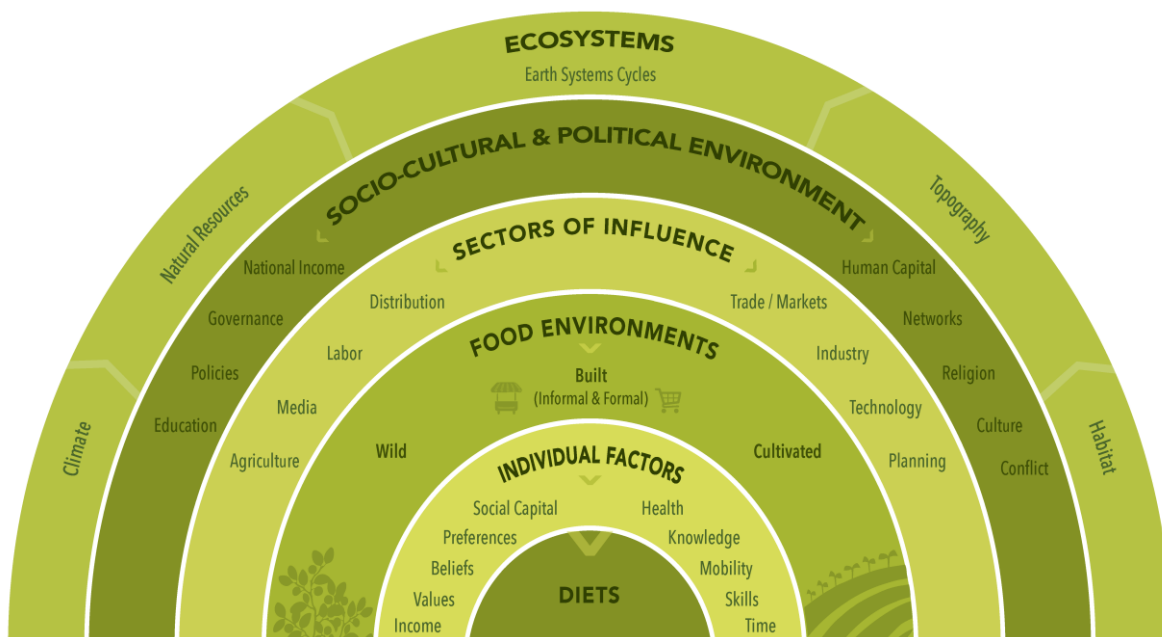


Figure 1: Positioning diets within the broader food system based on a socio-ecological model (Downs et al., 2020)

To identify leverage points in food systems requires the development of a systems map of the food system that allows for capturing the main dynamics at a relatively high level of abstraction. For this, we have developed a basic stylized food systems map based on a state-of-the-art conceptualisation of food systems in five steps: (1) identification of food system trends, (2) description of mechanisms behind EU food system trends based on literature review, (3) development of a first systems map, (4) first adaptation of the systems map based on expert interviews and (5) second adaptation of the systems map and identification of leverage points through focus groups.



This deliverable is organised as follows. Section 2 conceptualizes food systems and leverage points. Section 3 describes the methodology used. Section 4 introduces the food systems map and discusses the leverage points identified in the focus groups. Section 5 concludes this deliverable.

2. Conceptualizing food systems and leverage points

A food system can be conceptualised as the range of activities carried out by food system actors leading to a set of outcomes, including economic and social well-being, food and nutrition security and environmental sustainability (Zurek et al., 2022). Food system activities are governed by institutions and influenced by driving forces that originate from within the system or from adjacent (e.g., climatic, economic). The authoritative HLPE food system conceptualisation categorizes such drivers into five groups (Figure 2):

- Biophysical and environmental drivers
- Innovation, technology and infrastructure drivers
- Political and economic drivers
- Socio-cultural drivers
- Demographic drivers

Food system activities considered include production, storage & distribution, processing & packaging and retail & markets. Figure 2 shows food system interactions at a high level of abstraction with the systemic nature mainly represented by feedback loops that run from outcome and impacts to drivers on the one hand and political actions on the other. Most food system conceptualisations (including the HLPE one) takes the supply chain as starting point, with arrows depicting food flows and supply chain activities shaping the food environment. Figure 3 provides an example of a simplified conceptual framework of these interactions between steps in the supply chain and broader systemic parameters in the field of public health nutrition.

The leverage point framework is used to isolate policy intervention points that may trigger renewed patterns of interaction throughout society (Meadows, 2009). Such efforts have led to recommendations for policy interventions targeted at leverage points in domains such as finance (Ferrando, 2018), health (Bolton et al., 2022; Grzywacz & Fuqua, 2010, Hawkes, 2009), processed food (Anastasiou et al., 2023), food waste (Messner et al., 2022), agriculture (Pérez-Ramírez et al., 2021) and the bioeconomy (Schanz et al., 2019). While these efforts provide a diverse range of leverage points relevant for the EU food system (Dorninger et al., 2020; Zimmermann et al., 2023), there remains a lack of integrated approaches that take into account interaction effects between leverage points. Moreover, targeting just leverage points runs the risk of either making only shallow contributions to a transition (Dorninger et al., 2019; Abson et al., 2017), or to encounter backlash and lock-ins because the modification does not align with the rest of the institutional landscape (Herrero et al., 2021). Given that a delay in response to environmental or health problems likely aggravates environmental pressures, it is essential that whatever transition pathway will be followed is performed as quickly as possible.

The leverage point framework distinguishes between four types of leverage points within a system: (1) parameters, (2) feedbacks, (3) design, and (4) intent (Abson et al., 2017, based on Meadows, 2009). These types of leverage points are ordered from shallow to increasingly deep structures.

Shallow leverage points are concrete and directly observable:

- The shallowest leverage points are **parameters**, consisting of quantifiable and tangible characteristics that are relatively easy to map and measure (such as subsidies, taxes, standards, size of buffers) (Brock, 2023; Meadows, 2009).
- **Feedbacks**, such as delays and strength of feedback loops, are also considered to be shallow, but have a more relational nature because they are based on the interrelationship between parameters.

Deep leverage points tap into relational meaning-making structures that are harder to map and measure, but have a wide influence on social processes.

- The first deep level of leverage points concerns the **design** of the system that manages how parameters and feedbacks operate (by influencing the access to information, the rules of the system, and who is able to change those).



- Lastly, the deepest type of leverage points entails the **intent** of the system (including the goals, values, and paradigms embedded in the system). Those leverage points do not even exist as explicit or tangible entities, but only become apparent in their association with shallower leverage points.

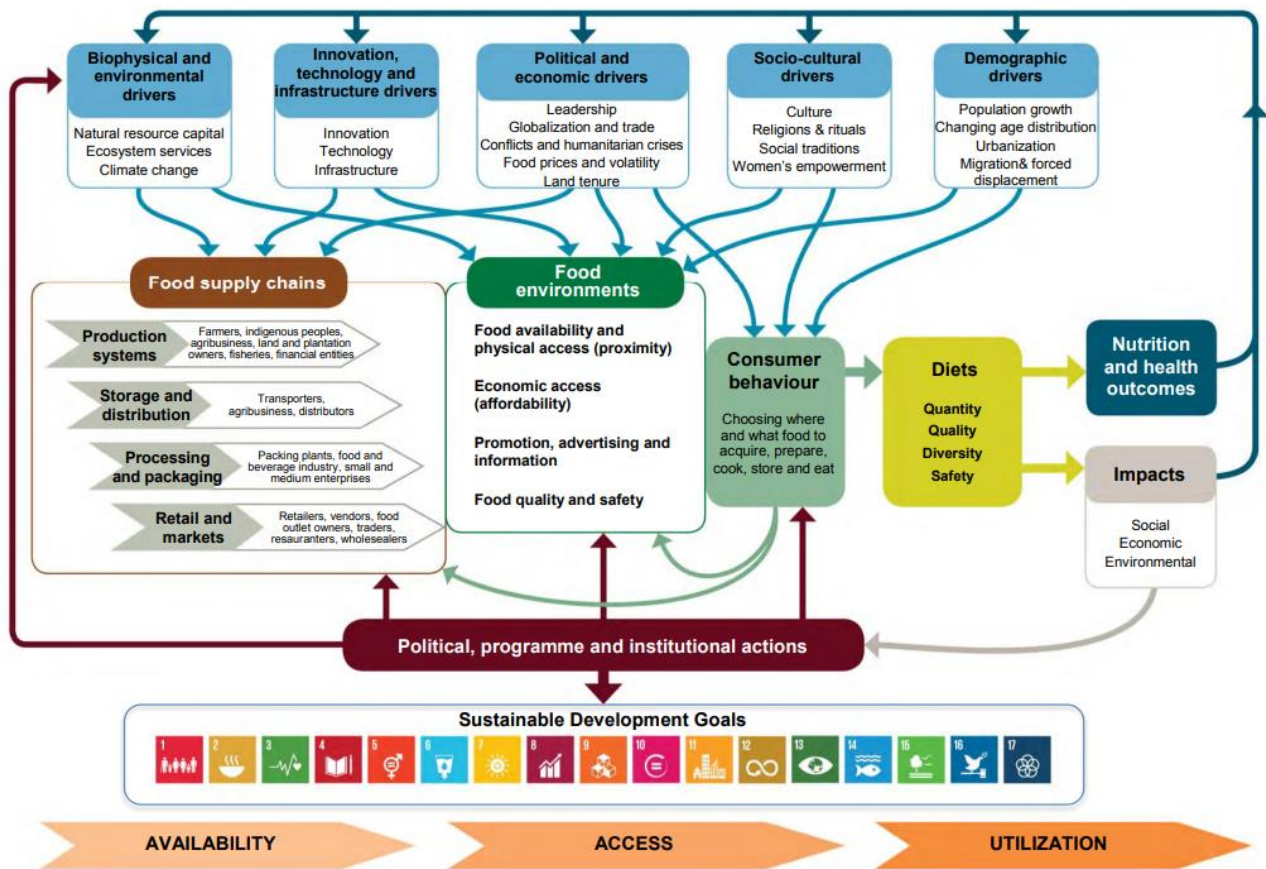


Figure 2: Food system conceptualisation by the High Level Panel of Experts at FAO (HLPE, 2017)

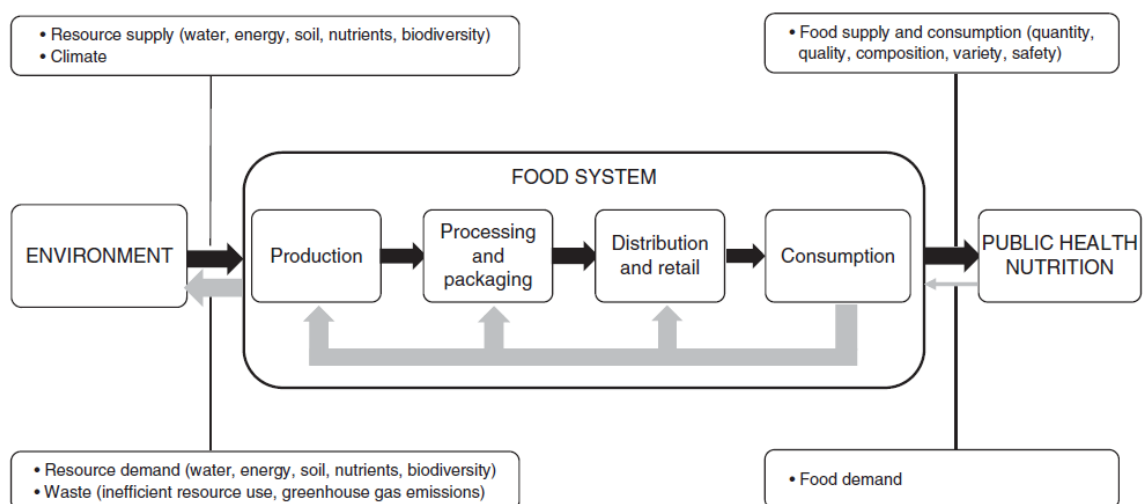


Figure 3: Simplified conceptual framework of the environment-public health nutrition relationship (Lawrence et al., 2015)



3. Methodology

To identify and analyse the underlying drivers that affect the European food systems and identify leverage points that can change the system, a stylized systems map was created to depict the EU food system at a high level of abstraction. This food system map was then used to identify leverage points. To construct the map, a set of food system trends was identified and analysed to serve as an entry point into the analysis of underlying mechanisms and their drivers.

3.1. EU food system trends

A rapid literature review of EU level food system documents (e.g., reports, visions, foresights) was conducted to identify a long-list of trends. Trends are mid- to long-term evolutions in terms of important variables within the food system, e.g., increased business consolidation within parts of the food system. These trends are used as entry point into the food system to identify drivers influencing these trends. As Task 2.3 (meso) focuses on the food environment and Task 2.4 (micro) focuses on consumer behaviour, we focused on those food supply chain activities preceding consumption as point of departure. More specifically, following HLPE (2017), we started from four sub-systems: (1) production systems, (2) storage and distribution, (3) processing and packaging and (4) retail and markets, but then added the input provision system (fertilizers, feed, chemicals, machinery, etc.). This is an important delimitation of our analysis, which we underpin by arguing that the main aim of the analysis is to find out the main mechanisms of how business actors function within the food system.

Overarching trends—affecting all sub-systems—as well as sub-system specific trends were identified. The sub-systems were taken as a starting point for a quick-scan of 18 documents concerning the European food system to isolate trends using an iterative approach (see Annex 1). These reports were selected due to their broad and systemic approach. A shortlist of trends was compiled on the basis of the insights obtained from scanning the reports. As insufficient trends were identified in the sub-systems processing & packaging and storage & distribution, six additional documents were included. The discussion of the trends and their variables was integrated in the discussion of the food system map.

An extended literature review was conducted to identify the drivers for each trend, i.e., the factors that influenced the various trends. Sufficient attention was devoted to ensure that drivers from the various HLPE categories (see Figure 2) were covered, so biophysical and environmental; innovation technology and infrastructure; political, economic and commercial, socio-cultural and demographic drivers. The targeted literature review was conducted through a snowball sampling approach until qualitative saturation was reached. Inclusion of documents depended on three criteria: (1) the publication regarded the EU food system, (2) describes interactions driving one of the selected trends on the macro-level, and (3) is published in the last 20 years.

3.2. Food system map

First, the variables and their interrelations collected through the literature review were converted into causal-loop diagrams using the online tool Kumu©. Then, all causal loop diagrams were merged into one large map which was used for validation by 18 experts (9 female, 9 male) representing different aspects of the food system. Experts included representatives from NGOs (2), professional associations (5), the European Commission (2) and academics (9) representing the various sub-systems and themes. Online interviews were carried out with these experts to collect feedback on the large map. The interview guide is included in Annex 2.

Based on their feedback and literature on food systems maps, a core food system map was built taking the food supply chain as point of departure. The causal-loop diagrams earlier developed were then connected to the core food system map. Redundant or overlapping variables were removed. Some—very specific—trends and influencing variables were not retained in the final version of the map. This selection was based on our own expert judgement with the aim of covering the most important drivers and underlying mechanisms



rather than being exhaustive. Next, five thematic maps were created for validation in focus groups (see point 2.3): these maps contained the core food system map and the variables related to the specific theme (see Figure 4). These themes refer to the clusters of external drivers as depicted in Figure 2. In comparison with the original HLPE framework, we integrated demographic drivers with socio-cultural drivers, while adding a cluster of health-related drivers (and associated subsystems), as we felt the latter remained an omission in the framework. This resulted in the following five themes:

- Environment, representing biophysical drivers
- Innovation and infrastructure drivers
- Political and economic drivers
- Socio-cultural and demographic drivers
- Health-related drivers.

Based on the feedback of the focus group participants a final food system map was constructed. An impression of how the food map and its five themes is visualised is provided in Figure 4. Refer to Figure 7 for the full map.

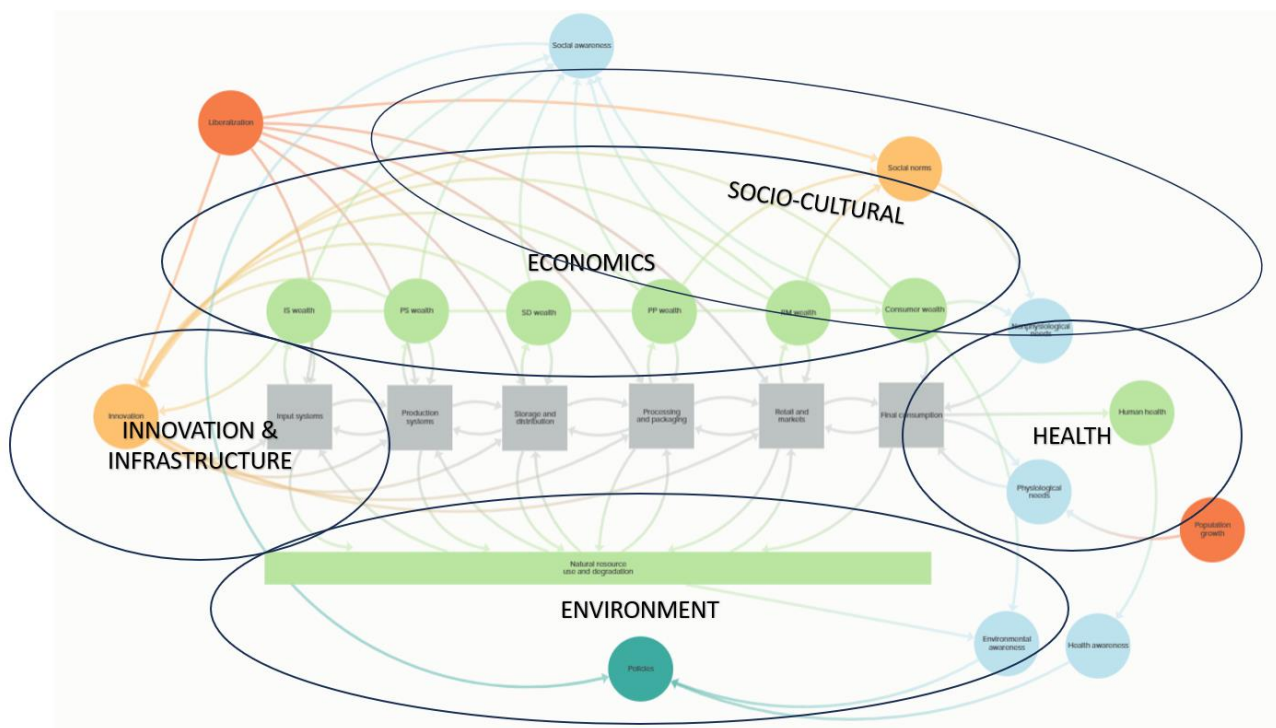


Figure 4: Impression of food system map and five themes

3.3. Identification of leverage points

Five focus groups were hosted in Brussels in March 2024. Representatives of different directorate-generals (DGs) of the European Commission (EC), NGOs, companies and research institutions based in or near Brussels were invited. Each focus group discussed one of the five thematic maps (health, environment, political-economic, innovation & infrastructure, socio-cultural) and had the following composition:

- Health: 4 participants (2 from NGO, 2 from EC)
- Environment: 6 participants (2 from NGO, 4 from EC, 1 research institution)
- Political-economic: 7 participants (2 from NGO, 3 from EC, 1 research institution, 1 private company)
- Innovation & infrastructure: 4 participants (1 from NGO, 2 from EC, 1 research institution)
- Socio-cultural: 5 participants (3 from NGO, 1 from EC, 1 research institution)

The main aim of the focus groups was to identify leverage points based on the EU food system submaps. Focus groups took above themes as starting point, but also reflected on embedding interactions with broader food system. The focus groups were organised in a strictly planned protocol that guided participants step-by-step towards the selection of the most promising leverage points during the sessions that lasted exactly 2 hours. The process started with a presentation of around 10 minutes of what participants could expect during the focus groups. The first exercise entailed the validation of the subsystem maps by asking participants to provide recommendations about any improvements that might be made to the map. A subsequent solution brainstorm invited participants to discuss what general solution directions might address sustainability and health issues in the EU food system. In a following exercise, the most promising solution for the EU food system was selected through voting. Participants were asked how this solution could be upscaled or spread throughout the system by modifying drivers as depicted on the food system submap. The researchers wrote down any of such places on the subsystem map that ought to be modified on post-its and stuck those to the wall of the conference room. The exercise thereby led to an array of potential leverage points that might help in promoting sustainable and healthy solutions. In a last ranking exercise, each focus group participant could choose only their favourite leverage point based on perceived depth, feasibility and impact (see Figure 5), which resulted in a total of 30 recommended leverage points across five EU food subsystems. The focus group guide is included in Annex 3.

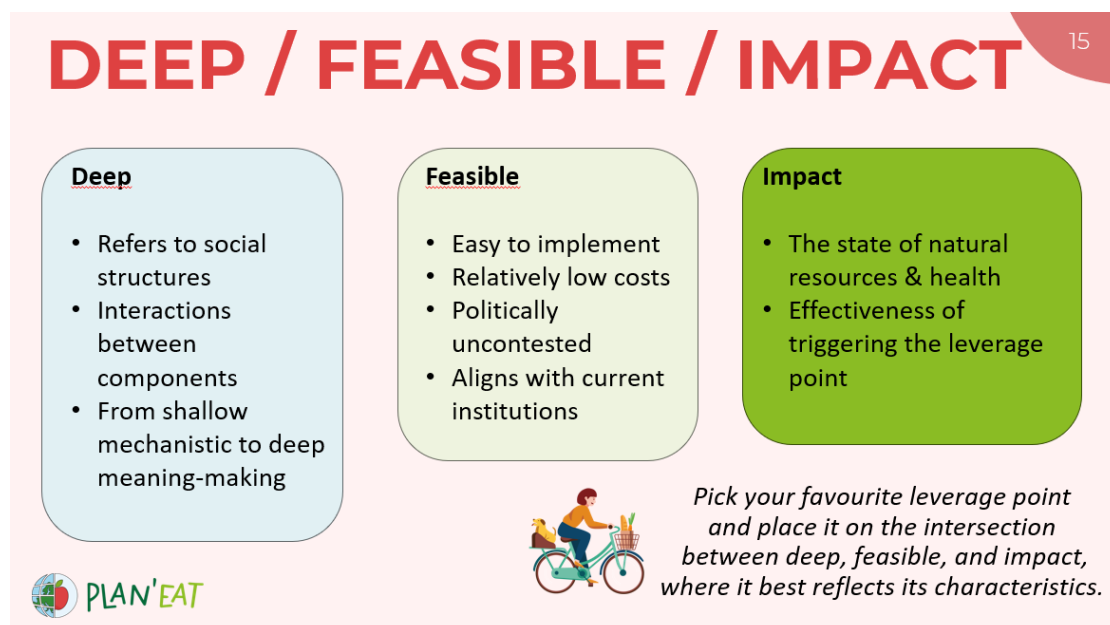


Figure 5: Criteria for selecting leverage points

3.4. Data protection and ethics

Written informed consent was obtained from experts and focus group participants, who were informed about the purpose of the study, that participation in the study is completely voluntary and that they can stop at any time without having to provide any explanation on the discontinuation. The sessions were recorded, while written input were photographed. Data were pseudonymised within a retention period of 6 months. Pseudonymisation means that raw data will be processed in such a way that it does not contain information that can be used to directly identify participants. For this purpose, personal or sensitive data were replaced with more artificial identifiers such as pseudonyms. After pseudonymisation, data are stored securely and retained for a minimum of 10 years. Part of the data may be useful in pseudonymised form and may be made publicly available after proper pseudonymisation.



4. Food system map and leverage points

This section discusses the results of our analysis. Section 4.1 gives a brief overview of the food system trends investigated. Section 4.2 discusses the food system map and the mechanisms or patterns underlying the structure of the food system. Section 4.3 discusses the leverage points as identified in the focus groups.

4.1. EU food system trends

A total of 21 trends were selected for further inquiry through a targeted literature review. Table 1 lists the trends by food supply chain actor category. While most trends are self-explanatory, the trends that are retained will be discussed in section 4.2. Please keep in mind that these trends were not selected to capture all dynamics in a comprehensive way, but rather to be able to identify the typical patterns of drivers and consequences of food actor activities in the food system

Table 1: Food system trends along the value chain

	Production	Storage & distribution	Processing & packaging	Retail & markets
Intensification	X			
Scale increase	X	X	X	X
Specialisation	X			
Concentration		X	X	X
Vertical integration	X	X	X	X
Internationalisation		X	X	X
Financialisation	X	X	X	X
Datafication	X	X	X	X
Tertiarisation			X	X
New distribution models	X			X
Land abandonment	X			
(Sub)urban food production*	X			
More sustainable packaging		X	X	
Private label (B2C)*			X	X
Cold chain logistics*		X	X	X
Online sales	X			X
Growth of aquaculture*	X			
Alternative agricultural systems	X			
SME sized industry for fish*	X		X	
Private voluntary standards*	X	X	X	X
Ultra-processed food			X	X

*Trends not retained in the discussion of the food system map

4.2. Constructing the EU food system map

4.2.1. PATTERN 1: THE CORE ECONOMIC ENGINE AND BASIC NEEDS

As business actors are primarily driven by economic motivations, following Nevens et al. (2017), we consider the core mechanism driving the food system to be the interaction between supply and demand. More specifically, this mechanism is based on the main aim of the food system to provide healthy food to consumers to fulfil their physiological needs (macronutrients, micronutrients, energy,...). This is demonstrated in Figure 6 for the interaction of supply and demand at the food environment, so consumers interacting with those who supply food to them. So, physiological needs trigger demand for food (1) that is signalled to retailers (2) who provide food at a price (3), thereby fulfilling consumers' initial need (4). Retailers earn income (5) that is accumulated into wealth which flows to (some) consumers who are employed by retailers (8). The consumers can then spend their income on food (7). Retailers may invest part of their income back into the business (6). This basic pattern represents the basic cycle of economics (Fisher et al., 1988). In systems language, it is a reinforcing loop that forms the engine of market economies (Jackson, 2009). Total demand here is driven by physiological needs—the amount of which increases with population growth (9), and further influenced by prices (3) and consumer income (7) as predicted by economic theory.

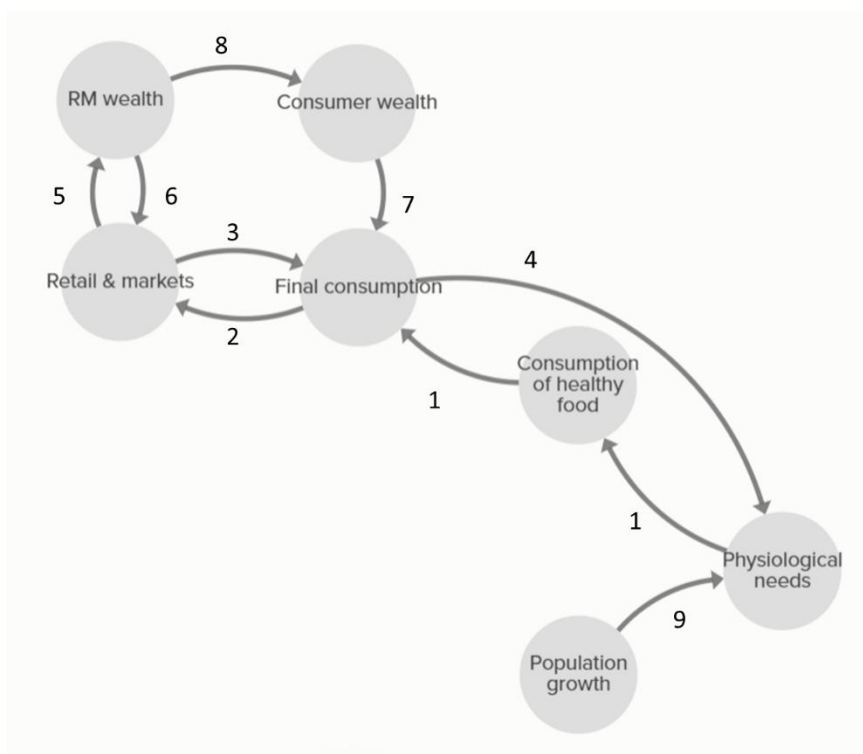


Figure 6: The economic engine as core pattern of the food system

Next, we add the other actors in the value chain. Each link in the chain is basically a replication of the logic introduced in Figure 6: a buyer signals demand, the supplier offers produce at a given price, hereby earning income contributing to wealth, which can be used to pay labour (contributing to consumer wealth) or to reinvest in the business. Of course in reality there are manifold configurations, but we opt here for a simplified version of a long supply chain, involving food production systems (PS) (farmers, fishers, etc.), storage & distribution (SD), processing & packaging (PP) and retail & markets (RM). We added farm input providers (IS) (fertilizer, seeds, pesticides, feed, machinery, etc.), as they are an important type of actor in food systems, while often being overlooked in food system depictions. The full food system map is displayed in Figure 7.



Here, we can already explain two food system trends, i.e., specialisation and scale increase, as these are implicit features of the core economic engine. **Specialisation** can be defined as “the process of concentrating resources (labour, capital and land) on producing a limited variety of goods, and concentration is the process of consolidation of specialised production across time, space, and socio-economic dimensions” (Abson, 2019, p. 301). Specialisation allows firm to become more efficient and competitive in what they are doing, which is reinforced by capturing economies of scale (Abson, 2019). In terms of the systems map this results in the separation of input provision, food production, storage & distribution, processing & packaging and retail & markets, but it may also result in specialisation within each of the stages, i.e., within the food production stage. Specialisation goes hand in hand with **scale increase**, which is greatly enhanced by technological innovation (Zimmermann et al., 2009).

4.2.2. PATTERN 2: ECOLOGICAL, HEALTH AND SOCIAL LIMITS

We subsequently added more food system outcomes: human health, which is a result of a certain consumption pattern, and natural resources (air, water, land, biodiversity), which are used as an input into production processes—albeit asymmetrically along the value chain—either as a source or as a sink of residues. More specifically, all systems use energy and thus contribute to air pollution in various ways, including greenhouse gas emissions leading to climate change. In addition, production and processing systems are heavy users of water. Production systems also have a large impact on water quality and biodiversity. At the same time, all systems can also improve their contribution in a positive way to land, water, biodiversity and air quality (Stoate et al., 2001), although such contributions are relatively limited in comparison to the negative impacts.

There is no market-based pricing mechanism regulating the use of most natural resources. There are feedback loops going back from natural resources to the various production processes, for example as a result of their deterioration. Ideally, this feedback would signal to producers to change their production practices accordingly, but the feedback comes with a time delay and many resources are in fact part of the commons. In the map, we specifically drew feedback loops from land and biodiversity to production systems, from water to production systems and processing firms. The feedback via air pollution is rather indirect via its contribution to climate change that affects biodiversity, water and land. Further, all systems produce secondary flows, such as manure, plant residues, food processing by-products, food losses and waste, etc., that can be used to recycle nutrients, add biomass to the soil or generate renewable energy (waste processing).

Production processes greatly influence the use of and impact on natural resources. An important trend taking place mainly at the food production level is **intensification**. Intensification can be defined as increasing the level of input of any kind to increase physical or economic productivity. In agriculture, intensification usually refers to an increase of input per unit of land, but it can also be used in a much wider sense. Intensification can refer to making more use of internal and external inputs, such as land, seed, manure, fertilizer, water, and credit; labour and other human resources; fossil fuel and mechanisation, knowledge and communication; institutions; or a combination of all these. In fact, intensification of the use of one type of input can be associated with reduced intensification of the use of another input: capital-intensive agriculture will allow a high labour productivity and thus a low labour input. Simultaneous increases in land productivity and labour productivity will assist the farmer in capitalizing on the benefits of the economies of scale in farming. The main driver of intensification is efficiency: per unit of product, intensification increases efficiency (Struik et al., 2014; Godde et al., 2018; Jayne et al., 20119, Clay et al., 2020). The opposite trend is **land abandonment**, which occurs mainly in the southern and eastern parts of the EU, resulting from a lack of economic viability of low-input and small-scale farms in remote areas (Nisini et al., 2013).

The impact of consumption on human health is generally positive, provided that consumers’ intake corresponds to their physiological needs, which are very diverse, depending on gender, age, activity level, etc. However, feedback to the food system from a deterioration of human health due to unhealthy diets is less visible and has not been incorporated into the systems map, as most food system actors consider human health to be an externality to be addressed by the health care system.



Food systems also have socio-economic outcomes and may thus also face socio-economic limits. An important element here is the extent to which all value chain actors are able to earn a decent income (e.g., the opportunity costs of labour used). Unequal wealth accumulation not only leads to unequal income distributions, but also to a lack of capacity to invest.

4.2.3. PATTERN 3: INNOVATION

All food system actors may invest part of their wealth into innovation. In addition, public actors invest resources in innovation. With innovation, we mean the whole process that ranges from research & development to the adoption of technological or social innovations. As a result, production processes of all food system actors are influenced by innovation. Innovation not only increases economic efficiency, as discussed earlier, but also increases resource use efficiency and decreases pollution. In other words, innovation can be said to at least partly mitigate the negative feedback loops that arise from ecological limitations. It is important to note that innovation may be incremental—supporting existing ways of producing and distributing food—or disruptive, leading to new foods and new ways of producing and distributing food, based on alternative paradigms.

Technological innovations refer to the development of new products or technologies at each stage of the supply chain, so ranging from the input stage (e.g., fertilizers, crop varieties, chemicals) to the production stage (e.g., alternative proteins) and the processing stage (e.g., meat analogues). Refer to section 4.2.4 for developments related to processed foods and the increasing addition of services. Innovation also refers to the production processes in the various stages of the supply chain, e.g., decarbonisation of the production of inputs, precision agriculture, preservation techniques, etc. During the last decades, digital technologies have played a major role as enabling technologies for all types of innovation. Digital technologies encompass a wide set of tools such as big data analytics, blockchain technology, Internet of Things (IoT) and cloud computing (Annosi et al., 2021). Digital solutions greatly enhance automation processes in the food system that are critical to increase labour efficiency, given the high cost of labour but also heavy workload (Ferrari et al., 2022). At the same time, automation also leads to the standardisation of procedures and processes, which relates to the need for specialisation as discussed in section 4.2.1. The result of applying digital solutions is increasing **datafication**: the increasing importance of data generated by these solutions as an input in the various production processes. Internet access is a very important condition to apply such technologies and may still be an important barrier in some rural areas (Ferrari et al., 2022).

Next to product and process innovation, also system and/or social innovations should be considered. In terms of the systems map, this may result in a completely new configuration of the supply chain stages, like in the case of short supply chains. An important barrier for such innovations may be the lack of compatibility with mainstream systems, such as IT systems. More generally, the rise of **alternative agricultural systems** is an important trend in the EU food system. Alternative farming systems encompasses farming approaches that focus on the environmental, social and economic dimensions of sustainability. The dimension which generally receives the most attention is environmental sustainability. Some examples are agroecology, organic farming and permaculture (Garibaldi et al., 2017). Important factors contributing to the rise of such systems is the increasing environmental, social and health concerns following negative outcomes of the food system, both from the side of the consumer (Fiorilla et al., 2022) and the producer (Garini et al., 2017).

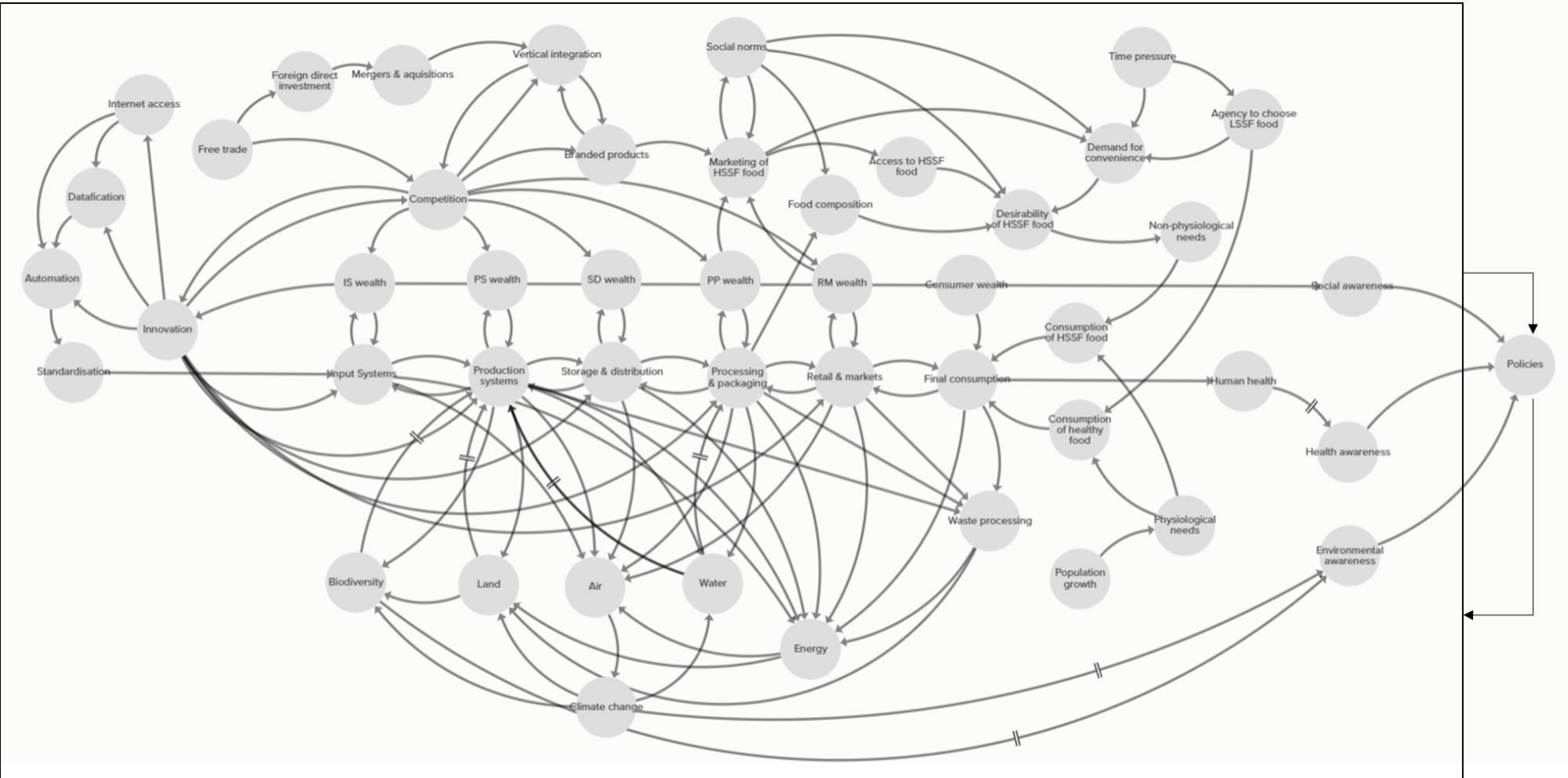


Figure 7: Food system map

4.2.4. PATTERN 4: NON-PHYSIOLOGICAL NEEDS

An important addition is that of non-physiological needs, which we define as all components of food demand that go beyond the recommended levels of nutrition, leading to various types of **highly processed foods** and ready-to-eat meals. Examples of such needs are the need to save time—leading to convenience food, to psychological well-being leading to comfort food, the need for enjoyment, etc. Food manufacturing companies and retailers have a strong incentive to develop such foods in a highly competitive landscape in which basic foods do not provide enough income to keep profitability high enough.

When non-physiological needs affect physiological needs in an adverse way (e.g., by excess consumption of simple carbohydrates), the effect on human health may be negative. Such foods are referred to as Energy Dense Nutrient Poor foods or as ultra-processed foods (Monteiro et al., 2018). Given the controversy surrounding the notion of ultra-processed foods (e.g., Forde, 2023), we refer to these foods as foods high in sugar, salt and fat (HSSF). The desirability of consuming HSSF foods is driven by various factors. The composition of HSSF foods often increases their palatability making foods addictive to consumers (Schulte et al., 2015). In addition, marketing for HSSF foods increases their desirability, both directly by advertising and indirectly by influencing the social norm, i.e., what society considers as normalised consumption patterns (Bailey et al., 2016; Moran et al., 2019). Next, the low cost of ingredients makes HSSF foods cheaper than more healthy foods. These costs are in turn influenced by economic processes discussed before, involving innovation, specialisation and scale increase, but also by agricultural policy (Anastasiou et al., 2023). In parallel, increasing competition between firms incentivise them to differentiate their products into branded products. Finally, the desirability of HSSF foods is partly related to the demand for convenience that results from consumers' time pressure. Such time pressure may result from high income and the desire to spend time on other activities but also from low income, putting pressure on people to take on multiple jobs (Anastasiou et al., 2023). Demand for convenience also relates to food literacy and personal agency to choose food low in sugar, salt and fat (LSSF) (Contento et al., 2007; Lam et al., 2017).

The demand for convenience gives rise to a process which can be called **tertiarisation**—a term from French indicating the addition of services to products to fulfil additional consumer needs (Lorino and Nefussi, 2007). As a result, value added is created, usually downstream from the farming sector, but potentially also environmental impacts. Gallouj (2021) has expanded the concept to tertiarisation to agricultural servitisation and pointed to the positive contribution farmers can contribute to sustainable development, for instance by offering health, social and educational services such as care farming. Increasing demand for convenience due to lack of time also gives rise to increased **online sales**, which are enhanced by digital solutions.

4.2.5. PATTERN 5: LIBERALISATION

Next, we added the variables free trade and foreign direct investment, which both result from liberalisation policies, which is a concept that embraces many elements that are all linked to free trade of goods, services and inputs (incl. capital). Liberalisation impacts each stage of the supply chain directly in various ways: competition, exchange of ideas, innovation, labour and many more. In addition, there is a link with wealth formation at each stage as ownership may shift abroad, there is more access to international capital markets but also to other markets (e.g., futures markets), etc.—a phenomenon generally indicated as **internationalisation**.

More specifically, liberalisation leads to **financialisation**, “the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economies” (Epstein, 2005, p. 3). Financialisation in the food system is related to the increase in agricultural prices and the corresponding increase in speculation, but also to vertical integration (Hugonnet et al., 2022). In turn, **vertical integration** in supply chains has several drivers, such as increased cost efficiency and the need to assure quality following food safety requirements and/or the development of branded, differentiated product with credence attributes (Balman et al., 2006). In addition, mergers and acquisitions (Clapp, 2023) and foreign direct investment (Dries and Swinnen, 2004) by multinational corporations also leads to more vertical integration. At the same time, more vertical integration may lead to **concentration** and thus threaten competition.



4.2.6. PATTERN 6: POLICIES

So far, policies have not been discussed, although policies affect all the patterns discussed earlier but also all variables in the food system map. In other words, an arrow could be drawn from a variable 'policies' to every element in the food system map, which would make the map unreadable. We have visualised this in the map by encapsulating the whole system in a box and drawing an arrow from the variable 'policies' to the box and vice versa—indicating that policies arise due to things that are happening in the system. At the same time, policies encompass the leverage points for food system change. Hence, a more elaborate discussion of mechanisms related to policy will follow in section 4.3. A particular aspect of the policy domain is its multi-level character, i.e., policies are enacted at EU, national and regional level.

One specific mechanism we did elaborate in the map entails the variables environmental, health and social awareness and their impact on policies. Adverse outcomes on human health (e.g., rising obesity), the environment (e.g., climate change, water pollution), on animal welfare and in the social domain (e.g., food inflation, low farm incomes) increase public awareness and concern (albeit with a time delay), which translates into policy changes. Note that various policy mechanisms exist, ranging from preventing, to mitigating and regulating negative outcomes.



4.3. Identifying leverage points

4.3.1. SELECTING LEVERAGE POINTS DURING HEALTH FOCUS GROUP

In the focus group on health, participants explored the broad solution of "true cost accounting" (TCA), which aims to incorporate all externalities, such as environmental and social costs, into the price of food. This approach seeks to ensure that food prices more accurately reflect their true cost, promoting healthier and more sustainable outcomes in the EU food system. The focus group identified several leverage points within the existing food system map and provided detailed justifications for their recommendations. The focus group in doing this adopted a planetary health perspective, i.e. also reflecting on environmental and climate risks.

One significant leverage point identified was ensuring that people can afford foods even when production costs increase. This recommendation addresses the potential financial burden on consumers, particularly those from lower socioeconomic status (SES) groups, due to true cost accounting. By making sure that food remains affordable, the focus group emphasized the depth of impact this leverage point could have on citizens, especially those with limited financial resources.

Another key leverage point was the phasing out of environmentally harmful subsidies within the policies production systems. The health risk stemming from zoonoses and pollution may be reduced by promoting organic farming. This approach involves removing financial supports that encourage environmentally detrimental practices, thereby promoting more sustainable production methods. The focus group highlighted this leverage point for its depth, feasibility, and impact, noting that eliminating harmful subsidies could significantly shift agricultural practices towards sustainability. The primary target group for this recommendation is policy-makers, who have the authority to enact such subsidy reforms.

The focus group participants also discussed the importance of social norms, particularly households' focus on quality cooking time and prices. This leverage point aims to shift societal behaviours and attitudes towards valuing the quality of cooking and the true cost of food. By encouraging households to prioritize these aspects, the recommendation seeks to have a deep and impactful influence on dietary habits and health outcomes. The target groups for this leverage point include healthcare professionals and citizens, with a particular focus on non-communicable diseases (NCDs) and children, who can benefit greatly from improved dietary practices. While not raised during the focus group, one of this report's reviewers noted that gender equality would be an important aspect to be mindful of in such a pursuit.

Increasing taxes on products such as pesticides was identified as a leverage point within the input system wealth. This recommendation aims to reduce the use of harmful agricultural inputs by making them more expensive, thereby encouraging more sustainable farming practices. The focus group chose this leverage point for its depth and impact, as higher taxes on pesticides can drive significant changes in the agricultural sector. The primary target group for this leverage point is the industry, which would need to adapt to the increased costs of using these inputs.

Distribution policies were another area of focus, with the recommendation to implement a system of taxes to achieve a more even distribution of margins throughout the food value chain. This approach aims to ensure fairer economic returns for all stakeholders in the food system, from producers to retailers. The focus group noted the feasibility and impact of this leverage point, highlighting its potential to create a more equitable food system. The target groups for this recommendation include both industry stakeholders and policy-makers, who can collaborate to design and implement these tax policies.

Addressing the costs of making sustainable and healthy foods palatable was another leverage point within processing and packaging wealth. This recommendation recognizes the additional expenses involved in producing foods that are both healthy and appealing to consumers. The focus group emphasized the deep impact of this leverage point, as well as its significance for the industry, which must bear the costs of developing and marketing such products.

Finally, the focus group participants discussed the leverage point of liberalisation, suggesting that imported products should comply with environmental and health requirements, and that EU exports should benefit



everyone involved. This recommendation aims to ensure that all food products, whether imported or exported, meet high standards of sustainability and health. The focus group selected this leverage point for its deep impact, highlighting its potential to improve both local and global food systems. The primary target group for this leverage point is policy-makers, who can establish and enforce these requirements.

An important potential trade-off to mitigate when introducing TCA would be to ensure the continued security of food supply, as was raised by one of the reviewers of this deliverable. This was not discussed during the focus group, and would warrant further reflection. The focus group discussed that wealth from the processing and packaging industry should be addressed in conjunction to households' focus on cooking time. The idea is that people may still be able to afford the true price of whole foods, if they cook their own meals instead of buying pre-cooked convenience foods. For that to happen, focus needs to shift from impulsive purchases of convenience foods, to cooking whole foods, and this will require the processing & packaging industry to divest.

Table 2: Discussed solution and recommended leverage points during Health focus group

Solution	Recommended leverage point	Description	Reason for recommendation	Expected target group
True cost accounting	Consumer wealth	<i>Making sure that people can afford foods when production costs increase</i>	Deep	Citizens (Low SES)
	Policies production systems	<i>Phasing out environmentally harmful subsidies</i>	Deep + feasible + impact	Policy-makers
	Social norms	<i>Households' focus on quality, cooking time, and prices</i>	Deep + impact	Healthcare professionals & citizens (NCDs + children)
	Input system wealth	<i>Increase taxes on products such as pesticides</i>	Deep + impact	Industry
	Distribution policies	<i>A system of taxes to achieve a more even distribution of margins throughout the food value chain</i>	Feasible + impact	Industry & policy-makers
	Processing & packaging wealth	<i>The costs of making sustainable and healthy foods palatable</i>	Impact + deep	Industry
	Liberalisation	<i>Imported products have to comply with environmental & health requirements, and in the EU will have to export in everyone's benefit</i>	Impact + deep	Policy-makers



4.3.2. SELECTING LEVERAGE POINTS DURING ENVIRONMENT FOCUS GROUP

In the Environment focus group, participants selected subsidies and taxes for ecosystem services as a solution to be introduced into the food system. This solution was selected because multiple participants proposed a variety of targeted subsidies and taxes. So participants agreed to combine those potential solutions and discuss how a coherent system of subsidies and taxes may be introduced to the system. The following discussions revolved around which leverage points may be best to support that solution.

A main leverage point regarded subsidies and taxes aimed at the processing & packaging industry. Participants noted how a system of taxes on feed, harmful pesticides, on sugar, and a levy on slaughter houses are connected to each other throughout the food system. Tax breaks on new technologies such as precision farming are mentioned as a promising example. New and emerging industries will probably need some (financial) support to be able to upscale. To aid such industries, money flows from the retailing industry should in that sense not only be redirected to primary producers, but also to other parts of the system. By readdressing how profit is made in the processing & packaging industry, unsustainable and unhealthy products may become more expensive. This might be a relatively feasible intervention that can have a large impact on what foods people buy from what type of industry.

A problem is that subsidies and taxes should be accompanied by clear benchmarks that differentiate unsustainable and unhealthy modes of production from sustainable and healthy ones. These benchmarks can also be connected to private financing: what modes of production will be funded through private loans? This is why the Environment focus group recommends to introduce earmarking and a system of labelling that define policy actions regarding climate change. Such labels may also help to increase revenue on the market. A stoplight system for farmers may differentiate between desirable and undesirable modes of production. These can be tied to a system of subsidies and taxes that make undesirable modes of production more expensive. The participants think this is a feasible leverage point because the intervention would simply address externalities caused by unsustainable production.

The group does agree that consumers might end up paying for such a system of taxes. Therefore the retail & markets wealth is addressed as a leverage point. It may be important to generate a money flow backwards from consumers and retailers towards primary producers, through a system of subsidies and taxes that share benefits throughout the value chain more evenly. In this system, clear benchmarks and transparency requirements are linked to a stoplight system for farmers to enable taxation of the worst polluters. This system of taxes and subsidies may support farmers to produce more sustainably, whilst keeping their produce affordable. Such a policy intervention may clash with a dominant paradigm, which is why the leverage point is recommended for its potential impact and depth, but not for its feasibility.

What type of products people consume may also help to keep foods affordable. Final consumption was therefore recommended as a leverage point. Mainly meat and dairy intake need to be reduced. But the vast majority of consumers is not processing this information, let alone changing their diets. In that sense organic production may not always be the best option because high consumption of organic meat and dairy would mean that the food system would use more land. So policy interventions might ensure that organic production of meat and dairy should also be accompanied by a reduction of consumption of animal protein. Aligning the consumption of animal-based products with national dietary guidelines would already have a large positive impact on natural resources.

A danger of focusing too much on reducing meat intake is that it could lead to a populist backlash of people who do not accept such changes. Therefore, consumer wealth is recommended as a leverage point, so that they can at least afford more sustainably produced meat. A system of taxes and subsidies may ensure that more sustainably produced meat does not increase in price, whereas less sustainably produced meat becomes more expensive. This may have a limited impact on natural resources, and because of political sensitivities it may not be very feasible. And in this scenario people would continue to buy and eat more or less the same types of foods, so this leverage point is not considered to be deep.

The focus group continued on with discussing innovations in the EU food system, and how a system of subsidies and taxes might aid such innovations.



Table 3: Discussed solution and recommended leverage points during Environment focus group

Solution	Recommended leverage point	Description	Reason for recommendation	Expected target group
Subsidies and taxes for ecosystem services	Retail & markets wealth	<i>Generating money flow backwards from retailers towards primary producers, through transparency requirements for ecosystem services</i>	Impact + deep	Industry
	Production systems	<i>Feed tax & spotlight labels for farmers; tax the worst polluters</i>	Impact + feasible	Industry
	Climate change	<i>Clear benchmarks & earmarking of ecosystem services</i>	Impact + feasible + deep	Industry + policy-makers + citizens
	Input systems	<i>Pesticide tax & Incentives for private financing</i>	Deep + impact	Industry
	Processing & packaging	<i>Sugar tax & levy on slaughter houses</i>	Deep + feasible + impact	Industry
	Final consumption	<i>Start to get people consuming less meat and dairy</i>	Deep + impact	Citizens (Children & parents)
	Social norms	<i>Addressing the political sensitivities around eating meat and dairy</i>	Deep + impact	Citizens
	Consumer wealth	<i>Redirect income from increased taxes to people with lower SES</i>	Impact	Policy-makers & Citizens (low SES)

4.3.3. SELECTING LEVERAGE POINTS DURING POLITICAL-ECONOMIC FOCUS GROUP

In the political-economic focus group session, participants explored the broad solution of "re-valuing food," aiming to shift the perspective of food beyond just a commodity to include views such as food as a human right or a commons. The assumption was that such renewed paradigms would set the system on a course towards healthier and more sustainable outcomes. The focus group participants identified several leverage points within the existing food system map and provided detailed justifications for their recommendations. Here, we present their findings, highlighting the leverage points, descriptions, reasons for selection, and the expected target groups.



One of the key leverage points identified was reinforcing habits of people regarding whole foods that require cooking, combined with free educational resources. This approach emphasizes encouraging individuals to develop and maintain habits around consuming whole foods. The focus groups recommended this leverage point due to its depth, feasibility, and potential impact. By reinforcing healthy eating habits and providing educational support, this solution can profoundly influence societal norms around food consumption. The primary target groups for this recommendation are healthcare professionals and citizens, with healthcare professionals playing a crucial role in advocating and educating about healthy eating habits.

Another leverage point discussed was better connecting societal value and monetary value by acknowledging that GDP does not calculate whether people are healthier. The recommendation is to refine the way GDP is calculated to better reflect societal well-being and health, rather than merely economic output. This involves creating stronger links between societal value and monetary metrics. The focus groups selected this leverage point for its feasibility and potential impact, as adjusting GDP calculations to include health metrics can significantly influence policy-making and resource allocation. The main target group for this leverage point is policy-makers, who can be encouraged to prioritize health and well-being in their decisions.

Providing vouchers for healthy and sustainable foods was another leverage point identified by the focus groups. This approach involves distributing vouchers that can be used to purchase healthy and sustainable foods, particularly aimed at supporting lower socioeconomic status (SES) groups. The participants suggested this option is both feasible and impactful, as providing vouchers can directly improve access to healthier food options for economically disadvantaged groups, thereby promoting better dietary habits and overall health. The focus here is on citizens, specifically those with lower SES, to help bridge the gap in food accessibility and affordability. One of this report's reviewers, however, questioned the effectiveness of this option, as subsidizing fruits and vegetables might make that consumers would spend the money saved on unhealthy foods. This could be mitigated by combining such a system with a TCA-based mechanism of pricing unhealthy foods.

Encouraging companies to adjust their products to healthier and more sustainable options, ensuring the entire sector complies to avoid competitive disadvantages, was also discussed as a significant leverage point. This involves pushing companies to modify their products towards healthier and more sustainable options, with the understanding that sector-wide compliance is necessary to prevent competitive loss. The focus groups selected this leverage point primarily for its potential impact, as ensuring that the entire industry complies can prevent individual companies from facing competitive disadvantages for making positive changes. The target group for this leverage point is the industry itself, with companies within the food sector encouraged to adapt their products collectively.

Finally, redirecting marketing efforts towards promoting positive impacts on food consumption was another key leverage point. Given that marketing already has a significant influence on food consumption patterns, this approach involves using marketing strategies to promote healthier and more sustainable food choices. This leverage point is considered both feasible and impactful, as leveraging existing marketing channels and techniques can shift consumer behaviour towards more positive food consumption patterns. The primary target group for this leverage point is the industry, with companies using their marketing capabilities to drive changes in consumer behaviour, supporting the broader goal of re-valuing food in society. One of this report's reviewers critically reflected that such marketing efforts would have to be accompanied by a genuine reformulation or replacement of products in order to achieve the desired health impacts.



Table 4: Discussed solution and recommended leverage points during Political-economic focus group

Solution	Recommended leverage point	Description	Reason for recommendation	Expected target group
Broad re-valuing of food	Health	<i>Reinforce habits of people regarding whole foods that require cooking; combined with free educational means</i>	Deep + feasible + impact	Healthcare professionals + citizens
	GDP growth	<i>GDP does not calculate whether people are healthier; better connect societal value and monetary value</i>	Feasible + impact	Policy-makers
	Consumer wealth	<i>Provide vouchers for healthy & sustainable foods</i>	Feasible + impact	Citizens (Low SES)
	Branded products	<i>Companies can adjust their products, but the whole sector has to comply because otherwise they lose at the expense of competitors</i>	Impact	Industry
	Marketing	<i>Marketing already drives food consumption to a large extent, so we can try to put it towards positive impact</i>	Feasible + impact	Industry

4.3.4. SELECTING LEVERAGE POINTS DURING INNOVATION FOCUS GROUP

In the Innovation & Infrastructure focus group, participants collectively selected alternative protein as the most promising solution to introduce to the EU food. Alternative protein includes technologies such as precision fermentation, that allows producers to artificially create very specific flavors and textures without needing a livestock sector. The conception of alternative protein may also regard other types of meat substitutes. The question that was addressed during the focus group revolved around what intervention points in the EU food system may best help to promote alternative protein as a solution. Note that the precise environmental and health impacts of various types of alternative proteins remain uncertain. Moreover, one of the report’s reviewers critically reflected that much of the below may also be applied to other, existing mildly processed foods, some of which entail a lower risk of perpetuating the current industrial food system.

One of the key leverage points that was identified during the discussion is exnovation in production systems: companies need to have time to phase out unsustainable mode of productions. Though participants note that people working in industries that need to be phased out, such as the livestock sector, will probably not be happy about such a decision. So participants expect quite a lot of political contestation around this leverage point. Still, the focus group picked this leverage point as one of the main recommendations because of its potential to change social structures in an impactful way.



Participants discussed how the current system is geared towards unsustainable modes of production, such as the intensive livestock sector being linked to the processing & packaging industry. These interlinkages may pose a barrier for a transition as different components of the system benefit from stability. So participants propose to affect a transition through positive means by investing in new industries that rely on alternative protein as an input. Investments in new markets may entice businesses to change their mode of production to a new rising market. In a growth market, new technologies will have to be implemented, and the government can play an active role by investing in required technologies through public procurement and subsidies. Therefore subsidies for production systems was selected as a recommended leverage point. It may provide a nexus between feasibility, impact, and depth, depending on which specific technologies may be supported through subsidies.

A group discussion continued about the interrelationships between new technologies, current production systems, environmental awareness, and social norms. These factors are interrelated in such a way that when trying to make a change in the EU food system, policymakers need to consider how interactions may change as a result of policy interventions. Therefore, the focus group recommended social norms as a key leverage point. Specifically the way how technology adapts to current social norms, and how social norms may be shaped by the introduction of technologies, should be adopted in any policy intervention before it can be effective. The group thought that it would be essential to carefully plan policy interventions with regard to social norms to avoid political contestation against a sustainable and healthy transition in the EU food system.

A important uncertainty of introducing new technologies into the food system concerned the energy to power precision fermentation processes. A shift from the livestock sector to bioreactors would entail a surge in electrical energy consumption, which would risk clashing with reducing CO₂-emissions and mitigating climate change. Therefore participants recommended to introduce a smart energy grid, where policymakers, industry, and consumers work together to share the production and consumption of electricity through a decentralized grid that balances offer and demand. The group recommends this leverage point because it is a change that is already ongoing, but also a necessary step to support the introduction of technologies that may renew social structures in a more sustainable and healthy way. Therefore, smart energy was recommended as a impactful, as well as deep leverage point, albeit going beyond the food system quite considerably.



Table 5: Discussed solution and recommended leverage points during Innovation focus group

Solution	Recommended leverage point	Description	Reason for recommendation	Expected target group
Alternative proteins	Production system wealth (subsidy)	<i>Investments to renew social structures that allow actors in the value chain to make profit in a sustainable and healthy way</i>	Deep + impact	Policy-makers
	Production system wealth (subsidy)	<i>Investments to renew social structures that allow actors in the chain to make profit in a sustainable and healthy way</i>	Feasible + impact	Policy-makers
	Smart energy	<i>Decentralized energy production that balances availability of renewable energy and awareness about demand</i>	Deep + feasible + impact	Industry + Policy-makers
	Production systems	<i>Providing time for unsustainable producers to exnovate</i>	Deep + impact	Industry
	Social norms	<i>The way innovation adapts to and shapes certain social norms regarding food (production) needs to be planned to avoid conflict</i>	Deep + impact	Citizens (Adults + children)

4.3.5. SELECTING LEVERAGE POINTS DURING SOCIO-CULTURAL FOCUS GROUP

The socio-cultural focus group selected community-based initiatives as a solution to introduce to the EU food system. Community-based initiatives include participatory farming such as community-supported agriculture (CSA), as well as food forests, and community kitchens. A benefit of such initiatives may be two-fold: intermediaries in the food value chains are bypassed which may free up more margins for primary producers, and consumers have more control over the way their food is produced and processed.

One of the main leverage points recommended during the socio-cultural focus group was food environment policies. The contemporary food environment is dominated by large multinationals that promote the sales of unhealthy and unsustainable convenience foods. If we want to make community-based initiatives more present in the social environment, participants argued that we will need better tailored laws and regulations that promote competition between community-based initiatives and current companies dominating the food environment. This leverage point was recommended because it seems feasible to promote competition, and community-based initiatives may provide a way to affect deep and impactful change.

The next recommended leverage point, physical food availability, ties to the previous one. Participants note that in some places, healthy and sustainable foods may be hard to come by. Especially in more rural areas, the offer may be more limited and people may be more pronged to buy what is on offer in the local supermarket. Therefore, policy may also focus on what type of foods retailers sell. When the offer would for example regard more whole foods, this might reinforce changes in the way people eat. This leverage point



was therefore recommended because its ability to change social structures (deep) and support more healthy and sustainable diets (impact).

A consequence of steering towards community-based initiatives is that it requires individuals to put in more effort. A question raised by one of the participants was whether EU citizens have sufficient time and willingness to do so. Beside price, busy lifestyles may be a driver for convenience foods. So providing leisure time is an essential requirement to allow people to change the way they obtain and consume food. The amount of time available to consumers is tied to their working hours, which is why policymakers would have to cooperate with industries in freeing up more time, although there is uncertainty about whether people will use this time for cooking. Participants recommended this leverage point for its ability to renew social structure (deep), impact on diets, and feasibility due to a relatively low likelihood of political contestation. People may actually demand more freedom when the debate around labour market participation is politicized.

A challenge of reducing working hours, may be that wages could turn out to be lower. Especially for people with lower SES this may turn out to be problematic. Contemporary community-based initiatives seem to mostly attract people with higher SES, for example because it is required to pay in advance for a full year. Not everyone can afford such sums, so people's ability to pay for community-based initiatives was recommended as a leverage point. When people with low SES can join community-based initiatives, this may enable them to radically change the way they obtain and consume food. Which is why ability to pay was recommended for its potential depth and impact. One of the reviewer's critically reflected that genuine changes of incentives within the food system may also make these community-based initiatives more accessible to a broader range of citizens.

According to participants, an important requirement for community-based initiatives was social cohesion. People have to be willing to work together locally in producing, cooking and consuming food. When people see themselves as separate individuals, they may not be willing to join community-based initiatives. Therefore social cohesion was recommended as a leverage point. And it may specifically be addressed through new generations that learn, by efforts of their parents and schools, how food production and consumption is a group inquiry instead of an individual economic activity. It may not be very easy to change people's mindset in such a way, but when policy interventions succeed in promoting social cohesion, this can affect a deep restructuring though society and thereby have impact on diets and natural resources. A special point of attention, in this respects, are online social environments, such as social media.

Lastly, one of the participants noted that some people may be hesitant to join a community-based initiative because it is not something they know. Therefore, the group recommends to promote community-supported initiatives as a "hip" thing. So efforts to promote community-based initiatives should look into the social acceptability of the initiatives, to prevent that members will be frowned upon, which would be a barrier for change. It is noted that it is not easy to make initiatives socially acceptable, but if you succeed in doing so, it may change a lot in terms of depth and impact.



Table 6: Discussed solution and recommended leverage points during socio-cultural focus group

Solution	Recommended leverage point	Description	Reason for recommendation	Expected target group
Community-based initiatives	Food environment policies	<i>Laws and regulations that influence what foods are present in consumers' surroundings</i>	Deep + feasible + impact	Policy-makers
	Social cohesion	<i>A powerful precondition for community-based initiatives that can potentially shape norms on eating and preferences for the right kind of food</i>	Feasible + impact	Citizens (parents + young adults)
	Food availability (physical)	<i>The type of food retailer in people's neighborhoods has an impact on people's behaviors</i>	Deep + impact	Industry
	Labour market participation (leisure time)	<i>How much time you have to spend for working and how much is left for buying/preparing food</i>	Deep + impact + feasible	Policy-makers + industry
	Social norms	<i>People will be hesitant to change behaviors if it is not generally accepted</i>	Deep + impact	Citizens (toddlers; middle and high SES)
	Ability to pay	<i>Whether people can afford community-based initiatives comes before their willingness to pay</i>	Deep + impact	Policy-makers + citizens (low SES)



5. Conclusions

The aim of this deliverable was to understand how the food system works and how it can be changed at the macro-level. For this, we created a stylized food systems map at a high level of abstraction. Based on a combination of literature review, theoretical reasoning, expert interviews and focus groups, we identified a pattern that captures the main functioning of the current food system. Food system activities are strongly driven by economic motivations (1), but may face limitations resulting from the adverse social, environmental and health-related impacts it creates (2). Resources are invested in innovation partially to address and lift these limits in both incremental and more disruptive ways (3). The system seeks new opportunities to fuel the engine addressing and creating demand that goes beyond basic needs (4), but that may result in more adverse outcomes for health and the environment. Liberalisation amplifies the aforementioned mechanisms but also the related outcomes (5). And finally policies may also amplify some of these mechanisms or create opportunities for developing solutions driven by rising public concerns (6). Leverage points and corresponding policies need to take into account this basic pattern.

Five focus groups identified solutions and corresponding leverage points in the food system on how to address these adverse social, environmental and health-related outcomes. The food systems map helped groups to take a systemic and comprehensive approach in developing leveraging points. The health and environmental focus groups selected economic solutions. True cost accounting aims at providing food system actors with the right feedback with respect to the social, health-related and environmental outcomes of their activities. In the current food system, these feedbacks are relatively weak, primarily because of the time delays involved. True cost accounting would accelerate these feedbacks, directly changing the economic engine of the food system in order to prevent a deterioration of environmental resources and human health. Subsidies and taxes for ecosystem services are basically a subset of the true cost accounting, focusing specifically on ecosystems. The political-economic focus group expanded the notion of value and selected broad re-valuing of food as solution, thus introducing other objectives into the food system on top of economic ones. The innovation focus group selected alternative proteins as preferred solution, which implies a shift of resources to be invested in innovation but also puts less pressure on ecosystem and human health. The socio-cultural focus group selected community-based initiatives as preferred solution, given that the local community is the level at which direct connections can be made.

Implementing the identified solutions and leverage points to change food environments and consumer behaviour to foster healthier and more sustainable diets requires careful consideration of social equity and gender issues. Policies need to consider the financial constraints of people, particularly when interventions make food more expensive or involve other types of barriers for vulnerable people.



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Annex 1: Publications consulted to identify food system trends

Author	Title	Link	Trends
Dawson (2006)	Retail trends in Europe	https://www.researchgate.net/publication/225203494_Retail_Trends_in_Europe	vertical integration, scale increase, datafication, concentration, internationalisation
Sandberg (2010)	The retail industry in Western Europe	https://www.diva-portal.org/smash/get/diva2:309658/FULLTEXT01.pdf	internationalisation, vertical integration, online sales, private label
SCAR (2011)	Sustainable food consumption and production in a resource-constrained world	https://scar-europe.org/images/SCAR-Documents/scar_3rd-foresight_2011.pdf	tertiarisation
SCAR (2015)	Sustainable Agriculture, Forestry and Fisheries in the Bioeconomy - A Challenge for Europe	https://scar-europe.org/images/SCAR-Documents/4th_SCAR_Foresight_Exercise.pdf	concentration
IPES Food (2016)	From uniformity to diversity	https://www.ipes-food.org/_img/upload/files/UniformityToDiversity_FULLL.pdf	concentration, alternative agricultural systems
Moragues-Faus et al. (2017)	Exploring European food system vulnerabilities: Towards integrated food security governance	https://www.sciencedirect.com/science/article/pii/S1462901117304689	concentration
IPES Food (2017)	Too big to feed	https://www.ipes-food.org/_img/upload/files/Concentration_FullReport.pdf	vertical integration, concentration, financialisation, scale increase
EEA (2017)	Food in a green light: A systems approach to sustainable food	https://www.eea.europa.eu/publications/food-in-a-green-light	scale increase, internationalisation, vertical integration, alternative agricultural systems, SMEs in fish
Metabolic (2018)	Using systems thinking to transform society: The European food system as a case study	https://www.metabolic.nl/publications/using-systems-thinking-to-transform-society-pdf/	scale increase, land abandonment, intensification
Moller et al. (2019)	50 trends influencing Europe's food sector by 2035	https://www.fox-foodprocessinginabox.eu/wp-content/uploads/2019/11/50-trends-influencing-Europes-food-sector.pdf	datafication, concentration, tertiaryisation
Moller et al. (2020)	Three scenarios for Europe's food sector in 2035	https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccv/2020/Fox_Scenario_Brochure.pdf	datafication
Baker et al. (2020)	Ultra-processed foods and the nutrition transition: Global, regional and national trends, food systems	https://onlinelibrary.wiley.com/doi/full/10.1111/obr.13126	concentration, ultra-processed food, new distribution models



	transformations and political economy drivers		
SAPEA (2020)	A sustainable food system for the European Union	https://scientificadvice.eu/advice/a-sustainable-food-system-for-the-european-union/	concentration, financialisation, private voluntary standards, land abandonment, more sustainable packaging, private label, online sales
SCAR (2020)	Resilience and Transformation	https://scar-europe.org/images/FORESIGHT/FINAL-REPORT-5th-SCAR-Foresight-Exercise.pdf	scale increase, online sales
Pessot et al. (2021)	A Journey into the European Supply Chains: Key Industries and Best Practices	https://link.springer.com/chapter/10.1007/978-3-030-63505-3_9#Sec9	new distribution models, datafication, tertiarisation
EEA (2022)	Reimagining the food system	https://www.eea.europa.eu/publications/reimagining-the-food-system-the	alternative agricultural systems
EIT Food (2022)	Top 5 European food trends in 2022	https://www.eitfood.eu/blog/top-5-european-food-trends-in-2022	alternative agricultural systems
Béné (2022)	Why the Great Food Transformation may not happen – A deep-dive into our food systems' political economy, controversies and politics of evidence	https://www.researchgate.net/publication/359181060_Why_the_Great_Food_Transformation_may_not_happen_-_A_deep-dive_into_our_food_systems'_political_economy_controversies_and_politics_of_evidence	concentration, internationalisation
DG AGRI (2022)	Study on agri-food imports and their role in the EU supply chains	https://op.europa.eu/en/publication-detail/-/publication/9284af7e-79a0-11ec-9136-01aa75ed71a1/language-en	concentration, internationalisation
FAO (2022)	The future of food and agriculture – Drivers and triggers for transformation	https://openknowledge.fao.org/server/api/core/bitstreams/002ef5c5-3501-413f-b226-c87da30a7a29/content	concentration, datafication
Preiss et al. (2022)	Trends Shaping Western European Agrifood Systems of the future	https://www.mdpi.com/2071-1050/14/21/13976	(sub)urban food production, new distribution models
EEA (2023)	Rethinking agriculture	https://www.eea.europa.eu/publications/rethinking-agriculture/rethinking-agriculture	scale increase, intensification, land abandonment
EC (2023)	Drivers of food security	https://commission.europa.eu/system/files/2023-01/SWD_2023_4_1_EN_document_travail_service_part1_v2.pdf	intensification, land abandonment, concentration, financialisation,
Allied Market Research (2023)	Europe cold chain logistics market by end-use industry, temperature type and mode of operation: Global opportunity analysis and industry forecast, 2022-2032	https://www.alliedmarketresearch.com/europe-cold-chain-logistics-market-A11032	cold chain logistics

Annex 2: Expert interview guide

1. Can you tell me something about your expertise?

- What is your professional occupation?
- What educational background do you have?
- What is your previous work experience?
- What led you to become interested in your field?

2. What do you think about the current state of the EU food system?

- What are the problems and opportunities?
- How do you think health & sustainability are related to the EU food system?
- What are current modes of production, processing, retailing, and or consumption, and are those good or bad?

3. How do you see the future of the EU food system evolving?

- Where do you think the EU food system is heading to?
- Who are the most important actors in driving change? Is that desirable?

4. To check whether this map is clear, what do you think the map represents?

- What do you find striking in this map? Is there anything unclear?

5. What do you think can be rearranged or should be changed in this map?

- Can you think of any other way of presenting the data so that the map is clearer?

6. What factors and/or interactions do you think are missing?

- What are the main constraints of the displayed trends?
- Why are some trends relatively large or small in scale and scope?

7. Do the arrows illustrate the correct kind of feedback and interaction?

- Can you spot any arrows that are not fitting or that are incorrectly placed?
- Do you see any negative or positive feedback loops missing?

8. Based on this map, at which points do you think it would be possible to intervene?

- If necessary, explain again what leverage points are: places in the system where an intervention can have system-wide effects
- Why do you think this intervention point is of particular interest?
- What effect could an intervention have when it would be targeted at the leverage point(s) you indicated?
- Who would be the main winners and/or losers of making a change on that leverage point?

9. How easy or hard do you think it will be to change the intervention points you have spotted?

- Can you rank the leverage points in increasing order of influence on the food system?
- How large is the impact likely to be when the leverage point is sufficiently modified?
- Who would be the main winners and/or losers of making a change on that leverage point?

10. What do you think are the most important trends or innovations in the EU food system?

- Where do you (like to) see those trends or innovations going towards?
- How will values and worldviews across the EU be impacted if the leverage points are changed?
- Can you think of other worldviews, values, and goals of the EU food system that are not represented in this map



Annex 3: Focus group guide

In this guide you will find a detailed instructions for conducting focus groups for Task 2.2 of the PLAN'EAT project. It is organized in six sections:

1. Preparatory instructions to read before conducting the focus groups
2. A rationale for conducting the focus groups
3. Specific aspects that need to be discussed in the focus groups
4. Setting the right ambiance for the focus groups
5. What data should be collected and how it can be stored
6. Participant checklist for presence and informed consent



1. Preparatory work

To help you prepare for the focus group sessions, this chapter lists all requirements necessary to ensure a productive and engaging discussion. This chapter outlines the essential steps to take prior to the focus group, setting the stage for an effective exchange of ideas and insights. By attending to these preparations, PLAN'EAT partners can lay the groundwork for a successful focus group session where participants feel empowered to share their perspectives and insights.

Invitations to participants and prior information

Extend invitations to participants well in advance of the focus group session, providing them with sufficient time to prepare and confirm their attendance. Clearly communicate the purpose of the focus group, the topics to be discussed, and any expectations for participation.

Send and print informed consent forms (40x)

Prior to the focus group, it is imperative to obtain informed consent from all participants. This ensures that participants are fully aware of the purpose of the discussion, their role within it, and any potential risks or benefits involved. Providing participants with an informed consent form allows them to make an informed decision about their participation and reinforces the principles of ethical research practice.

Make sure to send the informed consent form at least one week prior to the focus groups. That way, participants can be assumed to know what the mode of conduct will be, and any unpleasant surprises during signing of the informed consent forms can be avoided. Not all participants will sign and send a digitally signed copy of the informed consent form. Therefore, make sure to print out enough informed consent forms for all participants plus some extra, and have those ready before the session starts.

Additionally, a list of participants will have to be printed out, including a checklist that keeps track of the presence of all signed informed consent forms. That way, an overview can be kept whether all informed consent forms are present.

Participants will also need to have pens to sign the informed consent forms. Make sure those are present in sufficient quantities.

Check the room equipment

Make sure that the equipment in the room is ready and functioning. Audio will be recorded through the built-in conference call webcam and microphone in the room and recordings will be made with Microsoft Teams, which also provides the opportunity to automatically transcribe conversations. Make sure that each session is planned through Microsoft Outlook, because an invitation to a Microsoft Teams meeting is necessary for the automatic transcription function to be present. This means that in advance, a separate Teams meeting has to be planned for each focus group session.

Print causal loop diagrams on A1 and A2 format

Visual aids will enhance the focus group experience by providing participants with additional context and facilitating understanding of complex concepts. Print out causal loop diagrams in both A1 and A2 format, ensuring they are large enough for all participants to view comfortably. These diagrams serve as valuable tools for visualizing relationships and dependencies within a system, sparking meaningful discussions and insights. By printing out the CLDs, participants are welcomed to draw any modifications or comments on the EU food system map they like.

Provision of pens, post-its and scissors

Provide participants with the necessary supplies to actively engage in the focus group discussion. Provision of colored pens and post-it notes encourages participants to annotate materials, jot down ideas, and contribute to group activities. These interactive tools foster creativity and collaboration, enriching the overall experience for all involved.

Print leverage point framework (5x)

Print copies of Abson et al.'s (2017) leverage point framework for distribution to participants. This framework serves as a reference point for discussions on identifying strategic points of intervention within complex



systems. Familiarizing participants with the framework enables them specifically to explore a diverse range of leverage points, and to guide attention to certain aspects of the EU food system map that may otherwise be overlooked.

List of documents to print out:

- Informed consent forms (40x)
- List of participants
- Causal loop diagrams on A1 (5x subsystem map)
- Causal loop diagrams on A4 (Each subsystem map 12 times; 60 in total)
- Leverage point framework on A4 (12x)

List of items to bring:

- Black pens (15x)
- Red pens (15x)
- Blue pens (15x)
- Pencils (15x)
- Notepads (15x)
- Writing board / whiteboard (including sufficient papers / whiteboard markers)
- Post its, diversely colored (5 packs of multiple colors)
- Spare audio recorder such as a mobile phone

2. Rationale of the focus groups

In this section, the aim of the focus groups is outlined so that you know what is important to focus on during the focus groups.

Each of the five focus groups will center its discussion on a specific sector within the EU food system and its interconnectedness with the broader system. This sector-specific approach allows for targeted analysis of the unique challenges, opportunities, and dynamics at play within each sector. By delving into sector-specific complexities, the focus groups aim to uncover nuanced insights and identify tailored strategies for intervention.

The aim of the focus groups is two-fold:

- 1) Validating the causal loop diagrams
- 2) Pinpointing leverage points on the causal loop diagrams

Validating EU food system map

In previous stages of this research we have compiled a EU food system map based on mapped interactions between macro-level drivers of the EU food system. Because we have renewed our EU food system map, we will have to ask for input of experts to check whether the map reliably represents the EU food system. In figure 1 you can see the renewed format we use to visualize interactions in the EU food system.

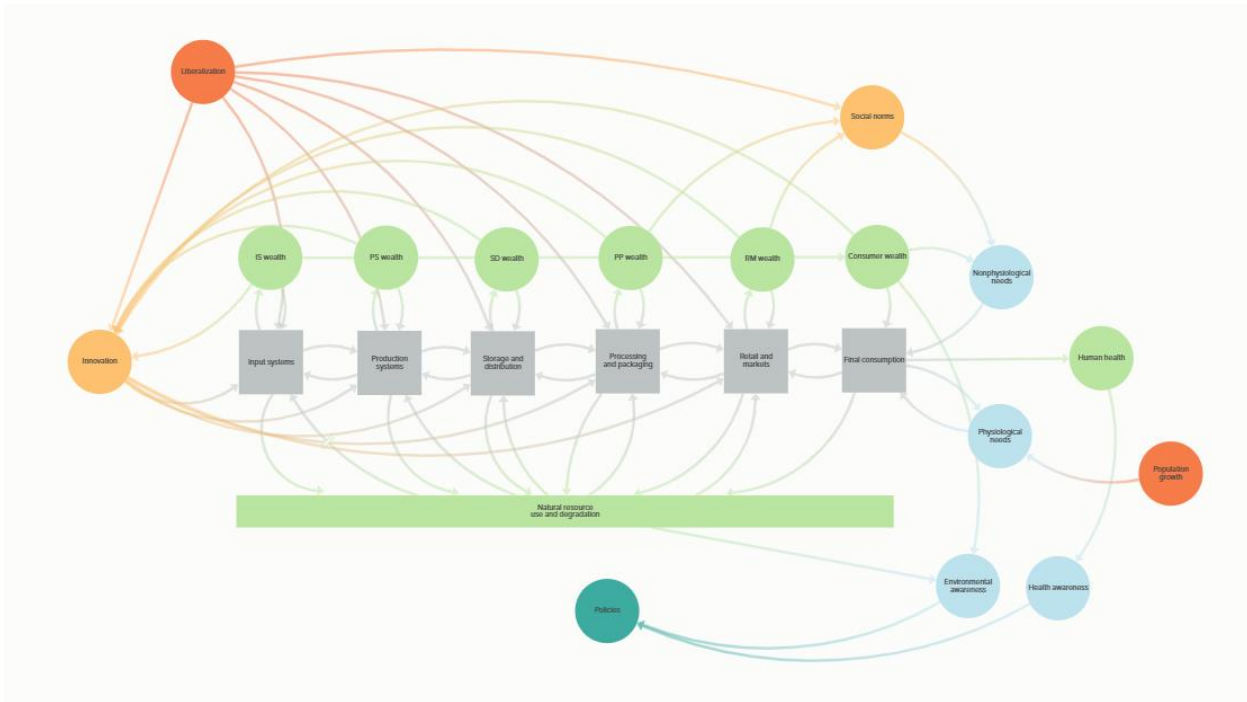


Figure 1: Impression of the renewed EU food system map

A diverse range of experts is invited to participate in the focus groups. These experts represent various sectors and disciplines relevant to the EU food system. This presents the opportunity to check whether the map is representative of the EU food system, whether participants are able to work with the model as intended.

Pinpointing leverage points

One of the aims of the focus groups is to find leverage points on the EU food system map. Previous research has defined leverage points as places in complex adaptive systems where a modification will have system-wide ripple effects (Meadows, 2009 #113). During the focus groups, participants will discuss which places on our EU food system map they think are most suitable to target policy interventions at.

Keep in mind though that we are not developing interventions during the focus groups. We are just interested in places in the system where we can intervene.

Leverage points can be recognized on the EU food system map through participants' recommendations on what interactions in the food system should change in order to affect a sustainable and healthy food system. Participants are free to point to any place on the causal loop diagrams where they think a modification is most suitable, desirable, or feasible. The reasons why participants argue a particular leverage point is of interest are crucial for further analysis. Section 3 explains in more detail how moderators can facilitate the discussion on leverage points.

Addressing problems and solutions

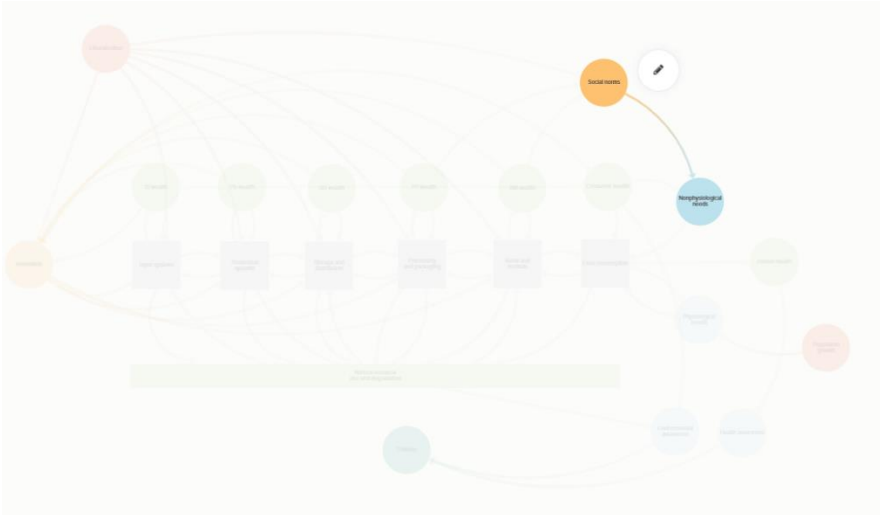
Before leverage points can be pinpointed, some directionality has to be given to efforts for affecting a transition. Our aim is to find leverage points for affecting a sustainable and healthy food system transition.

As a first step, participants are invited to think about what are the most pressing sustainability and health problems of the EU food system. Likewise, in the following round, participants are asked which solutions they think are most suitable to address sustainability and health problems of the EU food system (see section 6 that includes a planning). It is not necessary to reach consensus amongst participants which problems and solutions are most pressing or promising. We are just interested in what participants think are promising avenues for change, and how to affect those. In case there is large disagreement amongst participants, moderators can opt to list the diverse range of problems and solutions and aim to employ this list to guide further inquiry into competing leverage points that need to be addressed.

Example of pinpointing leverage points



Imagine for example that one of the participants during the focus groups mentions that social norms regarding non-physiological needs will have to change in order to affect more sustainable and healthy outcomes. This might be supported by an argument that it is helpful when social environments remind individuals about the redundancy of certain unsustainable food choices. If people would be less acceptant towards people who drink a lot of energy drinks, this might help individuals to choose healthier and more sustainable drinks such as a glass of tap water.



In this example, both social norms and non-physiological needs can be considered leverage points. During the analysis of the study, recommended leverage points will be listed, and distinct configurations of leverage points will be compiled on the basis of a conceptual framework regarding the relevance of types of leverage points per ideal-type transition pathway.

It is important that the session's moderators listen carefully to the recommendations of participants, and ask explanatory questions such as *'why do you think this interaction is especially important to modify?'* and *'how does this intervention point relate to a wider sustainable and healthy food system transition?'*

3. During the focus groups: What participants should actually focus on

The focus groups of T2.2 are the main method for data collection in our research. This means that in essence, the focus group participants will determine the results of the study. A careful balance is therefore necessary between guiding participants towards useful data production, but leaving space for participants to determine what inputs they think are relevant.

To guide the focus groups discussions, three questions are central to the debate:

- 1) What are the main solutions for addressing sustainability & health problems in the EU food system? (**Positionality**)
- 2) "What displayed interactions do you think have to be corrected because those make an incorrect representation of the EU food system?" (**Validation**)
- 3) "What displayed interactions do you think would have to change in order to affect a sustainable and healthy transition in the EU food system?" (**Pinpointing leverage points**)

Important notes for moderators

Make sure that a diverse range of leverage points is selected. A risk is that participants only focus on shallow leverage points, which is a common critique on the framework. This is also why the leverage points framework is printed out and shared with participants: to guide attention to increasing levels of depth amongst leverage points. This framework is introduced during the introductory presentation. Still, participants need to be encouraged to select leverage points from all four types.



A type of leverage points entails feedbacks: to what extent interactions are delayed, and to what extent drivers reinforce or limit each other. Our EU food system seems to obscure such types of leverage points, which is why moderators should have specific attention for feedbacks. The EU food system map does show feedbacks between consumption, resource use, and awareness, that feeding back through policy. This creates a delay between consumption and policy. But such delays are only apparent for the trained eye. Therefore it is important to ask participants about the time it will take before expected results can be achieved through triggering (a series of) leverage points. By asking that question, attention can be guided towards feedbacks as a type of leverage point.

Be aware that it will be important to record why participants recommend changing a certain leverage point. Be sure to ask participants for the reasons behind their recommendations. See the below checklist for probing questions.

Probing questions checklist

- Why do you think those leverage points are especially suitable?
- How do those intervention points relate to a wider sustainable and healthy food system transition?
- Can you recommend a diverse range of types of leverage points?
(Including parameters, feedbacks, design and intent)
- What deep leverage points can be combined with shallow leverage points?
- How long do you think it will take before impacts are noticeable?

4. Setting the right ambiance

Creating a conducive and respectful atmosphere is crucial for fostering open dialogue and productive exchange of ideas within the focus group setting. This chapter outlines how moderators can help to set the right ambiance. By adhering to these guiding principles and practices, focus group facilitators can create a supportive and inclusive environment that maximizes participant engagement, encourages diverse perspectives, and upholds ethical standards throughout the research process.

Welcome

Upon participants' arrival, extend a warm welcome and offer refreshments such as tea or coffee. Express gratitude for their attendance and willingness to contribute to the discussion. Establishing a welcoming and hospitable environment sets a positive tone for the focus group session, encouraging participants to feel comfortable and engaged.

Setting the stage

Provide participants with an overview of the research aims, objectives, and the structure of the focus group session. Clearly outline what is expected of participants in terms of participation, engagement, and confidentiality. Setting clear expectations helps to establish a shared understanding of the focus group's purpose and ensures alignment among participants.

Encourage respectful discussions

Emphasize the value of diverse perspectives and respectful disagreement within the focus group. Consensus is not a prerequisite; rather, the focus is on exploring different viewpoints and understanding where they converge or diverge. Encourage participants to express their opinions openly while maintaining a spirit of mutual respect and civility.

Cater to different personalities

Acknowledge that participants may exhibit different communication styles and comfort levels within group settings. To accommodate diverse personalities, incorporate a mix of private questions and group discussions. This allows individuals who may be more reserved to contribute their insights in a comfortable setting while also providing opportunities for dynamic group interaction.

Balanced participation

Be mindful of ensuring balanced participation and preventing domination by a few individuals in the discussions. Actively manage the conversation by giving specific individuals the opportunity to speak, rotating



turns, or directing questions to specific participants. Creating space for each participant to share their perspective fosters inclusivity and ensures a more equitable distribution of dialogue.

Provide aftercare

Following the conclusion of the focus group session, provide participants with information on how their inputs will be utilized and any follow-up steps that will be taken. Offer participants the opportunity to withdraw their contributions or raise any concerns they may have regarding their participation. Demonstrating respect for participant autonomy and well-being reinforces trust and transparency in the research process.

5. Data collection and storage

Deliverable

Make sure that you save the interview data and share it with PLAN'EAT partners. The following interview data are necessary to share with PLAN'EAT partners:

- (Video) recordings of the focus groups
- Automatic transcript of the focus groups
- Photos of edited CLDs, post-its, and notes
- A (preliminary) list of leverage points

Recording and transcript

At the start of each focus group, make sure to start the recording and automatic transcription. This can be done by opening Microsoft Teams, enter the scheduled meeting, and selecting meeting controls → more actions → record and transcribe → start recording / start transcription.

Be ready for equipment to fail. This means a back-up recording device should be ready. This can be done by a mobile phone with sufficient storage capacity.

Make photos of written data

Please make sure that all creative output of the focus groups is recorded. The analysis can be supplemented by including qualitative data such as participants' notes, written post-its, drawings on CLDs, and any drawings or text on the whiteboards that are present. Make sure to photograph all such output and to hand over the physical items to Tom so he can bring those with him back to Wageningen as a back-up.

Data processing & storage

The data should be pseudonymized within a retention period of 60 days. This means that all personal data (including name, title, occupancy, phone number, address) have to be edited out. Each participant gets assigned a unique identifier. This identifier can be edited in to replace personal data by introducing brackets. For example, you can refer to the contact details of [PARTICIPANT#1 E-MAIL] in such a way.

Raw data can be temporarily stored on the WUR's W-drive for a maximal retention period of 60 days. After pseudonymisation, the data can be uploaded to the following folder on Sharepoint:

Documents --> 4. Work Plan --> WP2 – Factors – T2.2 --> focus groups