

D2.5 Synthesis Report

Report on factors influencing dietary behaviour at micro/meso/macro levels



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DELIVERABLE PLAN'EAT – D2.5

Synthesis report on factors influencing dietary behaviour at the micro, meso and macro level



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DEM	Demonstrator, pilot, prototype, plan designs	
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.	

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Abbreviations

Terms	Definition
CWG	Collaborative working groups
COM-B	Capability Opportunity Motivation - Behaviour
FCAs	Food chain actors
F&V	Fruit & vegetable
HIB	High impact behaviour
HFSS	High fat, sugar, and salt
LL	Living Lab
SSB	Sugar-sweetened beverage

Executive summary

This report examines dietary behaviour and leverage points for change from a food system perspective, using a multi-method empirical approach that includes literature reviews, surveys, interviews, and focus groups. Incorporating the views of diverse food system actors—such as consumers, retailers, restaurants, and policy makers—the report identifies leverage points for change in four high impact behaviours: (1) reducing high fat, sugar and salt (HFSS) and sugar-sweetened beverage (SSB) consumption, (2) increasing fruit and vegetable (F&V) consumption, (3) decreasing meat consumption, and, (4) increasing plant-based protein consumption.

Leverage points are organized into thematic categories, with each theme exploring how leverage points are interconnected across the micro, meso, and macro levels of the food system. Common themes that emerged across the different high-impact behaviours include availability, accessibility, affordability, social norms, support networks, knowledge and skill dissemination, and innovations in product development and marketing.

The report examines these themes in detail for each behaviour and highlights similarities across behaviours, including a perspective on physiological and health markers. Additionally, it presents a selection of up to ten key leverage points specific to eight different European living lab contexts. As such, it serves a diverse audience by offering both a detailed understanding of leverage points relevant to individual target groups and behaviours, as well as broader summaries of recurring themes that shape multiple dietary behaviours.

Two general findings deserve particular emphasis. First, while there is significant overlap in leverage points and themes across target groups, there are also distinct differences that must be considered. For example, the themes of availability or social norms emerged across multiple target groups, whereby the theme of affordability more often emerged for target groups with limited financial means. For the future, it is of utmost importance that intervention strategies target main reoccurring leverage points, while simultaneously developing nuanced and context-specific solutions.

Second, the strong interconnections between leverage points at all system levels—micro, meso, and macro—highlight the critical need for collaboration among all food system actors. Consumers, retailers, institutions, and policy makers must work together to develop effective intervention strategies that address the leverage points presented in this report, in order to move the whole food system towards improved health and sustainability outcomes.

1. Introduction

The global food system is situated at the nexus of two of the most pressing challenges of our era: sustainability and human health. Over the past few decades, considerable progress has been made in increasing food production through innovations such as the Green Revolution and the intensification paradigm (Fanzo et al., 2020; Pingali, 2012). These developments have resulted in a reduction in hunger, an increase in life expectancy, and a decline in child mortality rates (De Bernardi & Azucar, 2020). However, these gains have not been distributed equitably, with regions in Africa and Asia still experiencing food insecurity (Padhani et al., 2022). Moreover, they have resulted in unintended consequences for the environment and human health. The intensification of agriculture has resulted in a considerable environmental burden, encompassing greenhouse gas emissions, biodiversity loss, and air and water pollution (Bodirsky et al., 2020; Crippa et al., 2021). Food system emissions represented 34% of the total greenhouse gas emissions in 2015, with the European Union being among the six largest emitting economies (Crippa et al., 2021). Concurrently, unhealthy diets, typified by excessive consumption of ultra-processed foods and animal-based products, represent a significant public health concern. They contribute to rising rates of obesity and non-communicable diseases, including cardiovascular conditions (Baker et al., 2020).

In light of the objective of a climate-neutral Europe by 2050 and the necessity to mitigate adverse health effects, transforming our food system is imperative (Boix-Fayos & De Vente, 2023). The term ‘food system’ encompasses all elements and activities related to food production, processing, distribution, preparation, consumption, and waste management (see Figure 1). The concept of sustainable food systems (SFS) builds upon this definition, encompassing food security and nutrition for all, while ensuring that the environmental, social, and economic foundations essential for future generations to enjoy the same benefits are not compromised (Fanzo et al., 2020). Reaching these aims is complex and calls for collaboration across sectors and disciplines (Boix-Fayos & De Vente, 2023). Different actions need to be implemented, such as reducing the use of chemical inputs in agriculture, reducing food losses and food waste, ensuring access to sustainable and healthy food, promoting environmental education, and, importantly, shifting dietary patterns (Guyomard et al., 2023; Li et al., 2024). The Plan'Eat project, and this report in particular, therefore place an emphasis on such dietary shifts.

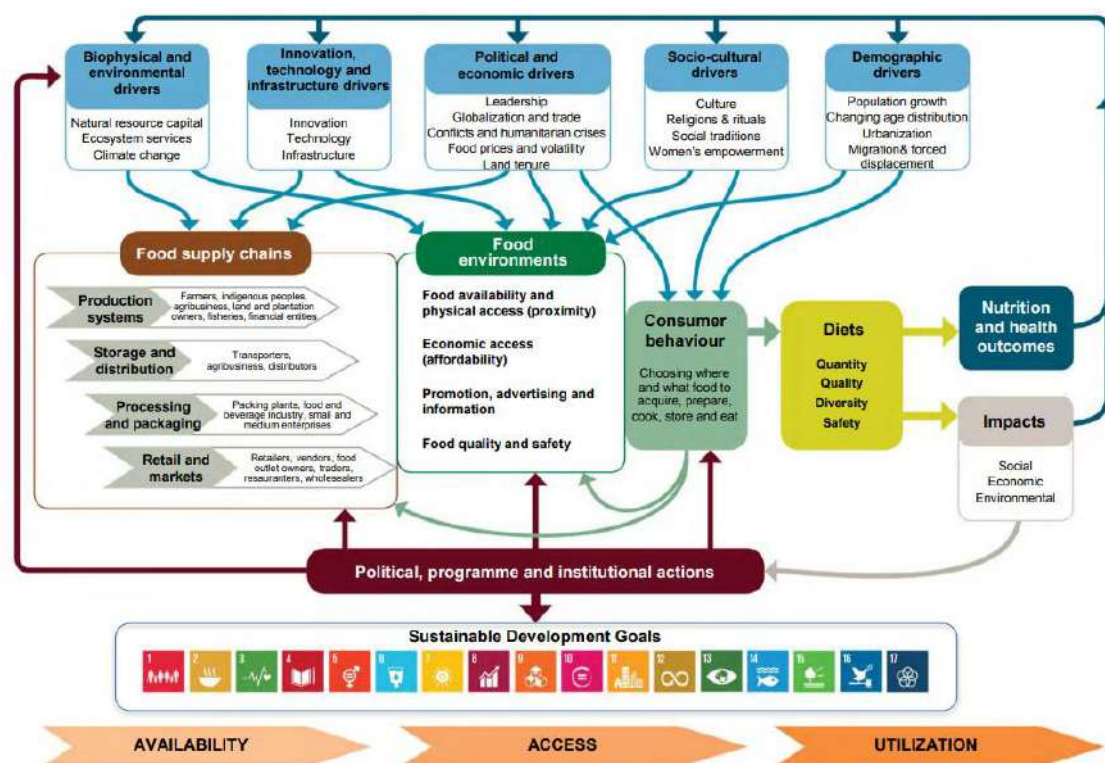


Figure 1 Food system conceptualisation by the High Level Panel of Experts at FAO (Pingault et al., 2017)

Decisions regarding which foods are produced and consumed are embedded in a system comprising multiple actors, each with their individual interests and ability to change these decisions. To foster change in the food system, it is thus of high importance to understand it as a whole. At the **micro level**, individual consumers in their local communities exert a significant influence on dietary choices and preferences. The **meso level** encompasses the food environment and supply chains, wherein retailers, food processors, and distributors exert influence over the availability and affordability of sustainable and healthy food options. At the **macro level**, governments and organisations establish regulations, policies and market conditions that shape food environments and, in turn, influence consumer decisions. An enhanced comprehension of the interrelationships between the diverse actors and components within the food system is imperative for effecting a transformation that will yield improved environmental and nutritional outcomes (De Bernardi & Azucar, 2020).

The identification of entry points for such a transformation, i.e., **leverage points**, is of utmost importance for the development of ideas for systemic change. Meadows (1999) defines a leverage point as a strategic intervention point within a system, where even a minor alteration can result in considerable shifts in behaviour and outcomes. These points can be characterised based on their potential impact, ranging from surface-level changes (e.g., taxes) to deeper changes involving system design and intent (Abson et al., 2017). Since dietary behaviour is acknowledged as a highly effective lever for enhancing both the health and environmental sustainability of the food system (IPCC, 2019), this report aims to investigate leverage points for shifts in dietary behaviour.

It is important to note that a universal approach to identifying leverage points within systems is not a promising strategy, i.e., there often are no one-size-fits-all solutions (Fanzo, Covic, et al., 2020). Context-dependent leverage points, specifically those that are linked to culturally appropriate dietary shifts, are necessary to identify appropriate solutions for different consumer groups and contexts (Loken et al., 2024). Accordingly, the Plan'Eat project, and this report in particular, employ a living lab (LL) approach, adapting measurements to different LL populations and discussing results in related contexts.

This report aims to integrate the perspectives of consumers, actors within the food environment, and policymakers in order to gain insight into the leverage points for selected impactful dietary behaviours within the food system. The objective is to generate a concrete and practical understanding of the specific leverage points that result in particular outcomes for the behaviours and actors under consideration. Accordingly, this report addresses two principal research questions:

- Firstly, which leverage points are associated with high impact behaviours and what are the interconnections between these points from a food system perspective?
- Secondly, what are the leverage points for high-impact behaviours specific to individual LLs and target populations?

The report answers these research questions by synthesising empirical research results from micro, meso and macro project partners. It offers insights from a robust multi-method empirical basis that reflects the views of a diverse range of food system actors, including consumers, farmers, food industries, retailers, food service providers, restaurants, policy makers, NGOs and research institutions. Our intention is to present the results of this study in a way that benefits a wide audience of interested readers, who may have a variety of agendas, ranging from broad changes within the food system to targeted interventions for specific populations, behaviours, and leverage points. Within this report, they will find valuable insights about what influences current high impact dietary behaviours at the micro, meso and macro level, and hence what are leverage points for potential change. These insights are presented both for the food system as a whole, as well as for selected target groups. This report offers a starting point for everyone that wants to work with similar target groups, as well as methodological considerations for analysing food system leverage points in different contexts.

2. Theoretical approaches

The present report is based on the empirical work of Plan'Eat research partners conducted at the micro, meso and macro levels. It thus draws upon a number of theoretical approaches. The following section provides a brief overview of the concepts of 'leverage points' and 'high impact behaviours', as well as the theoretical approaches associated with each level.

2.1 Leverage points

For the purpose of the current deliverable a leverage point is defined as an entry point for intervention at the macro (food system), meso (food environment) or micro (individual) level, that can either enable or constrain changes in behaviours with high impact potential. The leverage point can be activated through interventions, i.e., concrete measures that bring about changes in societal structures, new behaviours, and feedback loops between diverse components of the EU food system. For example, to encourage a shift in behaviour towards higher consumption of fruits and vegetables, an example leverage point at the macro level is consumer wealth, a meso level leverage point is food affordability and accessibility, and a micro level leverage point are consumers' concerns about food prices.

2.2 High Impact Behaviours

High impact behaviours (HIBs) are defined as behaviours that:

- 1) have a significant behaviour change potential ('*behavioural plasticity*'),
- 2) are acceptable to target groups and stakeholders ('*initiative feasibility*'), and
- 3) keep dietary behaviours safe with regards to environmental, social and health impacts ('*technical potential*') (Nielsen et al., 2020).

Figure 2 presents an overview of these defining characteristics and their association with each other and with high impact behaviours.

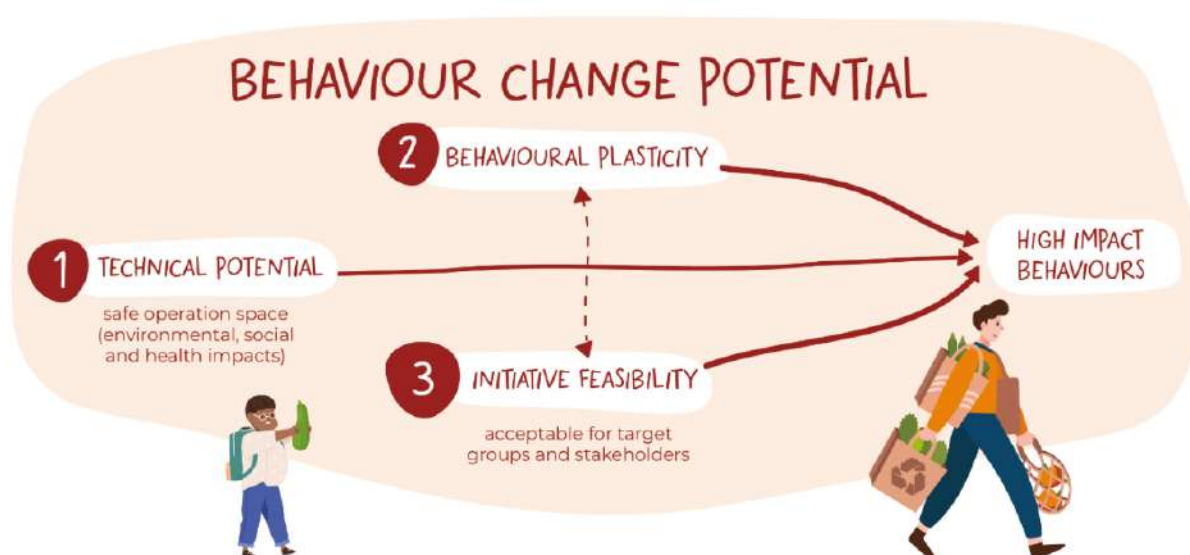


Figure 2 Defining features of high impact behaviours

HIBs were identified in an iterative process assessing all three characteristics across a large set of possible dietary behaviours based on dietary guidelines from all LL countries. This process included LL leaders and Plan'Eat project's internal as well as external experts, and implemented a mixed method approach combining surveys, interviews and workshops. As a result of this process, each LL leader identified a set of max. 5 HIBs for their LL, which they further explored with their LL citizens (see micro and meso methodology). Table 1 gives an overview of all HIBs as selected by the LLs.

Table 1 High impact behaviours across living labs

HIB/LL	France	Germany	Greece	Hungary	Ireland	Italy	Poland	Spain	Sweden	Total
MEAT 1 reduce meat consumption (eat 0-3 portions/week)	X	X			X		X			4
MEAT 2 choose poultry instead of red/processed meat										0
MEAT 3 Choose plant-based alternatives (e.g., legumes, nuts) instead of meat as an alternative source of protein (twice a week)				X						1
MEAT 4 limit the consumption of processed meat (both red and white meat) or even avoid it						X			X	2
MEAT 5 limit the consumption of red meat or even avoid it				X				X		2
F&V Eat 5 servings of vegetables and fruits per day		X	X	X	X	X		X		6
LEGUMES Eat 3 servings of legumes per week (1 serving for an adult diet: 70 g raw / 125 g cooked)	X		X		X	X	X	X	X	7
HFSS Limit the consumption of ultra-processed food products high in added fat, salt & sugar	X	X	X		X	X				5
SALT Limit salt (<1500 mg/day or 2/3 of teaspoon)			X							1
SSB Drink water instead of sugar-sweetened beverages						X			X	2
TAP WATER Choose tap water instead of bottled water							X			1
ENERGY NEEDS Know your energy (caloric) needs and eat accordingly (don't over-/under-eat)					X					1
Total	3	3	4	3	5	5	3	3	3	32

For the purpose of the current synthesis, we combined HIBs into suitable clusters based on the typical food products consumed in relationship to a HIB. E.g., all meat HIBs relate to the consumption of different types of meat and were hence merged. This resulted in the following four clusters:

1. decrease the consumption of foods high in fat, sugar and salt (HFSS) and sugar sweetened beverages (SSB),
2. increase fruit and vegetable (F&V) consumption,
3. decrease meat consumption and
4. increase plant-based protein consumption (with a strong focus on legumes).

Items specifically chosen by individual LLs (i.e., salt, tap water and energy needs) are not part of this synthesis.

2.3 Micro level approach

A multitude of factors influence dietary behaviours at the individual level. Our empirical investigation of these factors, which may be described as micro level leverage points, was based on a widely used framework in the behavioural sciences, namely the COM-B model. This model provides a comprehensive structure for the analysis of the leverage points that influence behaviour and serves as a foundation for the design of behaviour change interventions (Michie et al., 2011, Michie et al., 2014). The COM-B model postulates that behaviour (B) is the consequence of an interaction between three components: capability (C), opportunity (O), and motivation (M).

The term '*capability*' is used to describe an individual's psychological and physical capacity to perform a given behaviour. This encompasses the requisite skills, knowledge, and physical capacity. For example, an individual's capacity to adopt a healthier diet is contingent upon their accurate comprehension of the characteristics of such a diet (psychological capability) and the absence of physical constraints that would impede the ability to consume food in accordance with such a diet.

The term '*opportunity*' is used to describe external factors that either enable or encourage a particular behaviour. These factors are both social and environmental, with the current research focusing on the social aspect at the micro level. Social opportunities pertain to social norms within pertinent social groups and the influence of peers, whereas environmental opportunities relate to the availability of resources or physical conditions in the environment (e.g., the availability of food items or the proximity of retail outlets). For example, the transition to a healthier diet may be contingent upon the accessibility of cost-effective, wholesome food items, which represents a key concern at the meso level. Alternatively, it may hinge upon the provision of social assistance from family members and friends at the micro level.

'*Motivation*' is a multifaceted phenomenon that encompasses both reflective and automatic processes. Reflective motivation includes conscious decision-making processes, such as the evaluation of the benefits of a given behaviour. In contrast, automatic motivation pertains to emotional reactions, habits and impulses. For example, an individual may engage in reflective motivation, contemplating the health benefits of consuming a healthier diet, or may be driven by an automatic motivation, habitually selecting unhealthy options.



Figure 3 The COM-B model (adapted from Michie et al., 2011)

The principal strength of the COM-B model's lies in its integrative nature, capturing both individual and social-environmental leverage points that influence behaviour. This comprehensive approach permits a holistic understanding of potential leverage points and the implementation of targeted interventions addressing one or more of the three components. For example, an intervention designed to increase the consumption of legumes may enhance capability by providing training, improve social opportunity by offering advice on how to cook legumes for the whole family, and increase motivation through incentives or health education (Michie et al., 2014).

The COM-B model is complemented by the Theoretical Domains Framework (TDF), as it offers a more detailed breakdown of potential leverage points than the COM-B. It was developed with the intention of unifying theories of behaviour change and comprises 14 domains that collectively encompass cognitive, social, and environmental influences (Cane et al., 2012). The two frameworks are closely interrelated, with the TDF domains corresponding to the components of the COM-B model. To illustrate, the capability aspect of the COM-B model is aligned with the TDF domains of knowledge and skills, whereas the opportunity construct is associated with social influences and environmental resources. The COM-B model aligns with the TDF domains of beliefs about consequences and emotions with respect to motivation. This interconnection permits the utilisation of the COM-B model as a comprehensive structure for the comprehension of behaviour, while the TDF facilitates a more intricate analysis (Michie et al., 2014; Cane et al., 2012). Collectively, the COM-B model and TDF constitute a robust framework for the understanding and influence of behaviour, thus representing pivotal instruments in the domain of behaviour change research. For the research at the base of this synthesis, we ensured to cover all three domains of the COM-B model, and further differentiated potential leverage points according to the TDF.

2.4 Meso level approach

Food environments. It is increasingly recognized that dietary behaviour is influenced by the environments in which people live, learn, work and play (Moran et al., 2020). In Western countries, stores are the primary food sources in the environment. Therefore, the consumer environment in food stores represents a key leverage point of influence on dietary behaviour and a significant opportunity for dietary intervention (Middel et al., 2019). As a result, public health interventions are increasingly focusing on these environments.

Following the model by Glanz et al. (2005), there are further potentially relevant environments. This includes the 'community environment', which refers to the food environments available at the community level, next to the 'consumer environment', which encompasses the product range, presentation and pricing within each environment (Glanz et al., 2005; Caspi et al., 2012). Further environments with influence are the 'information environment' (e.g., media and advertising) as well as the 'organizational environment' (e.g., home, school or work) (Figure 4). Compared to nutrition interventions targeted at individuals or groups, upstream interventions considering the multiple actors playing a role in the consumer, community and organizational nutrition environments may be more effective in improving health. Hence, it is important to understand how these different environments impact consumers, and where leverage points for dietary behaviour change in these meso environments are.

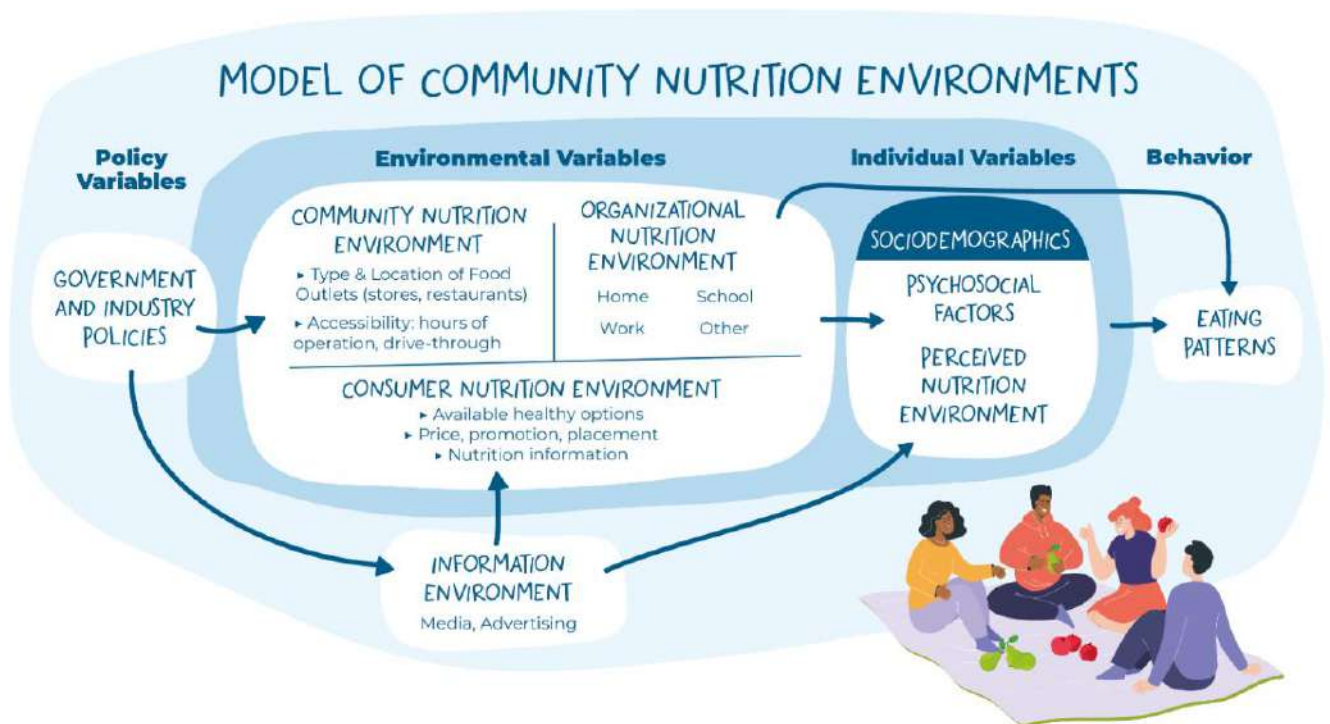


Figure 4 Model of Community Nutrition Environments (Glanz et al., 2005)

Food chain actors. Despite the increasing focus on consumer environments, there remains a limited understanding of how food is made available from the perspectives of diverse food chain actors (FCAs). Little research has examined how producers, distributors, and retailers each influence the consumer environment in ways that affect dietary behaviours. Each of these actors plays a distinct role in determining which foods reach store shelves, how they are presented, and ultimately how they are consumed. Recognizing and studying the perspectives of the food chain actors may reveal new intervention points within the consumer environment, enabling more effective strategies for promoting healthier food choices (Winkler et al., 2020).

Our analysis of the meso level and its components is therefore bidirectional, examining both consumer perceptions of food environments and food chain actors' perspectives. First, we study how consumers interact with the food available within the different consumer environments. To this end, the Model of Community Food Environments (see Figure 4) informed the meso level analysis of food environment factors influencing dietary behaviour by including questions considering all the different types of food environments. The results from the study contributed to the meso level leverage points in the current report.

In parallel, we explore the perspectives of key food chain actors (FCAs) (e.g., farmers, retailers, restaurants, food services, and food industries) involved in the Plan'Eat project, focusing on their perceptions regarding interventions to make the food supply and production healthier and more sustainable. Our investigation delves into the factors—both barriers and enablers—that influence the FCAs' decision-making processes in implementing interventions to make the consumer environments in which they operate healthier and more sustainable. The results are then discussed within the context of identified leverage points from the micro and meso consumer perspective and at the macro level.

This dual approach enables a nuanced understanding of how both consumers and food chain actors contribute to creating a healthier, more sustainable food environments. It also supports the design of targeted interventions in work package 4 of the Plan'Eat project, i.e., within food environments in the LLS, aligning these interventions with the specific needs of both food chain actors and target groups.

2.5 Macro level approach

In the macro level analysis, we conceptualised the food system as a dynamic network of activities leading to critical outcomes such as economic well-being, food security, and environmental sustainability. Our focus was on key activities like production, distribution, and retail, all influenced by various drivers (see Figure 1), including biophysical conditions, technology, politics, socio-cultural factors, and demographics. Inherent to the food system as a dynamic network are complex interactions characterised by feedback loops that link outcomes back to these drivers and inform political actions (Pingault et al., 2017).

We employed the leverage point framework (Meadows, 2009) to identify where policy interventions could most effectively transform the system. The framework allows to identify a variety of leverage points from shallow to deep, starting with (1) easily quantifiable parameters, such as subsidies, (2) feedbacks (the interrelations between parameters), and progressing to deeper aspects, including (3) system design and (4) underlying intent (Abson et al., 2017, based on Meadows, 2009). While shallow leverage points were more straightforward to identify and measure, we recognized that deeper leverage points—those influencing system design and intent—held greater potential for systemic change, despite being more challenging to address.

We also acknowledged the risks of targeting isolated leverage points, as this could result in superficial changes or encounter resistance if interventions are misaligned with existing institutional structures. To mitigate this, we used an integrated approach that accounts for the interconnectedness of leverage points. This approach aims to align interventions across multiple domains—such as finance, health, and agriculture—to facilitate a comprehensive and sustainable transformation of the food system. Given the urgency of addressing environmental and health challenges, we emphasized the need for rapid and coordinated action to ensure effective and lasting change.

3. Methodology

3.1 Micro level analysis

A comprehensive survey of LL citizens was conducted between November 2023 and January 2024 to identify leverage points at the micro level¹. The survey was primarily conducted online, except for two LLs (Poland and Greece), which employed paper-and-pencil surveys. The survey comprised a series of question blocks, including introductory and participant information sections, demographic data, a food frequency questionnaire (FFQ), and questions pertaining to leverage points for each HIB. The latter section of the questionnaire included questions addressing both individual (micro level) leverage points and food environment (meso level) leverage points (for further details, please refer to chapter 3.2). The study adhered to in accordance with the highest ethical standards, ensuring the principles of informed consent and anonymity. Ethical approval was obtained from all the Living Labs (LLs) involved, prior to the commencement of the study.

The FFQ was employed as a means of assessing current dietary behaviour. The instrument was adapted from the IDEFICS/I.Family Study (Arvidsson et al., 2015) and includes validated items. Furthermore, the HIB leverage point questions were based on previously validated items drawn from the literature. In the absence of validated items in the literature (for example, for behaviours that have been less researched, such as increasing legume consumption), items from other HIBs were adopted. Similarly, the questions were adapted to align with the specific characteristics and needs of the LL target adult populations, including parents of children and adolescents. For each HIB, the leverage point questions encompassed all three domains of the COM-B model (capability, opportunity and motivation).

The responses to the leverage point questions were rated on a scale of 1 to 5, with 1 indicating strong disagreement and 5 indicating strong agreement. Alternatively, comparable scales were used, such as a scale from 1 (not at all) to 5 (very much). In order to differentiate between potential and *main* leverage points for the single HIBs, cut-offs were set and applied to the average ratings provided by living lab citizens. In the initial stage of the analysis, the mean ratings for each leverage point question were calculated across participant for each living lab (LL). It is noteworthy that the wording of the questions differed in such a way that, for some, a high average rating indicated a main leverage point, while for others, a low average rating indicated a main leverage point. For example, in the case of the HIB 'limit ultra-processed food products high in fat, sugar and salt' (HFSS), a high average rating for 'I eat sweet or savoury foods when I am stressed' indicates a main leverage point. Similarly, a low average rating for the question 'How confident do you feel in your ability to limit the consumption of sweet or savoury foods you eat?' indicates a main leverage point for the same HIB. Consequently, in a second step, cut-offs for identifying *main* leverage points were set at average ratings of either 3.5-5 or 1-2.5, in accordance with the wording of each leverage point question. The present synthesis is based exclusively on the aforementioned identified *main* leverage points.

3.2 Meso level analysis

The meso level analysis incorporates two approaches focusing on different perspectives: firstly, the food environment as it is perceived by consumers, and, secondly, the perspective of different meso level food chain actors and. Below we briefly present the methodology of each perspective.

Food environments

The meso analysis of leverage points that influence dietary choices aimed to explore the influence of the different types of food environments (community, consumer, organizational and information environment) on the selected HIBs. The aim was to analyse how food offerings, food communication and the role of education through its curriculum and school practices influence dietary behaviours. A survey was distributed to living lab citizen panels (see micro level analysis for details). Where possible, we used published scales for

¹ The current report is based on the results of eight European living labs. The living lab Germany is not included in this report, since there was no sufficient amount of data available for this LL on time for the writing of this report.

the survey. Otherwise, we adapted published scales to the specific behaviour in question, or created new scales based on items from tested scales.

The questionnaire had four overall objectives:

- To measure participants' food intake frequency, namely in relation to the chosen HIBs (see 2.1 Micro level analysis)
- To explore the link between information and education and the HIBs
- To explore possible strategies respectively minimising and maximising the effects of barriers and enablers influencing food environments
- To uncover key dimensions of how food environments affect the chosen HIBs by identifying and analysing the key external and personal dimensions that shape participants' daily perceived experiences with their food environments and finding possible relations with participants' food intake within the HIBs

To measure the food environments, the NEMS-P was applied (Alber et al., 2018), and the five dimensions of food environments (availability, accessibility, affordability, acceptability, and accommodation) (Glanz et al., 2005) were also considered in the questionnaire design. The Nutrition Education questionnaire developed by The National Center for Education Statistics (National Center for Education Statistics, n.d.) inspired the questions about educational aspects. All living labs have taken measures to follow ethical standards and data protection obligations. Ethical committee approval was obtained by all living labs previous to the beginning of data collection.

Food chain actors

Members of five Collaborative Working Groups (CWGs) within the PLAN'EAT initiative, representing various European food chain actors—farmers, food industries, retailers, food services, and restaurants—participated in an exploratory study designed to identify the enablers and barriers they encounter in producing and offering healthy and sustainable food.

CWG leaders conducted an open-ended survey or interviews with their members to achieve two main objectives: first, to assess the knowledge and awareness of CWG members regarding healthy and sustainable food; and second, to determine whether the factors influencing interventions to enhance the healthiness and sustainability of consumer environments—previously identified in the literature by KUL and selected by CWG leaders—were experienced by CWG members. Furthermore, members were asked to indicate whether these factors were perceived as barriers or enablers to the implementation of such interventions.

The determinants identified by CWG members were categorized into five primary domains, following The Consolidated Framework for Implementation Research (CFIR) (Damschroder et al., 2009). These domains relate to: 1) the characteristics of the organization where the intervention is implemented; 2) the external context surrounding the organization; 3) the specifics of the intervention itself; 4) the planned process for implementing the intervention; and 5) the actors involved in the implementation process. This structured approach provides valuable insights into the multifaceted dynamics at play in promoting healthier, more sustainable food environments.

All CWGs have taken measures to follow ethical standards and data protection obligations. Each survey participant received clear and understandable written information about the nature, purpose, risks and benefits of their participation in PLAN'EAT. Participants were also provided with a detailed description of the PLAN'EAT project and data management.

3.3 Macro level analysis

To analyse the underlying drivers of the European food system and identify leverage points for change, we employed a structured methodological approach. We began by creating a stylized systems map of the EU food system, serving as a high-level abstraction to identify leverage points. This map was constructed based on an analysis of food system trends, identified through a rapid literature review of EU-level documents and

reports. These trends—mid- to long-term changes in key variables like business consolidation—served as entry points to examine the underlying mechanisms and drivers of the system.

We focused on food supply chain activities, particularly production systems, storage and distribution, processing and packaging, and retail and markets, while also incorporating input provision systems like fertilizers and machinery. Trends were identified through an iterative review of 18 key documents, supplemented by additional sources where necessary. An extended literature review was then conducted to uncover the drivers behind each trend, ensuring a comprehensive representation of biophysical, technological, political, socio-cultural, demographic, and health-related drivers.

The identified variables and their interrelations were converted into causal-loop diagrams using Kumu©. These diagrams were then combined into a comprehensive map, which was validated through interviews with 18 experts from NGOs, professional associations, the European Commission, and academia. Based on expert feedback and additional literature, we refined the map to focus on the most significant drivers and mechanisms.

Subsequently, we hosted five focus groups in Brussels, each dedicated to a specific thematic map—health, environment, political-economic, innovation & infrastructure, and socio-cultural drivers. Participants, including representatives from the European Commission, NGOs, and research institutions, validated the maps and identified leverage points. Through structured exercises, participants selected 30 promising leverage points across the five subsystems of the EU food system. Ethical considerations, including informed consent and data pseudonymisation, were strictly adhered to throughout the study.

3.4 Synthesis methodology

The synthesis was conducted by JLU with input from partners at all three levels (WU, KUL, EUFIC, JLU and UCD). During three consecutive workshops, partners presented their approaches with the aim of achieving a common understanding followed by the presentation of their results. Throughout the workshops, the partners engaged in collaborative efforts to develop a unified vision for the deliverable, establish a common lexicon, and present a synthesis of findings that represented each HIB as it was embedded within the food system.

At the inaugural workshop, the partners engaged in a discourse concerning the prospective synthesis approach, identifying concepts that necessitated a shared definition. Subsequently, partners provided each other with written input on their respective approaches, methodologies and illustrative results. Based on the aforementioned material, JLU proceeded to draft definitions and two potential synthesis options: one comprising a division into emerging principal themes and the other a synthesis for each HIB.

At the second workshop, the partners collectively decided to produce a synthesis for each HIB, to identify the principal themes that emerged across the micro, meso and macro leverage points for each HIB. Following the workshop, partners engaged in online collaboration over several weeks, working towards the creation of 'system maps' for each HIB. These maps were developed in accordance with an agreed-upon definition of leverage points, encompassing all three levels (micro, meso and macro) (see 2.1). The system maps for each HIB represent the inaugural output of the synthesis process and offer a comprehensive, detailed overview of the leverage points, differentiated according to LLs and target groups. The system maps are intended for stakeholders who are interested in seeing the results for a particular HIB and for different LLs or target groups.

The next stage of the process involved JLU synthesising the system maps for each HIB. First, we identified the primary themes that emerged across all three levels and all LLs for a given HIB. Second, we conducted a narrative exploration of the linkages across the micro, meso and macro leverage points within each theme. The objective of the synthesis is to provide an understanding of a specific HIB and related leverage points as they are embedded in the food system. Here, 'narrative' refers to a qualitative synthesis approach with which we seek to construct coherent and interpretative descriptions of how leverage points interact and reinforce each other across the micro, meso and macro levels.

In a last step, the current report discusses themes that reoccurred across different HIBs in order to offer insights for general leverage points to foster healthy and sustainable dietary behaviour. This summary is complemented by the results from interviews with various food chain actors from the CWGs (i.e., farmers, food industries, retailers, food services and restaurants) on these topics.

3.5 10 Key leverage points per LL

In order to deepen comprehension of the leverage points for specific LLs and target populations, and to facilitate a co-created understanding of the micro, meso and macro results in the context of specific populations and cultural settings, we collaborated with the LLs to identify 10 key leverage points pertinent to their respective LLs. In this phase, the identified micro, meso and macro leverage points were presented to the LLs, who were invited to explore them in the form of two worksheets. The first worksheet, titled 'A', invited the LLs to select a maximum of 10 key leverage points from the full set identified for their LL. The second worksheet, titled 'B', invited them to provide further explanation as to why they had selected these points. It invited reflections on the importance, potential for change and feasibility of the selected leverage points, as well as the level of stakeholder support they foresee in their LL and country for interventions targeting the leverage point. JLU then collated the information provided by the LLs on both worksheets into LL profiles, which qualitatively describe the key leverage points for each LL.

4. Results

In the following, we present leverage points for each HIB organized into themes (see Figure 5 for an overview of themes across all HIBs). The leverage points are interconnected across the micro, meso and macro level, whereby an understanding of a leverage point's place at these three levels largely depends on the perspective. For example, costs for consumers are a leverage point at the micro level, which is strongly impacted by prices at the meso level. Prices in turn are set in the framework of macro level policies, such as financial regulations. Each theme therefore explores related leverage points, where possible, from all three perspectives. At the end of each HIB chapter, a system map of leverage points for the respective HIB depicts the leverage points that are organized within each theme. In the Appendix A, we provide more detailed maps of the leverage points per HIB differentiating between different target groups. These detailed maps form the empirical basis for the results presented in this chapter 4.

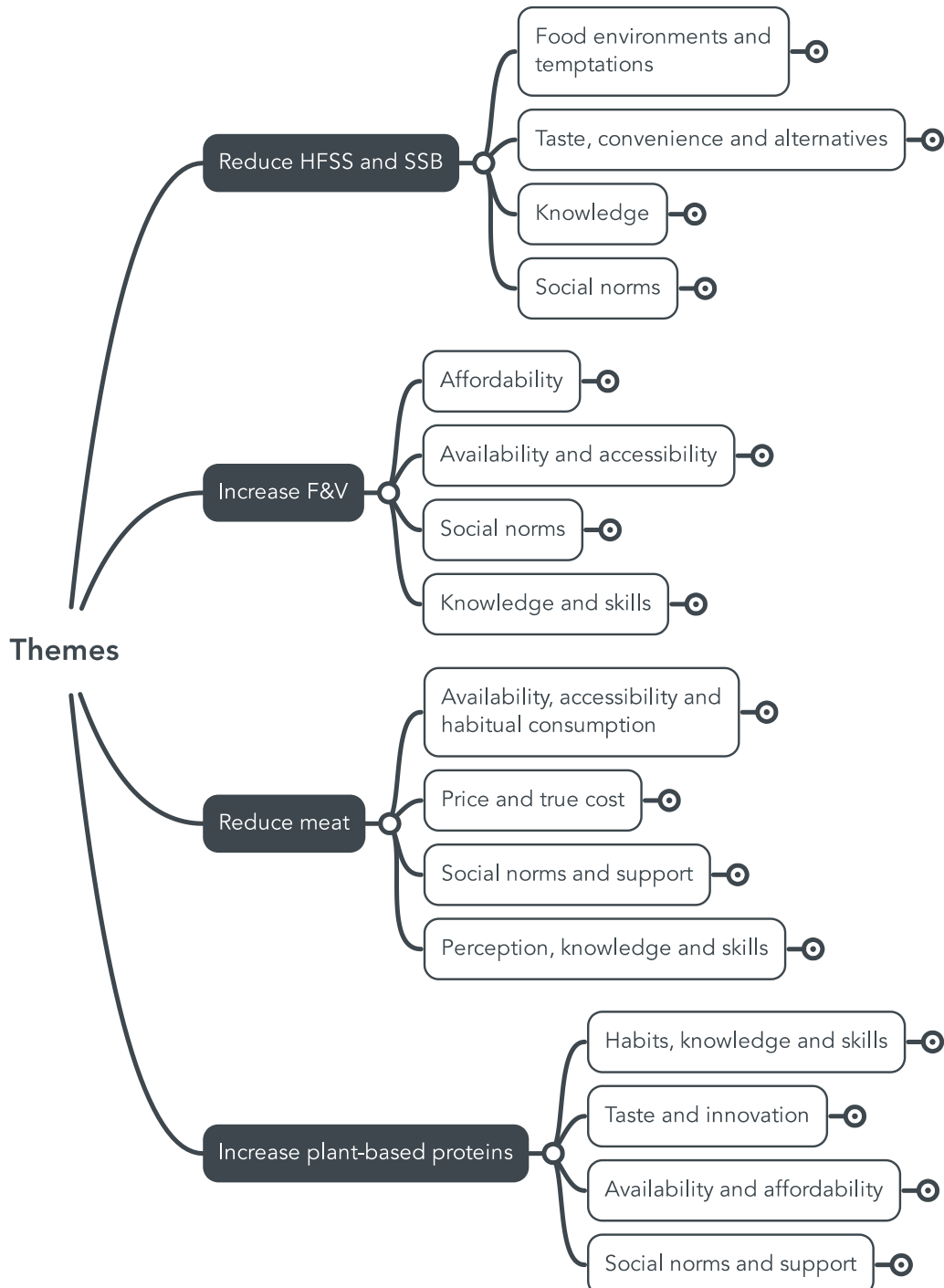


Figure 5 Overview over themes that emerged for each high impact behaviour

4.1 Reducing HFSS and SSB

For the HIB cluster ‘decrease consumption of foods high in fat, sugar and salt (HFSS) and sugar-sweetened beverages (SSB)’ four main themes emerged: (1) food environments and temptations, (2) taste, comfort and convenience, (3) knowledge and (4) social norms. While we present distinct leverage points within each theme, it is important to note that they are also interlinked in multiple ways. For example, the widespread availability of HFSS and SSB in food environments links to social norms around consuming these foods, and the ubiquitous need for convenience links to social norms about what to cook. In the following section, we present leverage points organized into the four main themes, and discuss their implications across the micro, meso and macro level. All leverage points are depicted in a system map in Figure 6.

4.1.1 PHYSIOLOGY OF HFSS AND SSB CONSUMPTION

In our analysis, intakes of saturated fat and sodium were used as proxy measures of High Fat Sugar and Salt (HFSS) foods. High consumers of saturated fat (mean $51\pm 16\text{g/day}$) had significantly lower levels of high-density lipoprotein cholesterol relative to low consumers (mean $22\pm 4\text{g/day}$), and high consumers of sodium (mean $3326\pm 784\text{mg/day}$) had significantly greater weight, BMI, fat mass, waist circumference, and hip circumference compared to low consumers (mean $1518\pm 291\text{mg/day}$). Our findings align with dietary recommendations to lower saturated fats, sodium and, by extension, HFSS foods. Reducing high sodium foods hence may be a leverage point to lower levels of adiposity, and, in reverse, targeting measures of adiposity could, in theory, influence sodium (and HFSS food) intakes. However, there is a lack of evidence that a change in physiological biomarkers causally impacts food consumption, and our data are cross-sectional in nature, precluding causal inference.

4.1.2 FOOD ENVIRONMENTS AND TEMPTATIONS

The high availability, visibility, and accessibility of foods high in fat, sugar, and salt (HFSS) and sugar-sweetened beverages (SSB) across various food environments are key factors driving their consumption. At the **micro level**, across age groups, the experience of temptation through visible access to these products represents a leverage point. This is connected to leverage points related to availability, promotion, and product placement at the **meso level**. The pervasive presence of HFSS foods and SSB in environments such as schools, workplaces, day-care centres, restaurants, shops, and homes—combined with prominent placement and promotional strategies in retail stores—creates high visibility and ongoing temptation for consumers. Additionally, consumers report that higher prices for these items at retailers and restaurants/cafes serve as a leverage point, underscoring the role of affordability in influencing consumption. At the broader **macro level**, food environments saturated with HFSS and SSB products are a direct consequence of liberalisation and deregulation. These processes have created a market-driven food system that prioritises competition and profits, often realised through the production and promotion of inexpensive, highly palatable, and profitable products with low nutritional value. The **macro level** leverage point of processing and packaging plays a crucial role in this context. Financial regulation targeting this leverage point, such as taxation of core ingredients in HFSS foods and SSB, could discourage their production and promotion, thereby reducing their availability. This, in turn, could incentivise the development and placement of healthier, more sustainable food options (see next theme).

4.1.3 TASTE, CONVENIENCE AND ALTERNATIVES

HFSS and SSB foods are highly palatable and ‘tempting’ (see previous theme). Thus, at the **micro level**, one leverage point is the consumers’ liking of these products, which is particularly prevalent among consumers with higher consumption rates. Furthermore, HFSS and SSB can often serve as comfort and convenient foods. For example, adults may view SSB as a thirst quencher, while young adults and the elderly may turn to sweet or savoury snacks as a quick fix when hungry or as a treat. Together, these leverage points highlight the convenience and immediate satisfaction these foods provide. Choosing rewarding and convenient foods is embedded in the context of the **macro level** leverage point of labour market participation and the broader

context of modern life. The demands of the labour market create high levels of stress and reduced leisure time, resulting in less time available for meal preparation. As a result, consumers are more likely to choose convenient, ready-to-eat options that fit into their busy schedules, or comfort foods as inadequate strategy for stress relief, even if these foods are highly processed and less healthy. The great availability and prominent accessibility of HFSS and SSB at the **meso level** in multiple food environments (see previous theme) only reinforces this pattern, making HFSS and SSB products the easy choice when convenience is a priority. Addressing these leverage points requires a balanced approach that considers the realities of modern life while promoting healthier eating habits. Cooking with whole foods (see social norms theme) is not a viable option for all consumers and situations. Hence, the availability and price of healthier alternatives to current HFSS and SSB products emerge as a leverage point at the **meso level**, which links to the processing and packaging leverage point at the **macro level**. By reducing the overall offer of HFSS and SSB products (e.g., via taxes on core ingredients) and making food processing more sustainable and healthier whilst equally affordable, the processing and packaging leverage point can help reduce the reliance on HFSS and SSB as comfort and convenient foods. A second related leverage point at the **macro level** are marketing strategies within the food environment. Marketing already drives food consumption to a large extent, and can potentially be used to make a positive impact by changing the focus of placement and advertisement efforts towards healthier alternatives to current HFSS and SSB products.

4.1.4 KNOWLEDGE

At the **meso level**, receiving more knowledge about health and environmental impacts of HFSS and SSB emerges as a leverage point towards a decrease in consumption. Possibly linked to a lack of knowledge of the negative impacts of these products, at the **micro level**, one adult consumer group indicates not keeping track of SSB consumption and seeing them as a thirst quencher, whereby the latter is a leverage point identified by consumers with a high consumption of SSB. Similarly, another adult consumer group perceives HFSS as a good value for money. In order to empower consumers to make informed choices, future efforts such as health campaigns, possibly at the **macro level**, could target the leverage point knowledge and educate consumers about the impact of the foods they are consuming.

4.1.5 SOCIAL NORMS

At the **meso level**, inspiration from peers for reducing SSB consumption is identified as a leverage point particularly among parents of younger children. Similarly, availability of HFSS and SSB in multiple social settings, such as friends' and families' homes, daycare or schools, also emerged as a leverage point. Both of these highlight the importance of social environments in promoting healthier choices. Collectively, these leverage points link to social norms at the **macro level**. Social norms play a significant role in shaping dietary behaviours, including the consumption of HFSS and SSB. While social norms around healthy eating are gaining importance, everyday choices are still influenced by the widespread availability and promotion of HFSS and SSB products across different **meso level** environments. Shifting social norms away from HFSS and SSB consumption therefore will require a concerted effort. One potential leverage point to counter their consumption is a return to appreciating fresh foods and a reinforcement of cooking whole foods. Such a shift can be supported by previously mentioned leverage points. At **meso level**, this links back to the leverage point of knowledge about negative impacts of consuming HFSS and SSB. Such knowledge could act as a stepping stone towards moving away from HFSS and SSB products, and towards cooking with whole foods as a desirable and attainable practice. Additionally, at the **macro level**, a reorientation of processing and packaging through incentives towards healthier products, coupled with regulations that limit the promotion of HFSS and SSB foods, can further support this shift.

4.1.6 Conclusion

Reducing HFSS and SSB consumption involves addressing a complex web of interconnected factors that influence dietary behaviours at multiple levels. The availability and visibility of these products in various food environments, driven by aggressive marketing and a market-driven food system, as well as their highly

palatable nature make them difficult to resist. Concurrently, the demands of modern life, e.g., reduced leisure time through labour market participation, make these convenient options particularly appealing. To effectively reduce consumption, interventions must target these leverage points collectively, reducing the widespread availability of HFSS and SSB products, while promoting convenient, tasty and healthier alternatives. A shift in social norms towards cooking with whole foods can be an important part of this change, indicating the need to provide knowledge about the health and environmental benefits of whole food cooking. This shift must also be understood in the context of broader systemic issues, such as labour market participation and practices, that sustain the demand for convenient HFSS and SSB products.

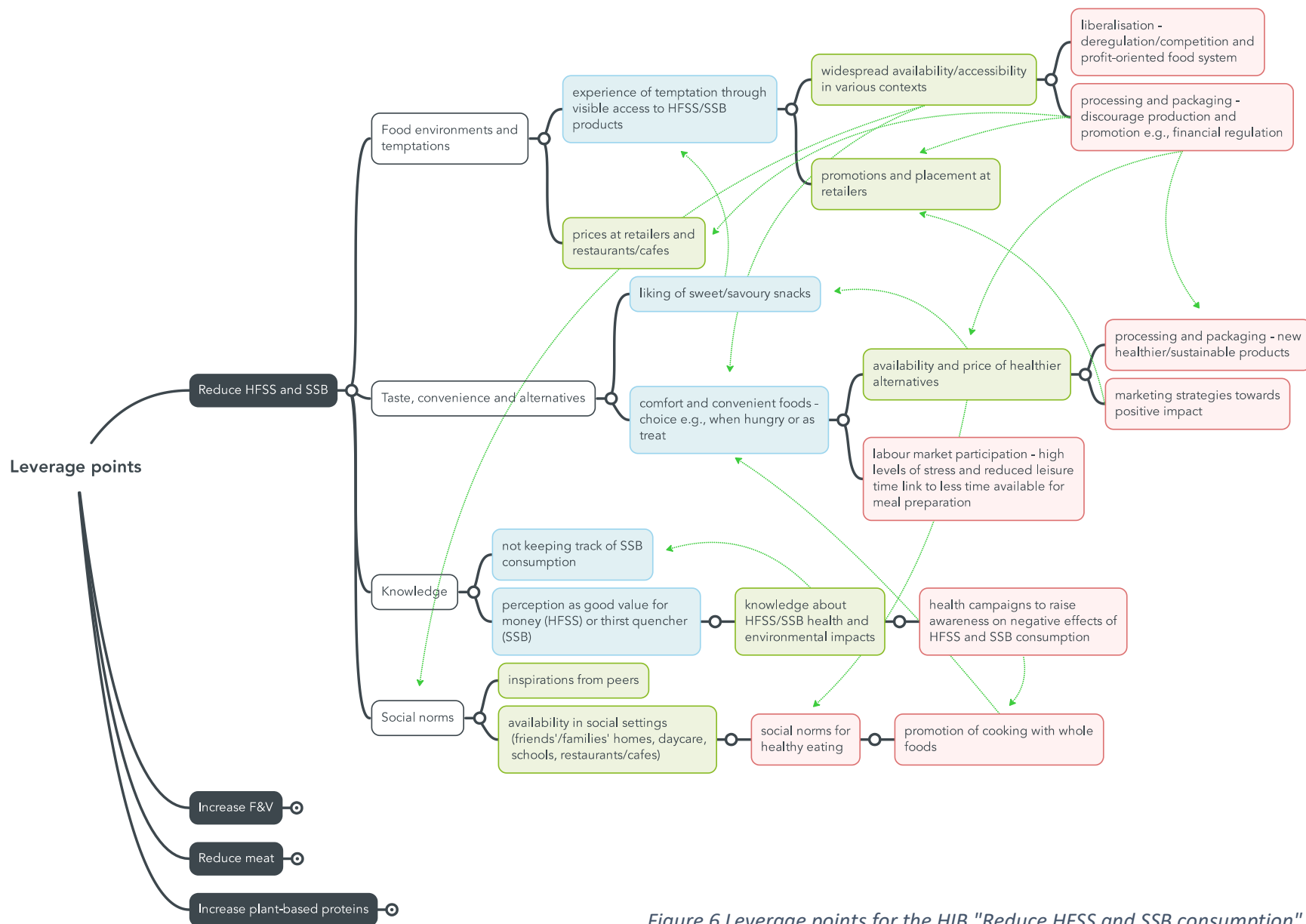


Figure 6 Leverage points for the HIB "Reduce HFSS and SSB consumption"

4.2 Increasing fruit and vegetable consumption

For the HIB ‘increase F&V consumption’ four main themes emerged: (1) affordability, (2) availability/accessibility, (3) social norms, and (4) knowledge/skills. The leverage points presented within each theme also link across themes. For example, an increase in affordability might be linked to increases in availability and accessibility, while an increase in F&V availability and accessibility in everyday environments such as restaurants or workplaces might contribute to changes in social norms around eating F&V. In the following, we present leverage points organized into the four main themes, and discuss their implications across the micro, meso and macro level. Figure 7 depicts all leverage points in a system map for this HIB.

4.2.1 PHYSIOLOGICAL CONTEXT OF FRUIT AND VEGETABLE CONSUMPTION

In our analysis, high consumers of fruits (mean 353±143g/day) had significantly lower body mass index (BMI), fat mass, waist circumference, total and low-density lipoprotein cholesterol, and fasting insulin compared to low consumers (mean 34±26g/day). High consumers of vegetables (mean 240±51g/day) also had significantly lower BMI, fat mass, and waist circumference compared to low consumers (mean 75±27g/day), while also having lower body weight and hip circumference relative to low consumers.

Our results could be used to help guide dietary recommendations to individuals. For example, for individuals with excess adiposity (e.g., high BMI), our results suggest that improving fruit and vegetable intakes could help to lower these measures of adiposity and thus improve their health status. While our results are cross-sectional, there are prospective data to support this relationship for fruits (1). In addition, there are established mechanisms of action that may mediate this relationship (e.g., effects of fruits and vegetables on satiety) (2).

From the perspective of the leverage points described in other sections, these relationships could suggest that physiological and metabolic health measurements could act as leverage points (i.e., intervention targets) for altering fruit and vegetable intakes. For example, it is possible that targeting a reduction in BMI or other measures of adiposity (e.g., body weight, fat mass, waist and hip circumference) could cause individuals to improve their fruit and vegetable intakes, perhaps if they become more health conscious as a result of improving their body composition. However, there is a lack of evidence that a change in physiological biomarkers causally impacts fruit and vegetable consumption, and our data are cross-sectional in nature, precluding causal inference.

4.2.2 AFFORDABILITY

At the **micro level**, especially for low-income consumer groups, the cost of F&V is a significant barrier to increased consumption. This financial burden is a key leverage point that must be addressed to encourage higher F&V intake. At the **meso level**, retailers and food environments play a critical role in shaping costs for consumers. Accordingly, all consumer groups presented lowered prices as a main leverage point for increasing their F&V consumption. Strategies such as discounts, promotions, and lower margins on F&V can help decrease prices at the meso level and ease the cost barrier experienced at the micro level. The leverage point of price and cost is further crucial in the future when discussing the affordability of more sustainably produced F&V, such as organic or local options, since these might increase instead of decreasing the prices for F&V. Additionally, fair wages and working conditions along the whole value chain, including farmers and producers, need to be ensured. At the **macro level**, these points link to the leverage point of consumer wealth, which can be a limiting factor in choosing F&V if not adequately addressed. Collectively, these leverage points underline the need to align macroeconomic policies with meso level retailer strategies and producer interests. Aiming to improve the overall affordability of F&V, such a strategy would enable individuals from all income groups to make healthier purchasing decisions at the micro level.

4.2.3 AVAILABILITY AND ACCESSIBILITY

At the **micro level**, the visibility of F&V during key moments—such as when choosing a snack or a meal at home—affects consumption choices. Consumers are less likely to choose F&V as a snack or part of their meal if they are not readily visible at home or, at the **meso level**, easily available and accessible in schools, workplaces, restaurants and shops. The availability and accessibility of F&V in these everyday environments are therefore crucial leverage points to address. By increasing F&V presence in the above-listed environments, meso level actors directly support the micro level need for easy access, helping individuals to make healthier choices in their daily lives. Likewise, strategies to increase the availability and accessibility of F&V in the home environment can also be of interest. To foster these changes at the micro and meso levels, **macro level** food environment policies can be implemented across all relevant settings. Regulatory frameworks that mandate or incentivize the provision of F&V with easy access in schools, workplaces, restaurants and shops can create a more consistent presence of healthy options. This approach ensures that visibility at the micro level is no longer a barrier, as individuals encounter F&V regularly in their daily environments. It further links to the first theme of affordability, and to the next theme of perceived social norms around eating more F&V, which can be affected by the increased presence of F&V.

4.2.4 SOCIAL NORMS

At the **micro level**, individual behaviours around F&V consumption are influenced by social norms. Currently, choosing F&V, e.g., as a snack, when hungry or to treat oneself, is not the norm. One leverage point worth exploring further is the replacement of commonly chosen HFSS snacks with F&V in negative situations, such as when experiencing stress or boredom. Such changes would require a shift in the perceived desirability of F&V, and in the perception of F&V as a suitable snack. Social norms are reinforced by the context, i.e., the **meso level**. It comprises the immediate physical environment, such as the above-discussed availability and accessibility of F&V, and the immediate social environment, including the behaviours observed among friends, family, or colleagues. When F&V are more commonly served and consumed in social settings, such as at friends' and families' houses, social events, and community places, they become a more normalized and acceptable choice. For example, community programs at the **meso level** can promote F&V as a desirable option chosen by many, helping to shift the leverage point social norms at the meso scale. At the **macro level** the leverage point social norms can be supported through public health campaigns and educational initiatives, which can build on the multiple health and environmental benefits of F&V consumption, but also their taste and enjoyment. These campaigns can create a broader cultural shift making F&V consumption not only acceptable but a standard choice. Ideally, efforts to shift the leverage point social norms at the macro level efforts are matched with activities at the meso level, leading to individuals adapting their behaviours at the micro level, resulting in increased F&V consumption.

4.2.5 KNOWLEDGE AND SKILLS

At the **micro level**, individual knowledge about the health and environmental benefits of F&V, as well as the skills needed to prepare them, are critical leverage points. For some target groups, preparation time, as well as a lack of knowledge about storing and preparing F&V can limit consumption. At the **meso level**, practical educational programs in schools, workplaces, and communities, or information provided at retailers and restaurants, can address these knowledge and skill gaps. By empowering individuals with an understanding of why it is desirable to increase F&V consumption, as well as with the tools they need to prepare F&V easily, quickly, and store them correctly to avoid spoilage, such programs make it easier for individuals to incorporate F&V into their diets. To reinforce these efforts, **macro level** policies can mandate or support widespread educational initiatives that promote the benefits of F&V and teach relevant skills. These could include national campaigns or curriculum changes that ensure individuals are equipped with the necessary knowledge and skills from a young age. When education policies are implemented through meso level interventions that emphasise practical application, individuals at the micro level are better equipped to support healthier choices through increased F&V consumption. This leverage point thereby is strongly dependent on individuals' motivation to engage with educational material and take action compared to the

other three leverage points. Therefore, interventions at the meso and macro level targeting this leverage point need to take into account best practices for improving knowledge and skills at the individual level.

4.2.6 CONCLUSION

Increasing F&V consumption requires a coordinated approach that addresses the interconnected leverage points of affordability, availability, social norms, knowledge and skills across the micro, meso and macro levels. Affordability is crucial, particularly for low-income groups, and is directly linked to availability. Ensuring F&V are both affordable and accessible in key meso environments (e.g., retailers, schools and workplaces) ensures that they are a viable choice for all. Increasing the availability and visibility of F&V in daily life can contribute to a shift in social norms that reinforces their consumption. Potential strategies such as targeted public health campaigns and community programs can support this shift in perceptions, helping to make F&V a more desirable option. Additionally, enhancing knowledge and skills related to F&V preparation and storage can empower individuals to incorporate these foods into their diets more frequently. The success of these efforts depends on aligning strategies across all levels, creating a supportive environment where F&V are affordable, easily available and accessible, and culturally embraced as great food options for many situations.

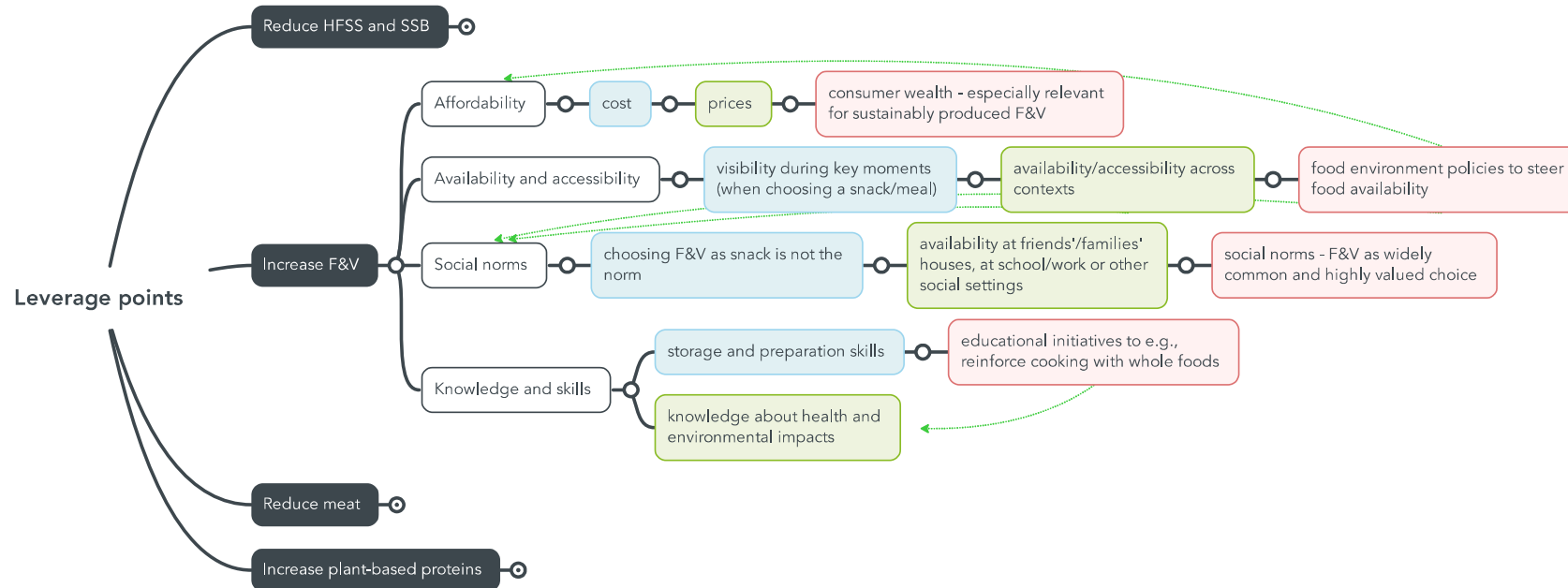


Figure 7 Leverage points for the HIB "Increase F&V consumption"

4.3 Reducing meat consumption

The HIB “decrease meat consumption” refers to different meat reduction behaviours in the different LLs, i.e., it can refer to a reduction in the consumption of meat in general, or of red or processed meat. The following leverage points are presented across these different types of behaviours. Four main themes emerged: (1) availability, accessibility and habitual meat consumption, (2) price and true costs, (3) social norms and support for reducing meat consumption, and (4) perceptions, knowledge and skills. These leverage points are often interconnected across themes. For example, the habitual consumption of meat might be tackled with changes in both availability and prices, having the potential to contribute to a shift in social norms regarding meat consumption in the long term. Where suitable, leverage points are briefly discussed in relation to (plant-based) alternatives to meat consumption. For a more comprehensive analysis of these alternatives see ‘4.4 increase plant-based protein consumption’. In the following sections, we present the leverage points organized into four main themes, and discuss their implications across the micro, meso and macro levels. Figure 8 depicts the leverage points in a system map.

4.3.1 PHYSIOLOGICAL CONTEXT OF MEAT CONSUMPTION

In our analysis, there were no significant differences in physiological and metabolic health measurements between high (mean $289\pm 103\text{g/day}$) and low meat consumers (mean $86\pm 25\text{g/day}$). However, high red meat consumers (mean $87\pm 45\text{g/day}$) had significantly lower fasting insulin concentrations compared to low consumers (mean $3\pm 5\text{g/day}$). While some other research shows higher risk of certain cancers associated with high red and processed meat intake (5); our research does not indicate meat as an intervention leverage point from a human health perspective. Of note, low meat consumers are consuming more than 1 recommended serving of meat per day (50-75g) - results might differ if comparing high consumers to non-consumers.

4.3.2 AVAILABILITY, ACCESSIBILITY AND HABITS

Meat consumption at the **micro level** is a habitual behaviour for multiple consumer groups, hence habits pose a crucial leverage point for efforts to reduce meat intake. Habitual behaviours are automatic and often driven by convenience and routine, making it a challenge for individuals to change their choices even when they are aware of the benefits of reducing meat consumption and motivated to do so. If meat is one of the most readily available options, it will likely continue to be consumed. This closely links to the **meso level**, where the widespread availability and accessibility of meat in various settings, such as schools, workplaces, restaurants, shops and (friends’) homes, is a leverage point across all consumer groups. Supported by high availability, meat can become the default choice, leading to repeated habitual consumption and discouraging the exploration of (plant-based) alternatives. Some consumer groups indicate that enhancing the availability and accessibility of plant-based alternatives in these settings can be a leverage point for making the shift away from meat. To address habitual meat consumption effectively, meso level actors can focus on altering the food environment by reducing the omnipresence of meat, while simultaneously promoting plant-based alternatives. **Macro level** policies that influence production systems are essential to support improvements in the availability and accessibility of such (plant-based) alternatives. A related leverage point lies in wealth distribution policies. Redirecting subsidies and support from, e.g., the livestock sector, to the production and processing of (plant-based) alternatives can ensure that product innovations and industrial production of (plant-based) alternatives are supported, leading to meat alternatives that are not only widely available but also tasty, healthy and affordable (see next leverage point). The interconnectedness between macro level policies and meso level availability means that systemic changes at the production level will have a direct impact on what is available and accessible to consumers in their everyday lives. By disrupting the easy availability of meat and replacing it with affordable, appealing, and healthy plant-based alternatives these coordinated efforts can help individuals break the habit of habitual meat consumption.

4.3.3 PRICE AND TRUE COSTS

While costs and affordability are not directly mentioned at the **micro level**, price is a significant leverage point at the **meso level**, with all adult consumer groups indicating that they would reduce meat consumption if meat were more expensive. It is crucial to discuss this leverage point in relation to tasty and healthy (plant-based) meat alternatives. The higher price of some of these (e.g., highly processed options) remains a challenge, especially for low-income groups. Importantly, at the **macro level**, production and processing system policies and subsidies are important leverage points. Currently, these policies disproportionately favour the livestock sector, making meat artificially cheap while keeping (plant-based) alternatives relatively expensive. Additionally, meat production incurs societal costs that are currently not internalized in the price of meat, such as environmental costs (e.g., through the production of livestock feed or the usage of synthetic fertilizers) and social costs (e.g., through diminished labour conditions). Policies aiming at the leverage point input system wealth can be used to achieve the inclusion of these ‘true costs’ of meat production, resulting in higher meat prices that will impact meso level food environments and consumer choice at the micro level. Such reduced affordability of meat combined with the wide availability of tasty, healthy and affordable (plant-based) alternatives can encourage consumers to reduce their meat consumption.

4.3.4 SOCIAL NORMS AND SUPPORT

Social support is a crucial leverage point influencing meat consumption at the **micro level**. Multiple consumer groups across all age ranges find that important people in their lives, e.g., people they share their household with, do not support eating less meat. This makes changing meat consumption particularly challenging, especially in contexts where food is eaten together (e.g., family meals). The lack of support is further reflected by the fact that in social situations, eating meat can be the easier choice because it is the default or expected option. This dynamic is closely linked to the habit of meat consumption, which can be reinforced through a shared understanding of what appropriate food choices are, reflected in culinary culture and traditions. At the **meso level**, this dynamic is reflected in the high availability of meat in social settings, such as schools, workplaces and friends/families’ homes, which perpetuates the norm of meat consumption and reinforces the lack of support for reducing it. Without changes in these social settings, individuals are likely to continue consuming meat to align with group expectations. Furthermore, the high availability impacts broader social norms around eating meat, which is an important **macro level** leverage point. Availability and social norms currently make meat consumption the standard from a cultural perspective. A change within the leverage point of social norms can enable the reduction of meat consumption by fostering cultural shifts that value and normalize (plant-based) alternatives, making them more socially acceptable and desirable. As these norms evolve, they can create a positive feedback loop where increasing numbers of individuals adopt and advocate for reduced meat consumption, further reinforcing and spreading the behaviour. Currently, however, the opposite is the case, with multiple consumer groups perceiving their social surroundings as not willing to reduce meat consumption. To support such a cultural shift, **macro level** initiatives can aim to support interlinked shifts in availability and affordability, away from meat and towards making (plant-based) alternatives widely available and affordable (see previous two themes). Such initiatives will create environments where reducing meat consumption is seen as a socially supported and desirable choice, eventually leading to tipping points when it becomes more the norm to reduce meat consumption.

4.3.5 PERCEPTIONS, KNOWLEDGE AND SKILLS

At the **micro level**, a key leverage point for reducing meat consumption especially for adolescents and young adults is a lack of cooking skills, which might link to a need for increased efforts and time to cook without meat. This is particularly challenging for one adolescent consumer group, which perceives vegetarian meals as boring and meat as too tasty to reduce. These challenges are closely linked to the **meso level**, where the leverage point of knowledge about the health and environmental impacts plays a significant role for all consumer groups except young adults. Furthermore, for two children consumer groups, their adult caretakers indicate that improved provision of cooking skills empower the adults to prepare alternatives to meat, which would help them reduce the meat intake of their children. Together, the leverage points of knowledge and cooking skills are crucial entry points for interventions to shift consumer behaviour towards reduced meat consumption. **Macro level** policies can provide support to these developments, through

promoting the availability and affordability of tasty, healthy (plant-based) alternatives (see previous themes). Likewise, initiatives that increase knowledge about the environmental and health benefits of reduced meat consumption (e.g., educational or public health programs) can support consumers by further including cooking skills building activities and promoting (plant-based) meat alternatives as equally acceptable options. Together, these steps can also contribute to social support for reducing meat consumption, e.g., when consumers have the products and skills to cook vegetarian meals in social settings such as family meals.

4.3.6 CONCLUSION

The synthesis of leverage points across the micro, meso, and macro levels demonstrates the complex and interconnected dynamics that influence meat consumption. Breaking habitual meat consumption at the micro level requires altering the food environment to disrupt the easy availability of meat, supported by policies that promote (plant-based) alternatives. Social support for meat consumption is currently reinforced by existing social norms and the high availability of meat. The availability of tasty, healthy (plant-based) alternatives that can be served in social settings is one potential leverage point to counter this. Further, targeting knowledge and cooking skill gaps, e.g., through educational programs, can also contribute to fostering social norms that value and normalize plant-based diets, making them more socially acceptable and desirable. Affordability and accessibility are closely linked, with macro level policies playing a pivotal role in setting the economic context that influences what is available and affordable at the meso and micro levels. By addressing these leverage points in a coordinated manner, it is possible to create an environment that supports and encourages reduced meat consumption, leading to healthier and more sustainable dietary patterns.

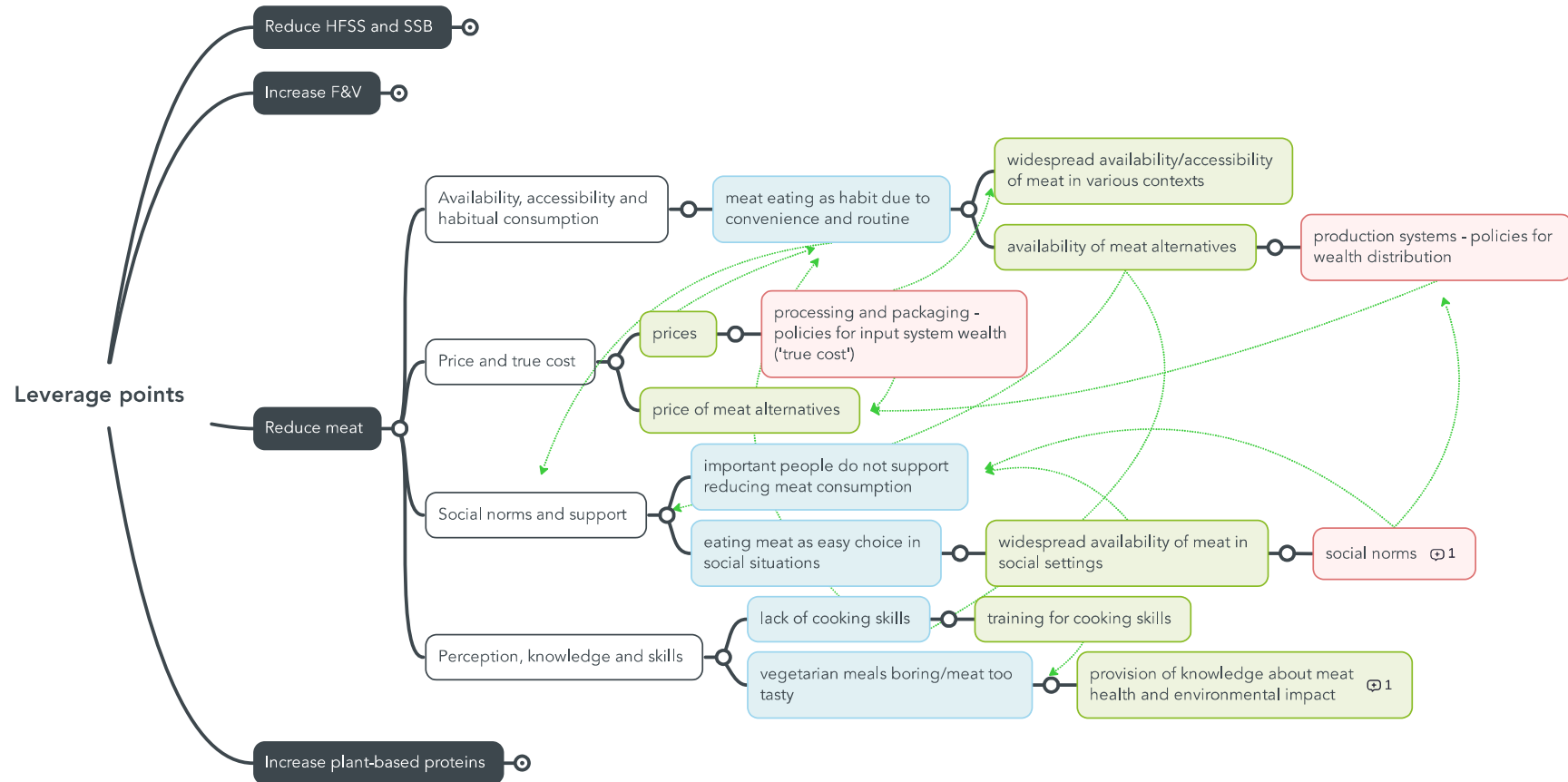


Figure 8 Leverage points for the HIB "Reduce meat consumption"

4.4 Increasing plant-based protein consumption

From the consumer perspective (at the micro and meso level), the HIB “increase plant-based protein consumption” refers to an affordable and available plant-based protein: legumes. As this HIB was chosen as a priority for many of the LLs, most target groups answered questions about increasing this specific food group. At the macro level, leverage points include a broader concept of plant-based protein alternatives (e.g., also including proteins obtained by fermentation or developed from meat cells in laboratories). Across all three levels, the following themes emerged: (1) habits, knowledge and skills, (2) taste, perceptions and innovation, (3) availability and affordability, and (4) social support and norms. The following presents leverage points across the micro, meso and macro level for all four themes, and discusses multiple linkages across themes.

4.4.1 PHYSIOLOGICAL CONTEXT OF MEAT CONSUMPTION

In our analysis, there were no significant differences in physiological and metabolic health measurements between legume consumers (mean 37 ± 26 g/day) and non-consumers (<10g/day). Based on our results, it is unclear how targeting legume intakes could direct dietary recommendations to individuals, or how targeting individuals' physiological health could affect legume intakes. However, it should be noted that legume consumers were consuming less than half a recommended serving of legumes per day (150g) and therefore should not be considered high legume consumers. While this level of legume intake is typical for Ireland and some other European countries, there is evidence for physiological health benefits associated with higher legume intakes elsewhere (3-4).

4.4.2 HABITS, KNOWLEDGE AND SKILLS

At the **micro level**, a significant leverage point for increasing legume consumption lies in consumers' eating habits, which do not commonly include legumes. Across multiple target groups, including young adults, adolescents, and children, there is a lack of habit and familiarity with legumes as part of regular meals. This is compounded by the leverage point of preparation knowledge, which was specifically noted by young adults and adolescents. One minor leverage point at the **micro level** is long cooking times for legumes, which could be remedied by the development of novel convenient products with shorter cooking times (see next theme) and complemented with enhanced provision of cooking skills (such as meal preparation skills) at the **meso level**. This links to the **meso level** leverage point of providing training for practical skills (e.g., for cooking with legumes). Similarly, at the **meso level**, across multiple target groups, more information about the health and environmental impacts of legumes was a leverage point for increasing their consumption. At the **macro level**, these topics link to the leverage point of reinforcing cooking with whole foods, which can be fostered through educational initiatives that also impart knowledge about health and environmental impacts as indicated by the meso level.

4.4.3 TASTE AND INNOVATION

At the **micro level**, for children of middle- to high-income groups, the taste of legumes is a crucial leverage point, with some perceiving it as unappealing. These perceptions create a barrier to broader acceptance and habit formation around legume consumption. Thus, tasty and healthy plant-based protein products are of high importance. This links to the **meso level** leverage point of availability described further below. At the **macro level**, production system policies and innovations in processing and packaging are crucial leverage points for promoting legumes and other plant-based proteins. Investments in research and infrastructure for plant-based food production is essential for developing tasty and healthy plant-based protein products that are convenient, socially acceptable and widely available. More financial support can enhance such

innovations in processing and packaging, which in turn can play a significant role in creating new innovative plant-based protein products. Further, marketing within food environments is a powerful **macro level** leverage point. The appeal of plant-based proteins, including legumes, can be enhanced through prominent placement and attractive packaging. These macro level strategies are essential for shifting perceptions of plant-based proteins, including legumes, and making them a more integral part of mainstream diets.

4.4.4 AVAILABILITY AND AFFORDABILITY

Apart from one target group, price was not named as a leverage point at the **micro level**. The reason could be the focus of the questions on legumes, which are an affordable plant-based protein. Notably, for the low-income target group that answered questions regarding other types of plant-based proteins, price emerged as a leverage point. Further, at the **meso level**, multiple target groups still indicated that reduced prices of legume products would be a leverage point for increasing their consumption. A related **meso level** leverage point is availability in everyday contexts: both the reduced availability of preferred alternatives (such as meat) and the increased availability of plant-based proteins. Almost all target groups indicate availability as an important leverage point across multiple contexts (such as schools, workplaces, restaurants, shops, and friends/families' homes). While whole-food legumes are mostly available in retail contexts, processed products based on legumes or other plant-based proteins might not be. In settings such as restaurants or canteens, dishes with legumes or other plant-based proteins might be less available. This is particularly relevant given the lack of knowledge about how to cook with legumes at home and concerns about the time it takes as shown at the micro level in the previous theme. An important **macro level** leverage point influencing the availability are production system policies. Redirecting financial resources, (e.g., subsidies) from animal farming to plant-based agriculture, could make legumes and other plant-based proteins more available and affordable. This shift could also support infrastructure development for plant-based protein production, addressing concerns about the pricing of plant-based meat alternatives and making them more affordable across different socioeconomic groups. Such increased availability, especially in public environments (e.g., workplaces, schools), could also contribute to social acceptance and hence link to the macro level leverage point of social norms.

4.4.5 SOCIAL SUPPORT AND NORMS

Social support plays a critical role in dietary choices, and the lack of support for eating legumes was identified as a significant leverage point at the **micro level**, among low-income children and adolescents. This lack of encouragement from others can discourage these groups from incorporating legumes into their diets. Further, adolescents highlighted that legumes are not perceived as a base for a proper, satiating meal, and notably, for one higher-income group, there is a stigma associated with legumes, which can be viewed as food for low-income individuals. These findings are in line with the leverage point of social norms at the **macro level**, which is currently evolving. While eating plant-based proteins has become a norm in certain niche environments, such as festivals or urban neighbourhoods, the broader social norm still favours meat over plant-based proteins. This is reflected at the **meso level**, where social norms regarding these foods are linked to their availability, especially in public environments (such as workplaces or schools), which was identified as a leverage point. Changing social norms could drive more widespread acceptance and consumption of legumes and create feedback loops. One first step towards the normalization of legume consumption could be, e.g., through awareness that others are also eating legumes, which was identified as a leverage point for low-income target groups at the **meso level**. The aim could be to reduce the stigma and increase social acceptance, which would be strongly supported by innovative legumes and other plant-based protein products that are tasty, healthy, and convenient.

4.4.6 CONCLUSION

Increasing the consumption of legumes and other plant-based proteins hinges on addressing several interconnected leverage points across themes of habits, innovative products, availability, and social norms. Habits and knowledge deficits about preparation and health benefits create barriers, especially for younger and low-income groups, and are linked to broader social norms that currently favour meat consumption. A potential stigma around legumes as 'low-income food' further compounds these barriers. Availability and affordability, particularly of new, innovative legume-based products, are critical leverage points, as increased access in public and everyday environments can enhance social acceptance and normalize consumption. Innovations in processing, packaging, and marketing, supported by macro level policies, can elevate legumes and plant-based proteins as desirable, convenient, and affordable choices, ultimately shifting habits and perceptions. The integration of these leverage points across all levels, from personal habits to production systems and social norms, is essential for creating a cultural and structural shift towards greater legume and plant-based protein consumption.

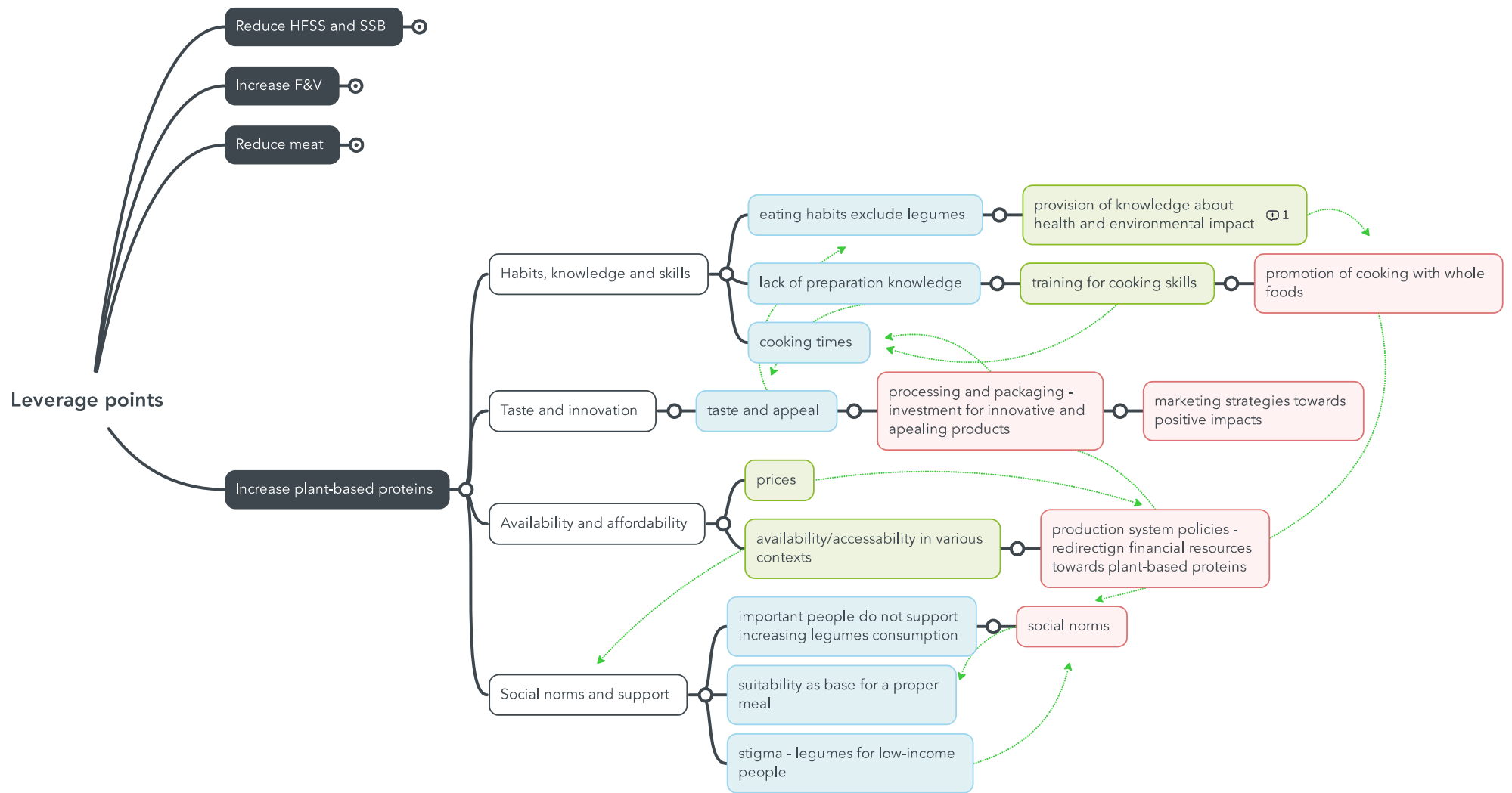


Figure 9 Leverage points for the HIB "Increase plant-based protein consumption"

4.5 Summary of themes across HIBs and FCAs perspectives

In examining the leverage points for four selected dietary behaviours—namely, reducing the consumption of HFSS foods and SSB, increasing the consumption of F&V, reducing the consumption of meat, and increasing the consumption of plant-based proteins such as legumes—several recurring themes emerge. These themes cut across the micro, meso, and macro levels, highlighting commonalities that suggest key intervention areas for promoting healthier and more sustainable dietary habits. In the following, each of these themes is discussed. Subsequently, the perspective of different food system actors (FCAs) (i.e., farmers, food industries, retailers, food services and restaurants) on these topics is presented.

4.5.1 AVAILABILITY AND ACCESSIBILITY

A key leverage point across all dietary behaviours is the role of availability and accessibility in influencing consumption choices. To reduce HFSS and SSB consumption, the high availability and visibility of these products create constant temptation, especially in environments like schools, workplaces, and homes. Similarly, for increasing F&V consumption, greater availability and accessibility in daily environments (e.g., shops, schools, restaurants) is essential for encouraging healthier choices. Likewise, reducing meat consumption and increasing plant-based protein consumption both hinge on shifting availability away from the omnipresence of meat and towards plant-based alternatives.

In all cases, the ease with which individuals can access these foods directly impacts their consumption patterns. At the macro level, policies that regulate production systems, processing and packaging, or the food environment in general are crucial for setting the framework for reshaping the food environment at the meso level. Increased availability and accessibility of healthier options in food environments not only facilitate healthier choices at the micro level but also normalise them through repeated exposure, which is particularly important for shifting habitual behaviours and social norms.

4.5.2 PRICE AND AFFORDABILITY

The issue of affordability represents a further recurring point of leverage. In order to reduce HFSS and SSB consumption, consumers indicate that a higher cost of these items would act as a deterrent to purchase. It may therefore be necessary to consider broader macro level leverage points (e.g., financial regulation such as taxation) to ensure such shifts in meso level food environments. With regards to the consumption of F&V, cost represents a significant obstacle, particularly for those with a low income. Similarly, the price of meat and its plant-based alternatives influence decisions regarding meat reduction. Presently, the artificially low cost of meat (e.g., due to subsidies in the livestock sector and a lack of acknowledgement of the true cost) maintains high levels of consumption, while plant-based alternatives are frequently perceived as expensive.

In examining the role of affordability in influencing consumer behaviour, it becomes evident that it emerges because of intertwined factors across levels. These include the purchasing power of the individual, the influence of systemic factors such as production system policies (e.g., subsidies) and consumer wealth, and the pricing strategies employed by actors within the food environment. The implementation of policies that address price disparities between unhealthy and healthy options has the potential to make healthier diets more affordable, particularly for those with lower incomes.

4.5.3 SOCIAL NORMS AND SUPPORT

The findings revealed that social norms and social support emerged as significant predictors of dietary behaviours across all four areas. The reduction of consumption of HFSS foods and SSB is impeded by the prevailing social norms that endorse the frequent consumption of these products. Conversely, the increase in consumption of F&V could be facilitated by a change in the norms surrounding healthy eating. Both are linked to a lack of appreciation of cooking with whole foods, which, at the systemic level, is embedded in a labour market characterised by high levels of stress and reduced leisure time. Similarly, meat consumption is frequently reinforced by social traditions and a lack of support for reducing meat intake. Conversely, plant-

based proteins, such as legumes, face barriers due to limited social acceptance and, in some cases, stigma (e.g., regarding taste).

Modifying social norms is neither a rapid nor an effortless process. The reinforcement of social norms occurs at the meso level, encompassing family meals, workplace cultures, retail environments, and community practices. Such factors can be influenced by educational initiatives at the macro level (e.g., public health campaigns). The normalisation of healthier dietary practices across social settings, however, has the potential to create feedback loops over time, whereby healthier choices become the default, thereby disrupting habits of unhealthy and unsustainable choices.

4.5.4 KNOWLEDGE AND SKILLS

There is a significant knowledge gap regarding the health and environmental impacts of foods, as well as practical cooking skills, which represents a crucial leverage point in understanding dietary behaviours. In the case of HFSS and SSB, a lack of awareness of their adverse effects or an erroneous perception of their value may contribute to the perpetuation of consumption. Similarly, an increase in F&V consumption is associated with an understanding of their benefits and the ability to prepare and store them correctly. Inadequate cooking skills and perceptions of plant-based meals as less tasty or satisfying represent significant leverage points for meat reduction. To increase the consumption of plant-based protein, particularly legumes, it is essential to raise awareness of the preparation methods and to highlight the associated health benefits.

It is possible to address these deficiencies in knowledge and skills through targeted educational programmes at all three levels: micro (e.g., information leaflets, newsletters, social media), meso (e.g., schools, workplaces) and macro (e.g., public health initiatives). Such initiatives can empower individuals to make healthier dietary choices and are most promising when combined with strategies targeting further leverage points above and beyond knowledge.

Excursus: Physiological and metabolic health outcomes related to the HIBs

Knowledge of the health outcomes associated with consumption of specific foods is an important leverage point for behavior change. To explore this leverage point in more detail, we analyzed dietary intake data, anthropometrics, and metabolic health markers of 355 adults (mean age 41.7±12.4 years; see Appendix B for more study details and detailed results). The aim of this analysis is to examine differences in physiological and metabolic health markers between high, medium and low consumers of the HIB foods (i.e. HFSS/SSB, F&V, meat, legumes). However, it is important to note that there is a lack of evidence that a change in physiological biomarkers has a causal effect on food consumption. Although the results show correlations between dietary choices and health markers, the cross-sectional nature of our data limits causal inferences.

HFSS consumption—assessed using sodium and saturated fat intake as proxies—was associated with adverse health outcomes. High consumers of saturated fats exhibited significantly lower levels of high-density lipoprotein cholesterol, and high consumers of sodium had significantly greater weight, BMI, fat mass, waist circumference, and hip circumference, reinforcing dietary recommendations to limit HFSS intake.

For *F&V* consumption, our results indicate an association between high intake and improved physiological markers. High consumers of F&V had significantly lower body mass index (BMI), fat mass and waist circumference (F&V); total and low-density lipoprotein cholesterol (F) and fasting insulin (F); and lower body weight (V) and hip circumference (V). Our results could be used to help guide dietary recommendations to individuals. For example, for individuals with excess adiposity (e.g., high BMI), our results suggest that improving fruit and vegetable intakes could help to lower measures of adiposity and thus improve their health status. While our cross-sectional data preclude causal claims, prospective studies and established mechanisms, such as the satiety effects of fibre-rich fruits and vegetables, lend additional support to these findings, suggesting that promoting fruit and vegetable intake could offer health benefits that may indirectly encourage further dietary improvements (Guyenet et al., 2019; Schwingshackl et al., 2015). From the perspective of the leverage points described in other sections, these relationships could suggest that physiological and metabolic health measurements could act as motivational leverage points for increasing F&V consumption. For example, it is possible that targeting a reduction in BMI or other measures of adiposity

(e.g., body weight, fat mass, waist and hip circumference) could cause individuals to improve their fruit and vegetable intakes, perhaps if they become more health conscious as a result of improving their body composition. However, there is a lack of evidence that a change in physiological biomarkers causally impacts F&V consumption, and our cross-sectional precludes this causal inference.

In terms of *meat* consumption, the analysis revealed limited associations with physiological health outcomes, with no major differences in health markers between high and low meat consumers, except for lower fasting insulin concentrations among high red meat consumers. Although broader literature links high red and processed meat intake to increased cancer risk (Di et al., 2023), our findings do not indicate that meat consumption is a direct leverage point for physiological health improvement. Of note, in our sample low meat consumers are still consuming more than 1 recommended serving of meat per day, and results might differ if comparing high consumers to non-consumers.

Legume intake, meanwhile, showed no significant differences in physiological health markers between consumers and non-consumers, likely due to the low intake levels observed (less than half a recommended serving of legumes per day for legumes consumers). This pattern reflects broader regional dietary habits in Ireland and other European countries, where legumes are not as commonly consumed as other food groups. While our data do not suggest legume intake as a standalone leverage point for health improvements, there is evidence for physiological health benefits associated with higher legume intakes elsewhere (Blanco Mejia et al., 2019; Zargarzadeh et al., 2023).

In summary, while physiological health benefits (both as felt experience and knowledge about them) could potentially serve as a leverage point to motivate dietary change, they lack the causal power to act as a stand-alone. Therefore, they should be considered within the broader multi-level framework of behavioral, environmental and policy leverage points presented in this report.

4.5.5 TASTE, CONVENIENCE, AND INNOVATIONS

The sensory appeal and convenience of food represent recurring leverage points, particularly in the context of reducing the consumption of HFSS foods, SSB, and meat. These items are often perceived as more palatable and convenient than healthier alternatives. It is imperative that convenient, tasty, and affordable alternatives to HFSS and SSB, as well as to meat, are made widely available in different meso contexts (such as retail environments, restaurants, schools and workplaces) to facilitate dietary shifts. Similarly, enhancing the appeal of legumes and other plant-based proteins through innovations in processing and packaging can facilitate a shift in consumer perceptions and promote greater consumption. To address taste and convenience as leverage points, it is necessary to not only improve the quality, availability and affordability of healthier alternatives, but also to leverage marketing strategies to shift consumer preferences towards healthier options.

4.5.6 FOOD CHAIN ACTOR PERSPECTIVES

Identifying leverage points for interventions to promote healthy and sustainable food environments and supply chains requires understanding how food chain actors (FCAs) perceive their environments and make business decisions. Open-ended surveys and interviews with various FCAs in Plan'Eat's CWGs explored the factors that either limit or encourage their willingness to implement interventions aimed at enhancing the accessibility and availability of healthier, more sustainable food options for consumers. Additionally, these open-ended surveys and interviews served as a preliminary engagement tool, encouraging CWG members to consider testing interventions that will be further pursued in work package 4 of the Plan'Eat project.

As a general context, from the FCAs' perspective, initiatives must balance economic priorities with a commitment to promoting healthier and more sustainable options. This requires alignment of initiatives with FCAs' business models and interests. In the following, key perceived barriers and enablers are discussed, offering preliminary insights into effective methods for engaging FCAs in shaping the consumer food environment. We anticipate that further testing in work package 4 of the Plan'Eat project will reveal more precise leverage points.

Results from the interviews with FCAs align with the leverage points identified in this synthesis, which emphasizes the consumer's perspective. FCAs identified two key barriers: the lack of consumer knowledge about healthy and sustainable food, and the low demand for these products. They noted that consumer eating habits, rooted in traditional cuisine, and scepticism toward healthy and sustainable options—due to their perceived low sensory appeal—strongly negatively impact their decisions regarding the promotion of such foods.

As a result, interviewed FCAs emphasized the need for food education campaigns that align national healthy eating guidelines with culinary traditions. Additionally, representatives of the food industries highlighted that a stronger collaboration with research centres would enable them to improve the appeal of healthy and sustainable products for consumers.

Another significant barrier revealed is related to the structural and supply chain deficiencies of healthy and sustainable food. These issues drive up the cost of purchasing (for restaurants, retailers, and food services) and producing (for the food industry and farmers) healthy and sustainable products. Hence, aiming at the macro level, interviewed FCAs highlighted the need of incentives from European and national institutions to support the promotion of healthy and sustainable food in their businesses, as well as the misalignment between European policies and national guidelines in the definition of healthy and sustainable diets.

The interviewed FCAs further indicated the need for more expert support in managing healthy and sustainable products, as well as guidance on how to promote these products in ways that make them more attractive to consumers.

5.10 Key leverage points per LL

Each living lab was presented with the leverage points identified for their LL and target group, and invited to select up to 10 key leverage points. In the following we present this selection for each LL, together with a rational and contextualization for each choice.

5.1 Children and adolescents

5.1.1 SWEDEN

1. **Availability at daycare, friends/families' homes, home, local supermarket (HIB: Decrease SSB consumption) (meso)**

Changing the availability of SSBs is challenging due to economic incentives and ingrained social norms, like the “fika culture” where SSBs play a central role. Reducing availability in restaurants or through institutional bans in public settings (e.g., preschools or sports stadiums) could be a more effective approach for broader change.

2. **Social norms- Reinforcing whole foods cooking supermarket (HIB: Decrease SSB consumption) (macro)**

Changing social norms to reduce food consumption at social gatherings, such as birthday parties or visits to grandparents, is challenging due to ingrained practices that frequently expose children to SSBs. While stakeholders may support interventions to limit SSBs, altering these established cultural habits seems to be difficult.

3. **(No) support of important people for reducing meat (HIB: Decrease meat consumption) (micro)**

While changing attitudes towards meat is challenging, developing effective communication strategies around lower meat or plant-based products seems to be more feasible. All stakeholders in the initiative are interested in reducing Sweden's meat consumption, and the majority expresses support for interventions aimed at this leverage point.

4. **Availability at daycare and home (HIB: Decrease meat consumption) (meso)**

Day care centers significantly influence children's eating habits, and clearer guidelines on meat portions and alternatives could be beneficial. While stakeholders support this, Swedish policy lacks backing for plant-based foods, with some municipalities requiring meat at every meal. To drive change, robust research must inform policymakers while parents and chefs need reassurance about the safety of plant-based meals.

5. **Social norms (HIB: Decrease meat consumption) (macro)**

High meat consumption in Sweden, including among children, is driven by social norms that prioritize eating meat and supporting farmers. Changing these norms is difficult, but new dietary recommendations from the Swedish Food Agency suggest reducing meat intake, offering potential progress. Stakeholders are willing to address these norms, but effective strategies are needed.

6. **Taste (HIB: Increase plant-based protein/legumes consumption) (micro)**

Legumes are not considered as tasty as meat, which limits their consumption. Product development could address this, although highly processed options may not appeal to consumers. Furthermore, early introduction of legumes in schools could increase acceptance. Support is needed from stakeholders in product development and pre-schools

7. **(No) habit of eating legumes (HIB: Increase plant-based protein/legumes consumption) (micro)**

Increasing the consumption of legumes can be promoted through public meals, especially in schools, as changing habits at home is hindered by parents' limited knowledge and time. Stakeholders emphasize the need for communication about the health benefits of legumes and the reduction of red and processed meat.

8. Availability at home (HIB: Increase plant-based protein/legumes consumption) (meso)

It is difficult to incentivize the purchase of legumes due to a lack of knowledge about meal preparation and the perception that meat substitutes are overly processed. Nevertheless, stakeholders agree that increasing the consumption of legumes among children and adults in Sweden is essential.

9. Social norms (HIB: Increase plant-based protein/legumes consumption) (macro)

Making legumes more trendy and less associated with poverty could shift social norms around their consumption. While this change is generally difficult, it may be effective within certain groups. Companies have the potential to support this effort through targeted marketing strategies.

10. Food environment (HIB: Increase plant-based protein/legumes consumption) (macro)

Addressing the availability, accessibility, affordability, and attractiveness of legumes is crucial for increasing their consumption. This requires a comprehensive approach across the food system to facilitate consumer choice and integrate legumes into public meals while creating economic incentives for producers, which is very challenging.

5.1.2 FRANCE

1. Liking of sweet snacks (HIB: Decrease HFSS consumption) (micro)

With children under the age of 8, it is easier to target as snack choices are usually determined by the family. However, it becomes more difficult with older children due to the influence of marketing and social identity factors associated with extremely processed snacks. Our collaborative working groups, including parents, teachers and nutritionists, are likely to support initiatives to promote healthier snack choices.

2. Availability of alternatives (HIB: Decrease HFSS consumption) (meso)

The availability of healthier alternatives to HFSS and UPF foods is not sufficiently recognized by parents and young people, although nutritionists and industry experts see potential for development. It is difficult to change this leverage point due to limited acceptance, knowledge and habits. While there are some less processed options, their shorter shelf life and reduced practicality hinder acceptance. To promote these healthy and sustainable alternatives, cooperative working groups are essential.

3. Food environment – Marketing strategies (HIB: Decrease HFSS consumption) (macro)

Marketing strategies aimed at children and their parents significantly influence the choice of HFSS and UPF foods. Modifying food environments, like school cafeterias and retail stores, could positively impact children's health behaviours. While challenging, successful initiatives, such as municipal bans on junk food advertising, exist. Engaging stakeholders and promoting healthier alternatives are essential for effective changes in food marketing.

4. Processing and packaging (HIB: Decrease HFSS consumption) (macro)

Appealing packaging targets children and encourages parents to buy HFSS and UPF products, but it can also be used to promote healthier alternatives. The industry can create sustainable, convenient and tasty alternatives, despite the difficulty of changing consumer habits. Future regulatory frameworks, such as the French packaging law, offer opportunities for innovation, while stakeholder engagement and transparent packaging can encourage healthier choices.

5. Production systems policies (HIB: Decrease meat consumption) (macro)

Converting production systems to balanced plant-based crops is essential for preserving the natural environment and supporting agroecological systems. While awareness of and demand for plant-based alternatives is growing, it remains a challenge to change entrenched subsidy strategies as current policies favour conventional agriculture. Stakeholders, including local chefs and organizations, support the development of plant-based meals and alternatives, but effective dialogue with regional policy makers is critical for meaningful change.

6. Social norms (HIB: Decrease meat consumption) (macro)

Shifting cultural habits toward plant-based options requires sustained efforts and support from guidelines like the PNNS. Although changing entrenched norms is challenging, there is a gradual rise in plant-based calorie consumption among adults and increasing awareness of animal welfare among children. Reducing ultra-processed meat products may serve as an effective initial strategy.

7. (No) Habit of eating legumes (HIB: Increase plant-based protein/legumes consumption) (micro)

Changing habits should not be difficult for children if appealing dishes are offered, but success depends on improved food choices and education. Stakeholders, including the French government and local initiatives, support the promotion of legume consumption through advertising and school education, while the PNNS should improve recommendations for weekly legume consumption.

8. Cooking skills (HIB: Increase plant-based protein/legumes consumption) (meso)

School cooks lack experience in preparing appealing legume-based dishes, presenting a key opportunity to enhance their skills, as they are open to change and eager for additional training. Stakeholders can support this initiative through targeted cook training programs, while local political decision-makers and food education associations can also play a vital role.

9. Processing and packaging (HIB: Increase plant-based protein/legumes consumption) (macro)

Current legume processing mainly results in ultra-processed foods, limiting the variety of appealing legume-based foods available in retail. This situation presents an opportunity to develop minimally processed products and enhance packaging. While reducing ultra-processing and innovating non-ultra-processed options is challenging, collaboration among stakeholders—such as industries, educators, and dieticians—can facilitate this change.

10. Food environment – Marketing strategies (HIB: Increase plant-based protein/legumes consumption) (macro)

Increasing consumer demand and promoting diverse, appealing legume alternatives through effective marketing could drive change. However, the low consumption of legumes in France, where they are not central to most traditional dishes except in certain regions, presents a challenge. Local lentils can serve as a lever for change, as some food industries are developing legume-based products, even if stakeholder support is not universal.

5.1.3 POLAND

1. Habit of eating meat (HIB: Decrease meat consumption) (micro)

Reducing meat consumption in Polish families is challenging due to cultural norms, cooking skills, social values, and economic factors. Engaging stakeholders like parents and school canteens is crucial, but their support may be limited by perceived risks and established routines. Education and reskilling are essential for promoting plant-based meals.

2. People co-living/ People in household do not want to reduce meat (HIB: Decrease meat consumption) (micro)

Most meals are consumed at home, making childrens' and teenagers' diets largely dependent on family habits. Changing these ingrained practices is challenging due to entrenched behaviors and limited tools for influencing family networks. Consequently, support from stakeholders is restricted, with only limited engagement from parents and some involvement from healthcare providers.

3. (Lack of) cooking skills (HIB: Decrease meat consumption) (micro)

Meat-based meals are easy to prepare, culturally accepted and have a long tradition, making them staples in the daily diet. Retraining cooking skills on a broad scale would require significant resources and systemic change. Support is available from parents and health care providers, but school cafeteria cooks and after-school teachers rely on institutional support.

4. Availability at home (HIB: Decrease meat consumption) (meso)

Enhancing the availability and exposure of non-meat products can increase the likelihood of switching to plant-based alternatives. However, low-income families may be less inclined to experiment with these options due to financial and time constraints. Providing support, such as food aid or free samples, could improve access. Stakeholder support exists among parents, policymakers, and social workers, but food chain actors are less likely to engage.

5. Providing cooking skills training (HIB: Decrease meat consumption) (meso)

Changing food habits and culture requires systemic initiatives across the food chain, including cook education. This is challenging due to the need for top-down policies. Policymakers and local authorities are likely to support these changes, while NGOs may engage, but food chain actors may vary in interest based on political views and perceived costs.

6. Social norms (HIB: Decrease meat consumption) (macro)

Meat consumption is deeply ingrained in social norms, symbolizing affluence, masculinity, tradition, national identity, and health, particularly among lower classes. Changing this leverage point is very difficult due to the complex interplay of values, social roles, and institutional patterns, as meat is highly politicized. Support may come from some policymakers, NGOs, healthcare providers, and food chain actors interested in expanding the plant-based sector, though it largely depends on political and cultural perspectives.

7. (No) habit of eating legumes (HIB: Increase plant-based protein/legumes consumption) (micro)

Legumes are often perceived as difficult to cook, hard to digest, and less tasty compared to meat or dairy. Changing this perception is relatively easy with proper incentives, knowledge, and exposure, given their accessibility and traditional role in cuisine. Support for promoting legumes is likely from food chain actors, health professionals, and NGOs, while engagement from social workers and food aid providers may be limited.

8. (Lack of) preparation knowledge (HIB: Increase plant-based protein/legumes consumption) (micro)

The lack of knowledge and skills in preparing legumes as main meals hinders their consumption. This issue could be addressed with institutional support and a systemic strategy. Stakeholders likely to support this include policymakers responsible for dietary education, healthcare professionals, parents, and children, particularly when engaged in hands-on cooking practices.

9. Food environment (HIB: Increase plant-based protein/legumes consumption) (macro)

Frequent exposure to plant-based meals is essential for increasing consumption but is relatively difficult to achieve due to its ties to other leverage points. Likely support comes from food chain actors expanding the plant-based sector, healthcare professionals, school canteens, parents, food system researchers, and NGOs focused on health and local food heritage, particularly legumes.

5.2 Young adults and general population

5.2.1 IRELAND

1. (Lack of) preparation knowledge (HIB: Increase plant-based protein/legume consumption) (micro)

People who eat legumes less than once a week are significantly less confident about preparing them than those who eat legumes more frequently. Eliminating this knowledge gap is feasible, as education measures are easy to implement, and stakeholders are likely to support them due to the low resource requirements. However, a combination of knowledge transfer and skill-building initiatives could lead to even better results, as cooking skills also play a crucial role in overcoming barriers to consumption.

2. (No) habit of eating legumes, (HIB: Increase plant-based protein/legume consumption) (micro)

Individuals who eat legumes infrequently report higher agreement with not having the habit of consuming them. While changing this leverage point may be moderately difficult, successful interventions utilizing habit-building strategies suggest it is achievable. Stakeholders are likely to support efforts targeting this leverage point, as there are no apparent barriers to their involvement.

3. Cooking skills, HIB: (HIB: Increase plant-based protein/legume consumption) (meso)

In-person cooking classes are expected to be highly effective for improving this leverage point, while remote methods could also yield benefits if participants actively engage with them. Stakeholders on campus are believed to support initiatives targeting this issue, creating a favorable environment for intervention.

4. Food environment (HIB: Increase plant-based protein/legume consumption) (macro)

Influencing the food environment, e.g., through accessibility, availability and advertising, can encourage the consumption of legumes. However, it can be difficult to achieve this change as institutional buy-in is required. While some stakeholders can support strategies such as product placement, changing food availability requires collaboration with suppliers and careful consideration of feasibility. Stakeholder consultation on tailored interventions is essential for effective intervention.

5. Choice of sweet and savoury foods when hungry or as a treat (HIB: Decrease HFSS food consumption) (micro)

Individuals who frequently consume HFSS foods struggle more to resist these options. However, it may be difficult to change this leverage point due to the food environment that encourages HFSS consumption. While health organizations support efforts to reduce the availability and promotion of HFSS foods, food retailers may resist these changes due to concerns about potential lost sales.

6. Availability at: universities, friends/families' homes, restaurants/cafes, home, retailers (HIB: Decrease HFSS food consumption) (meso)

The widespread availability of HFSS foods in a variety of settings makes change difficult in an environment that encourages the purchase of HFSS. While food service providers may be reluctant to reduce HFSS availability, other campus stakeholders are likely to support efforts to address this issue.

7. Promotion and placement at retailers (HIB: Decrease HFSS food consumption) (meso)

Promotion and placement of HFSS foods at retail increases their appeal and likelihood of purchase. Changing product placement to favor healthier options may prove moderately difficult but may be more acceptable to profit-driven retailers. Food retail stakeholders are likely to find these strategies feasible, and university stakeholders would likely support them.

8. Habit of eating meat (HIB: Decrease HFSS food consumption) (micro)

While changing this leverage point is challenging, habit-forming strategies have been effective in changing eating behaviour. Promoting alternative foods such as legumes could help reduce meat consumption. Relevant stakeholders are likely to support this initiative as it does not require structural changes.

9. People co-living do not want to reduce meat (HIB: Decrease meat consumption) (micro)

Changing this leverage point is expected to be difficult, as it is unclear how the eating habits of other people not involved in the study can be influenced. Even if the relevant stakeholders support efforts to address this problem, it is uncertain to what extent they are able to tackle it effectively.

10. Social norms (HIB: Decrease meat consumption) (micro)

Changing this leverage point is likely difficult, as social norms are deeply ingrained in culture. Relevant stakeholders are likely to support efforts to address this issue, especially since it doesn't require structural changes to their business model, particularly for food retailers.

5.2.2 HUNGARY

1. (No) Choice of F&V as snack for energy, to treat oneself or regulate stress (HIB: Increase fruit and vegetable consumption) (micro)

Increasing consumption of fruits and vegetables among single parents is influenced by emotional eating and stress. While they likely understand the health benefits, shifting snack choices is challenging due to ingrained emotional patterns. Relevant stakeholders are expected to support health-framed interventions, making this an important area for research, particularly with mindfulness and emotional regulation strategies.

2. Cost (HIB: Increase fruit and vegetable consumption) (micro)

Cost significantly influences the food choices of single parents, especially those with low economic status. Changing this leverage point is challenging, as stakeholders who influence pricing may oppose efforts to reduce the cost of fruits and vegetables, limiting the potential for change.

3. Prices (HIB: Increase fruit and vegetable consumption) (meso)

Price sensitivity significantly affects consumers, especially single-parent families, who would likely change their eating habits if fruit and vegetable prices were lower. However, there is limited influence over this leverage point, as farmers are pressured and retailers may resist efforts to lower prices, opposing their interests.

4. Consumer wealth (HIB: Increase fruit and vegetable consumption) (macro)

High consumer prices, exacerbated by inflation, affect single-parent families, who would likely change their eating habits if their socio-economic situation improved. Influencing this leverage point is challenging, as it requires systemic changes that may create conflicts of interest among stakeholders, limiting support for such initiatives.

5. (No) Support of important people for reducing meat (HIB: Decrease meat consumption) (micro)

Single-parent families, particularly single mothers, face a high risk of poverty and social exclusion, making social networks and peer support crucial for fostering healthier eating habits. Partnering with e.g., the Single Parent Families' Foundation can facilitate social interaction and networking, enhancing the feasibility of creating a sustainable community that promotes lasting dietary change. Further support of civil society organizations and health professionals will depend on the specific interventions implemented but is anticipated to be positive.

6. Prices of (plant-based) alternatives (HIB: Decrease meat consumption) (meso)

The willingness to buy plant-based alternatives may increase if these products offer good value for money. Parents are more likely to change their dietary habits for their children, especially with dietary support and recipes, though challenges like childrens' preferences for familiar foods may hinder this process even if prices were more affordable. While stakeholder support for promoting healthier, environmentally friendly food choices is generally favorable, familiarity with plant-based products and their health benefits is crucial for the initiatives' success.

7. Wealth distribution policies (HIB: Decrease meat consumption) (macro)

Individuals of lower socioeconomic status, including single parents, often have limited access to healthy food and relevant information, highlighting the need for better wealth distribution. Improving socio-economic conditions could promote healthier eating habits, but this would require significant changes to the Hungarian family support system, presenting considerable challenges and potential conflicts of interest between stakeholders.

8. Social norms (HIB: Decrease meat consumption) (macro)

Changing entrenched social norms in societies where there is a strong culture of meat consumption is complicated but could have significant long-term benefits. However, the politicization of the debate on meat consumption and the interests of large meat producers make it difficult for stakeholders to support such initiatives.

5.2.3 SPAIN (FROM MIDDLE AGE TO ELDERLY)

1. (No) Choice of F&V as snack for hunger (HIB: Increase fruit and vegetable consumption)

Increasing fruit and vegetable consumption as snacks is relatively easy to implement, making it an accessible intervention. Relevant stakeholders, including experts in psycho-nutrition, can support this initiative effectively. However, success depends on also addressing existing preferences for sweets and ultra-processed foods.

2. Availability at work, friends/families', restaurants/cafes (HIB: Increase fruit and vegetable consumption)

Improving access to fruits and vegetables in everyday environments is relatively easy to implement and directly impacts consumption. The main requirement is increasing their availability in common spaces. Stakeholders like supermarkets and catering providers are likely to support this initiative, making it a feasible approach.

3. Knowledge about health and environmental impact (HIB: Increase fruit and vegetable consumption)

Increasing knowledge about the health and environmental benefits of fruit and vegetable consumption is crucial for fostering long-term behaviour change, though it must be combined with other strategies. This can

be easily addressed through educational campaigns. Stakeholders such as researchers and academics can support this effort by creating and disseminating evidence-based information.

4. Cooking skills (HIB: Increase fruit and vegetable consumption)

Addressing the lack of cooking skills involves coordination among stakeholders such as cooking instructors and nutrition experts. This can be facilitated through cooking classes and online resources to enhance confidence in preparing plant-based foods. Relevant stakeholders are likely to support these initiatives, making them feasible despite the challenges.

5. Food environment policies - Food availability (HIB: Increase fruit and vegetable consumption)

Policies affecting food availability are difficult to implement due to the need for coordination among stakeholders and potential resistance from competing interests. Although policy changes are complex and time-consuming, they offer long-term benefits. Collaboration with policymakers and food retailers, supported by existing stakeholders, increases feasibility.

6. Knowledge about health and environmental impact (HIB: Decrease meat consumption)

While increasing awareness of the negative health and environmental impacts of high meat consumption can drive behavior change, knowledge alone may not be sufficient due to cultural and social factors. Educational campaigns are relatively easy to implement but may require complementary strategies for lasting impact. Stakeholders in research, academia, and public health are likely to support such initiatives.

7. Availability of alternatives (HIB: Decrease meat consumption)

Collaborations with retailers and food service providers can enhance the accessibility of plant-based alternatives, though logistical and financial barriers may pose challenges. Consumer resistance due to taste preferences could also slow the transition. Nonetheless, stakeholders such as supermarkets and catering companies are likely to support initiatives promoting these alternatives.

8. Availability at: schools/workplace, restaurants/cafes, friends/families' homes (HIB: Increase plant-based protein/legumes consumption)

Working with food providers to increase the availability of plant-based proteins in mainstream eating environments is feasible but may face challenges due to the need for coordination and potential consumer resistance to unfamiliar options. Relevant stakeholders, including supermarkets and caterers, could support this initiative, though collaboration would need to be assessed.

9. Knowledge about health and environmental impacts (HIB: Increase plant-based protein/legumes consumption)

Raising awareness about the health and environmental benefits of plant-based proteins can encourage sustainable dietary choices. While educational campaigns are relatively straightforward, translating knowledge into action is challenging due to established dietary habits. Further practical support strategies, like increasing legume availability and enhancing cooking skills, is essential for success. Stakeholders, including educators and health professionals, are likely to support these initiatives.

10. Cooking skills (HIB: Increase plant-based protein/legumes consumption)

Addressing the challenge of cooking skills for preparing plant-based proteins requires hands-on learning and targeted education, which can be facilitated through cooking classes and online resources. When combined with broader healthy eating campaigns, these efforts can enhance skills and confidence. Relevant stakeholders focused on improving cooking skills are likely to support these initiatives.

5.3 Elderly and NCD

5.3.1 GREECE

1. Choice of sweet or savoury foods when hungry (HIB: Decrease HFSS consumption) (micro)

Reducing HFSS consumption among the elderly when hungry requires addressing their preference for sweet or savoury foods. Introducing healthier alternatives tailored to individual taste can help reduce HFSS consumption. As older people tend to resist change due to ingrained habits, support through personalized guidance from healthcare professionals can be effectively in promoting healthier food choices and shifting habits.

2. Prices at: retailers, restaurants/cafes and in general (HIB: Decrease HFSS consumption) (meso)

High prices for healthy and sustainable food options at retailers, restaurants, and cafes hinder elderlies from adopting healthier and more sustainable dietary patterns. Addressing the cost factor involves discussions with retailers and restaurant owners to explore solutions or incentives that make healthier options more affordable. Engaging stakeholders could effectively reduce HFSS consumption through collaborative pricing strategies.

3. Food environment (HIB: Decrease HFSS consumption) (macro)

Elderlies lack sufficient knowledge about sustainable nutrition, which contributes to high HFSS consumption. Implementing targeted marketing campaigns that promote healthy food alternatives across various platforms can help address this gap, especially since such campaigns have not been conducted for this target group before. Engaging policymakers to discuss the Greek food environment could make this initiative feasible.

4. Knowledge about health and environmental effects/ impacts (HIB: Increase fruit and vegetable (F&V) and plant-based protein (legumes) consumption) (meso)

The promotion of unhealthy dietary options by food providers (such as retailers, restaurants and cafes) limits F&V and legumes consumption in elderlies. By effectively communicating the health and environmental benefits of F&V and legumes, these stakeholders can be encouraged to pursue healthier food trends and create alternative options like plant-based menus and innovative snacks. Aligning knowledge with profit can drive more sustainable dietary patterns that lead to increased F&V and legumes intake.

5. Social norms (HIB: Increase plant-based protein/legumes consumption) (macro)

Food choices are often influenced by perceived social norms, and in Greek tradition, meat remains a major protein source. Shifting this mindset to increase plant-based protein consumption, particularly legumes, will be challenging due to financial costs and the intangibility of health and sustainability outcomes, which often leads to a lack of investment in their promotion. However, engaging policymakers in exploring strategies to change social norms can create a more favorable food culture that encourages increased plant-based protein consumption, leading to long-lasting benefits that outweigh initial costs.

6. Processing and packaging (HIB: Increase plant-based protein/legumes consumption) (macro)

Government regulations on packaging design and processing significantly influence food choices, particularly as environmental concerns grow. The need for healthy, sustainable and innovative solutions will drive developments in the processing and packaging landscape requiring a proactive approach from policy makers and companies alike. By engaging policy makers in the discussion on improving the packaging and processing of plant-based proteins, consumption can be increased and health and sustainability promoted.

5.3.2 ITALY (NCD)

1. Keeping track of SSB consumption (HIB: decrease HFSS and SSB consumption)

Monitoring SSB consumption encourages diabetic and obese patients to take responsibility for their eating habits and has been shown to be effective. Implementing this change is relatively easy as it is a best practice that has already shown results. Stakeholders, particularly UNIBO's Department of Dietetics, are likely to support this initiative.

2. Cooking skills (HIB: increase plant-based protein/legumes consumption)

Cooking skills help people prepare legumes, which are not traditionally popular in this region, making it challenging but achievable to teach this new habit through engaging methods. Relevant stakeholders, such as the hotel management school, are likely to support this initiative by having students create video recipes that they can access at home.

3. Placing F&V in sight to remember eating them (HIB: increase fruit and vegetable consumption)

This leverage point is effective as we usually recommend avoiding unhealthy foods and presenting fruit and vegetables in an appealing way. However, as the target group has problems with sugar metabolism, we emphasize increasing vegetable consumption and limiting fruit consumption to two per day after meals. Relevant stakeholders, such as UNIBO's nutrition department and local political institutions, are likely to support this initiative through advertising campaigns and events to promote healthy eating.

6. Conclusions and next steps

This report synthesizes all findings of Work Package 2 (WP2) of the Plan'Eat project and presents leverage points for future interventions targeting high impact behaviours. It builds on empirical work with a multitude of food system actors, such as consumers, farmers, food industries, retailers, food services, restaurants and policy makers.

We organize leverage points into themes, whereby several leverage points and themes overlap across the four selected high impact behaviours ((1) reduce HFSS and SSB consumption, (2) increase F&V consumption, (3) decrease meat consumption, and, (4) increase plant-based protein consumption). It emerges that initiatives focused on the themes of availability, accessibility, affordability, social norms, support networks, knowledge and skill dissemination, and innovations in product development and marketing represent promising areas for advancing healthier and more sustainable diets.

The results thereby highlight the importance of adopting a food system perspective to change. Across various high impact behaviours, numerous leverage points for change were identified at all system levels (micro, meso, and macro). The interconnectedness of these leverage points across levels was evident, as illustrated by the above-mentioned emerging themes that cut across levels.

Crucially, some themes and leverage points, such as availability and social norms, were consistently important across all target groups. Others, like price and affordability, were particularly critical for vulnerable populations, such as low-income groups. Moving forward, it is essential to prioritize leverage points that recur across multiple groups while also addressing specific needs of vulnerable populations through tailored, nuanced solutions. The current report provides first valuable insights towards this direction by discussing key leverage points specific to individual living labs and target groups.

Equally important as the food system perspective is the recognition that the leverage points identified in this report require the engagement of all actors within the food system. While consumers are often the focal point when discussing dietary changes, the findings make it clear that transforming dietary patterns requires collective efforts from multiple stakeholders. Consumers must be willing to change their dietary habits, while food environment actors (e.g., retailers, restaurants, and canteens) must offer sustainable and healthy alternatives. Policy makers, in turn, should create a supportive framework that fosters innovation and ensures wide availability and affordability of these alternatives.

From the results it emerges that a particularly promising approach for interventions involves transdisciplinary teams that bring together citizens, researchers, food environment actors, and policy makers to co-create solutions. These teams can identify local leverage points and balance specific interests and goals to develop practical, context-sensitive strategies.

The next phase of the Plan'Eat project, Work Package 4 (WP4), will focus on identifying and testing such strategies. The work ahead for the consortium will involve building on the current findings to devise viable interventions for activating the identified leverage points. Co-creation will be a critical component, ensuring coordination across the micro, meso, and macro levels, and fostering commitment from all food system actors to achieve the shared goal of healthier and more sustainable diets. The leverage points identified here will serve as a fundamental basis for this work.

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7. Appendix

Appendix A Detailed maps for each HIB by analysis level and country/LL

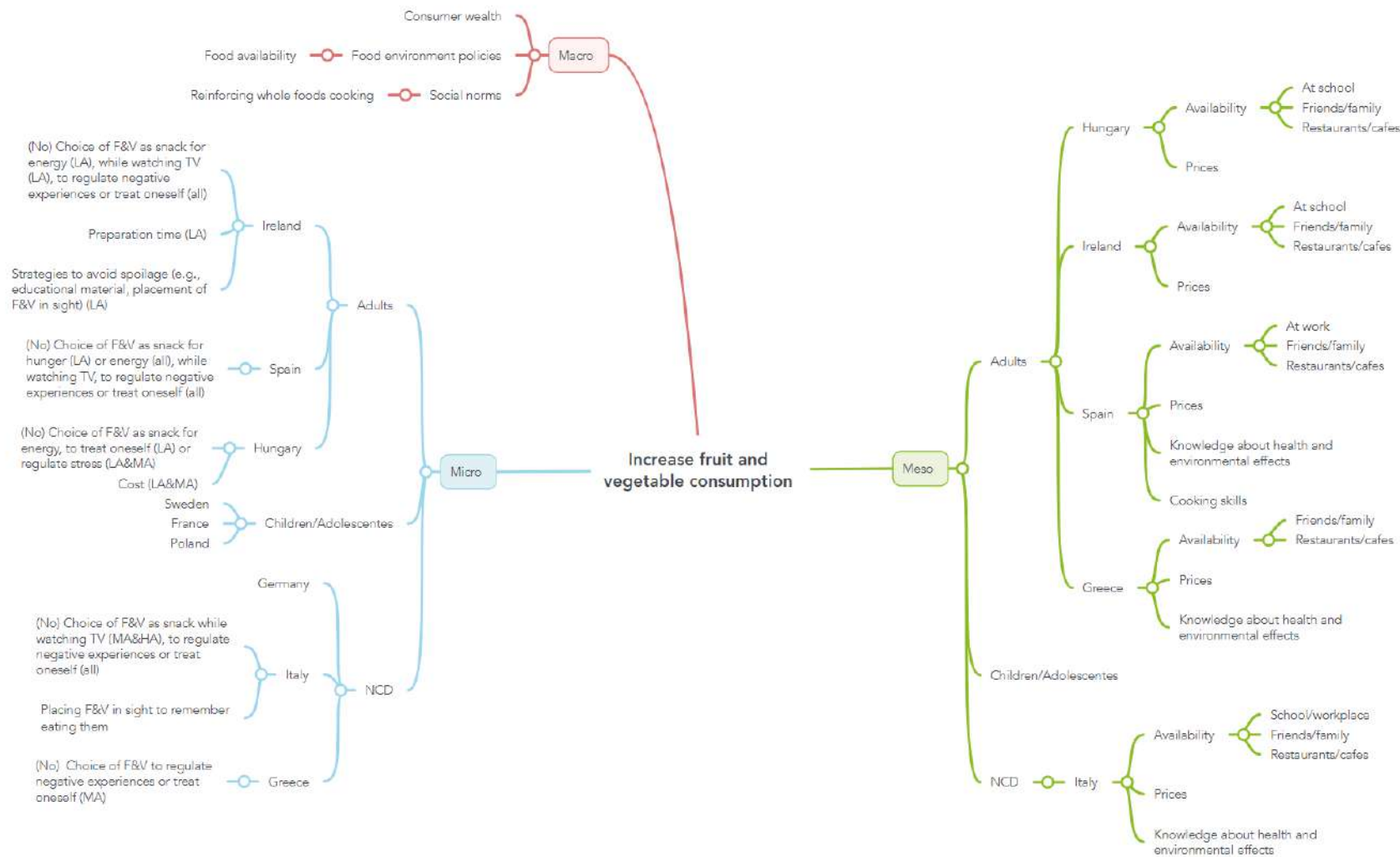


Figure 10: Detailed map for HIB "Increase fruit and vegetable consumption"

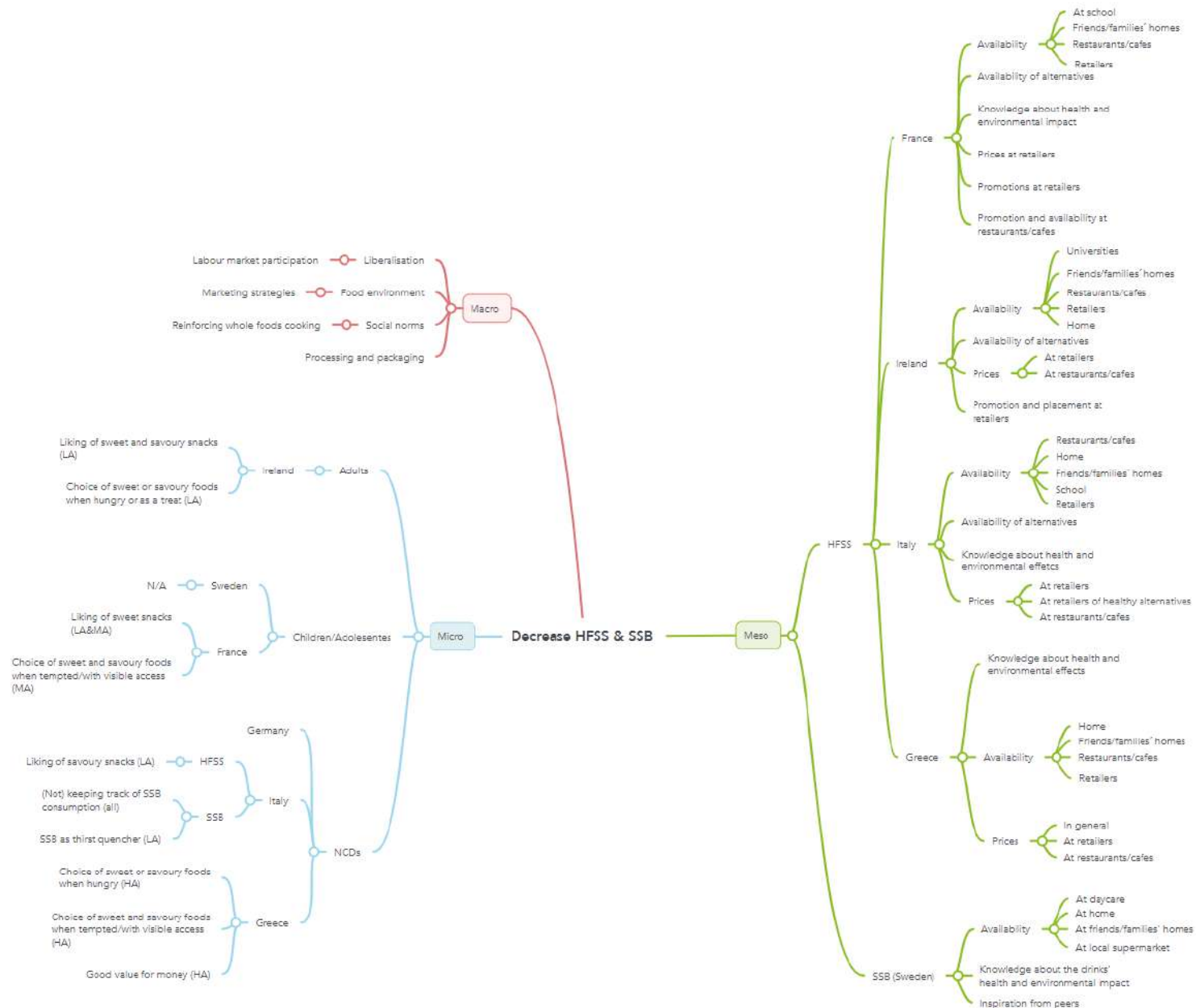


Figure 11: Detailed map for HIB "Decrease HFSS & SSB"

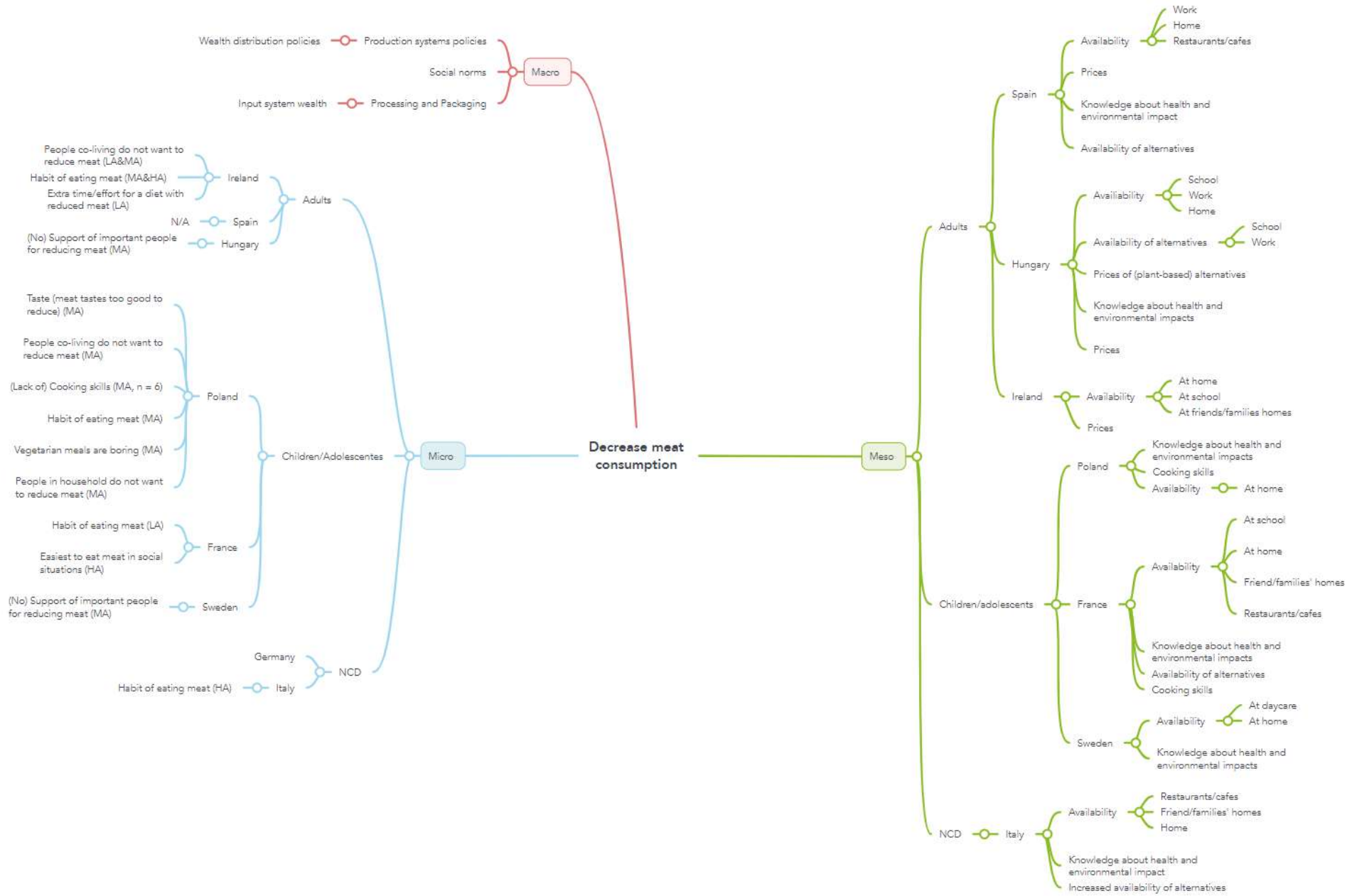


Figure 12: Detailed map for HIB "Decrease meat consumption"

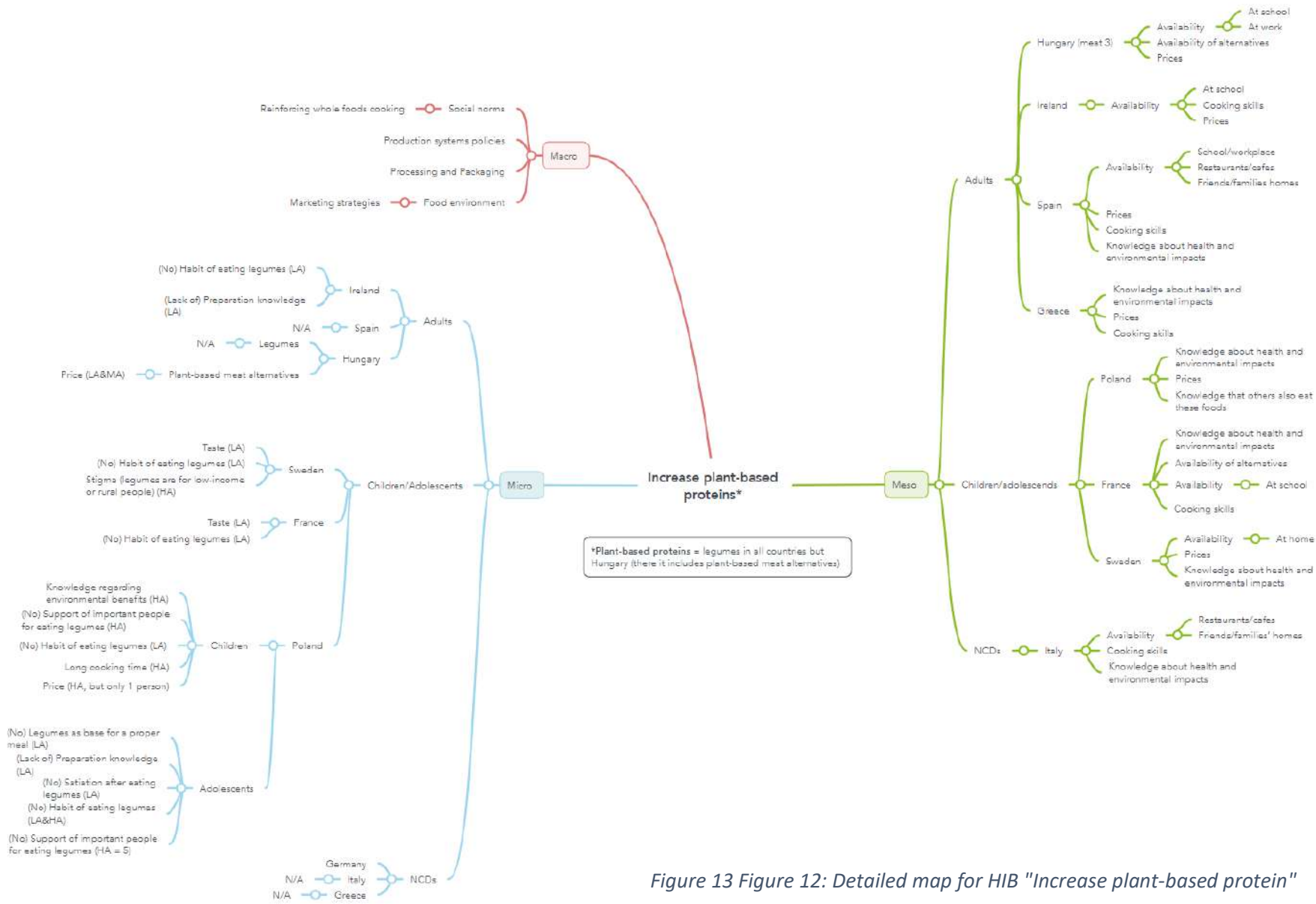


Figure 13 Figure 12: Detailed map for HIB "Increase plant-based protein"

Appendix B Study details

This analysis used baseline dietary intake data, anthropometrics and metabolic health markers collected as part of the SuHe Guide MyPlanet Diet (1). Dietary intake data was collected on 3 non-consecutive days using Foodbook24, an online 24-hour dietary recall tool (2). Foods were categorised into food groups and nutrient intakes were calculated using Foodbook24 data derived from McCance and Widdowson's Composition of Foods Integrated Dataset (CoFID). Anthropometrics were recorded using standard procedures. Serum total-cholesterol (C), HDL-C, LDL-C, triglycerides, glucose, insulin and C-reactive protein (CRP) was measured using standard kits for the Alinity c Clinical Chemistry Analyser (Abbott Laboratories, Illinois, USA).

Mean daily fruit, vegetables, legumes, nuts and seeds, total meat, red meat, saturated fat and sodium intakes (g) were quantified, and participants were grouped into tertiles. Participants were grouped as consumers or non-consumers of legumes (<10g) and nuts and seeds (<5g) as there was a high proportion of non-consumers of legumes (55%) and nuts and seeds (69%). Differences between groups were examined using analysis of covariance, controlling for sex, BMI and energy intake where appropriate. P-values <0.05 were considered statistically significant.

Detailed results

In our analysis, intakes of saturated fat and sodium were used as proxy measures of High Fat Sugar and Salt (HFSS) foods. High consumers of saturated fat (mean 51±16g/day) had significantly lower levels of high-density lipoprotein cholesterol relative to low consumers (mean 22±4g/day), and high consumers of sodium (mean 3326±784mg/day) had significantly greater weight, BMI, fat mass, waist circumference, and hip circumference compared to low consumers (mean 1518±291mg/day).

High consumers of fruits (mean 353±143g/day) had significantly lower body mass index (BMI), fat mass, waist circumference, total and low-density lipoprotein cholesterol, and fasting insulin compared to low consumers (mean 34±26g/day). High consumers of vegetables (mean 240±51g/day) also had significantly lower BMI, fat mass, and waist circumference compared to low consumers (mean 75±27g/day), while also having lower body weight and hip circumference relative to low consumers.

There were no significant differences in physiological and metabolic health measurements between high (mean 289±103g/day) and low meat consumers (mean 86±25g/day). However, high red meat consumers (mean 87±45g/day) had significantly lower fasting insulin concentrations compared to low consumers (mean 3±5g/day).

There were no significant differences in physiological and metabolic health measurements between legume consumers (mean 37±26g/day) and non-consumers (<10g/day).

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