foodpaths

D 2.4. DELIVERABLE

D 2.4: FUNCTIONING FOOD SYSTEM APPROACHES & OBSERVATORY

AUTHORS

NIELS HALBERG, HUBERT DE JONGE, SUSANNE HANSEN, DCA – DANISH CENTRE FOR FOOD AND AGRICULTURE, AARHUS UNIVERSITY

SOFIA REIS, ISEKI-FOOD ASSOCIATION

HUGO DE VRIES, INRAE, INSTITUT NATIONAL DE LA RECHERCHE POUR L´AGRICULTURE, L´ALIMENTATION ET L´ENVIRONNEMENT

foodpaths

D 2.4

FUNCTIONING FOOD SYSTEM APPROACHES & OBSERVATORY

Document ID	Number D 2.4
Due date	January 31, 2025
Submission date	January 31, 2025
Dissemination level	Public

Work package	WP 2
Author(s)	Niels Halberg, Susanne Hansen, Hubert de Jonge, Sofia Reis, Hugo de Vries
Document version	3.0

Grant agreement	101059497	**Duration**	42 months
Start Date	June 2022	**End date**	November 2025

Contributors

Name	Organisation
Niels Halberg (for Introduction, Science to Policy, recommendations)	Aarhus University – Danish Centre for Food & Agriculture
Susanne Hansen (for literature review Food Systems & observatories)	Aarhus University – Danish Centre for Food & Agriculture
Hubert de Jonge (for literature review observatories & recommendations)	Aarhus University – Danish Centre for Food & Agriculture
Anna Kirkegaard Vaarst (For focus group)	Aarhus University – Danish Centre for Food & Agriculture
Katherine Flynn, Sofia F Reis (For focus group)	ISEKI Food association
Hugo de Vries, (for literature review & recommendations)	INRAE, Institut National de la Recherche pour l'Agriculture, l'Alimentation et l'Environnement

Revision History

Version	Date	Reviewer(s)	Modifications
1	29/11-2024	Internal authors review	
2	19/01/2025	Internal authors review	References, discussion and consolidated set of recommendations
3	31/01/2025	FOODPathS partners; Thom Achterbosch on behalf of FutureFoods partnership	References, discussion, and revised consolidated set of recommendations

List of Abbreviations and Acronyms

CAP – Common Agriculture Policy

CBE-JU – Circular-BioBased Europe Joint Undertaking

CoR – the Committee of the Regions

CSRD – Corporate Sustainability Reporting Directive

DG Research – Directorate-General for Research

DPSIR – Drivers, Pressures, State, Impact and Response model of intervention

EC – European Council

EEA – European Environment Agency

Eionet – European Environment Information Observation Network

EIT – European Institute of Innovation & Technology

ESF-COST – European Cooperation in Science & Technology

ESRS – European Sustainability Reporting Standards

EU – European Union

FABLE Database – Food and Beverage Label Explorer

FADN – Farm Accountability Data Network

FAO – Food and Agriculture Organization of the United Nations

FSDN – Farm Sustainability Data Network

FS – Food Systems

FS Obs – Food System Observatory

FSCI – Food Systems Countdown to 2030 Initiatives

GDD – Global Dietary Database

GHG – Greenhouse Gas

GHO – Global Health Observatory

GNR – Global Nutrition Report

HLEG – High Level Expert Group

HoReCa – Hotels, Restaurants and Cafés

iPES FOOD – International Panel of Experts on Sustainable Food Systems

IFOAM – International Federation of Organic Agriculture Movements

JRC – Joint Research Centre

LCA – Life Cycle Assements

LL – Living Labs

OECD – The Organization for Economic Cooperation and Development

N and P – Nitrogen and Phosphorus

NGO – Non-Governmental Organisation

MS – EU Member States

R&I – Research and Innovation

SAM – Scientific Advice Mechanism

SAPEA – Science Advice for Policy by European Academies

SCAR – Standing Committee on Agricultural Research

SCAR SWG FS – SCAR Food Systems Strategic Working Group

SDG – Sustainable Development Goals

SFS – Sustainable Food Systems

UN – United Nations

UNEP – UN Environment Programme

UNDP – UN Development Programme

WHO – World Health Organisation

Table of content

Funded by
the European Union

1. Abstract

As part of the focus on transforming Food Systems (FS) towards long-term sustainable food systems (SFS), there is a clear need to gather, analyse, and utilise data on Food Systems. We cover here "Food Systems Observatory" (FS Obs), referring to a public data interface, a community of practice, and a data management service that will allow monitoring, analysis, and foresights across the European Food Systems. After an introduction to the food systems approach and food system concepts, we present methods and results from the different project activities throughout the FOODPathS project life. The results presented include a literature review of scientific literature on food systems, and an analysis of currently established observatories and food systems related databases that were found through the web- and literature search. Also, results from interactive sessions and focus groups are presented. We then present a set of consolidated recommendations based on results from review and stakeholder dialogues, as well as concluding overview and remarks.

Funded by
the European Union

2. Introduction and background

As part of the focus on transforming Food Systems (FS) towards long-term sustainable food systems (SFS), there is a clear need to gather, analyse, and utilise data on Food Systems from multiple sources to allow for the monitoring of performance and to guide FS transformation efforts (e.g. Rutten et al 2018; European Commission 2022). In fact, one of the main ambitions of the framework law was to establish a practice of monitoring progress towards the objective of sustainable FS across member states (Fanzo et al 2021). This focus is further accentuated by the ambition of the European Commission to develop a "farm to fork" legislative frame-work for sustainable food systems (EU, 2020).

As part of the establishment of the future FS partnership, a more systematic way of monitoring is needed. The background for this was - according to the SRIA for the future Partnership on Sustainable Food Systems (SCAR, 2023), now called FutureFoodS (quote):

"The current monitoring and reporting of FS activities, outcomes and drivers, are only available in a fragmented way.

- *Methods for data collection frequently lack scientific underpinning and harmonisation.*
- *Existing databases fail to cover the entire span of value chains, across all member states and are incomplete in their coverage of FS' contributions to societal and environmental goals.*
- *A particular omission is data on the midstream actors in FS, which involve food aggregators, processors, distributors, procurement and food services*."

A possible answer to the above, is to create an observatory. While the term "observatory" usually refers to a **location** that is equipped for the observation of natural phenomena, here we use the term "observatory" referring to a **digital platform** in which data are stored and made publicly accessible, for instance such as found in the "food system dashboard" and the EU Food System Monitoring Dashboard (e.g. Schneider et al 2023, Toth et al 2024; see section 5.2). Hence the term "Food Systems Observatory" (FS Obs) is referring here to a data interface, a community of practice, and a data management service that will allow monitoring, analysis, and foresights across the European Food Systems (SRIA 2023). Thus, according to the SRIA, *"The Observatory will be a platform, community of practice and data management service for:*

- Developing new common metrics on the sustainability performance of European FS connecting existing databases
- Developing and piloting new forms of data collection on FS from different sources
- Developing methods and protocols for combining data on partial aspects into coherent FS descriptions and assessments for informing governance and policy development at different scales.
- Establishing practices for reflexive monitoring and learning including stakeholder engagement on potential transition, pathways, leverage points and current progress."

Early Inspiration and argumentation for such a structured and transparent data approach may be taken from the European Environment Agency (EEA). Founded back in 1994, the EEA has for two decades consistently produced assessments based on quality-assured data on environment topics such as biodiversity, air quality, transport, and climate change. The data and assessments are closely linked and aimed towards to the European Union's environment policies and legislation, with the "State and Outlook of the Europe's Environment" (e.g. EEA 2020) as the flagship publication of EEA. The data feeding into these EEA reports are gathered through the partnership European Environment Information and Observation Network (Eionet). Here, a vast number of 400 institutions from 38 countries contribute with data on the various environmental topics and indicators, most of which can be found directly on the EEA website through the website interface in the form of charts, timetables and maps.

Thus, following the EEA model, a FS Obs may also provide assessments based on multiple data and insights vis-a-vis specific pertinent issues, challenges and policy objectives. It is noted here that attention for the

social dimension is less apparent in EEA indicators, while we do regard this a crucial element in FS approaches. Therefore, a particular challenge – and relevance - for the FS Obs will be to provide insights on social dimensions, and interactions between otherwise separately treated activities and stakeholders. Moreover, the FS Obs should highlight interdependencies in Food Systems outcomes (e.g. healthy diets, sustainable production, climate mitigation, recycling, ecosystems services, food prices) and describe to which degree there are synergies or trade-offs between objectives for sustainable healthy diets. For example, two goals that will give rise to dilemmas are safe and equitable access to food on the one hand, and the pressure from wider food systems towards ecosystems on the other hand (FAO/WHO 2019, "Sustainable Healthy Diets").

Several references point out that the science-based advice to policy makers becomes more demanding (see references in FOODPathS D6.1; House of Lords, 2024; European Commission, 2020; SAPEA, 2020), and policy coherence becomes more pertinent to achieve the abovementioned, ambitious goals. A coherent set of policies and regulations will be required to set a uniform direction for FS change across policy instruments and food system actors. Monitoring and evaluation across policies will be required to assess their effectiveness[1]. A coherent set of policies requires trans-disciplinary scientific advice based on evidence across different FS actors and outcomes, and policy coherence will be required from local to global scales.

A FS observatory may be one vehicle for such transdisciplinary collaboration in asking the right questions, finding the necessary data sources (for continuous monitoring and assessments) and facilitating "reflexive" monitoring and learning including stakeholder engagement on potential transitions, pathways, leverage points and current progress" in a consistent approach (Béné et al, 2024; Meemken et al, 2024). Thus, such considerations beg the following questions: Who are the likely users of a food system observatory, what are their main purposes and objectives and what are they looking for?

The FOODPathS effort D 2.4 will approach these questions from three angles:

I. What is the state-of-art in FS literature regarding holistic descriptions and system assessments of FS? Hereunder, we also like to assess the state-of-art of FS modelling, whether it be conceptual, statistical, or mechanistic modelling. The reason for this: we assume that modelling of FS "data" or "observations" by itself is a manifestation of a (food) system approach.
II. How may existing data hubs within the food and agriculture space be used as a starting point; and to what degree support existing databases a FS approach in terms of coverage of interactions between actors, and their relations to various outcomes; and finally, how may different datasets be combined in scale and time.
III. What do potential users representing different stakeholder types consider a relevant FS Obs?

[1] System-level monitoring evaluation and learning (MEL) is a term coined in evaluation literature for this approach

3. The food systems approach

A Food Systems (FS) approach suitable for research, innovation, policy and education will need to cover various practical aspects of governance and activities within a partnership. Specifically, portfolio management; call mechanisms and call text; science to policy activities; and observatory activities. However, no single definition of Food Systems exists, as Food Systems operate at different scales from the global to local levels, and they are often embedded in specific locations and environments (Braun et al. 2021). Moreover, from a constructivist epistemology viewpoint, the food systems do not exist in nature or society per se (Le Moigne, 1977). According to constructivism philosophy of science, systems models are constructs aiming at representing complex phenomena, which cannot be reduced to simple causality or deterministic processes, because they are in continuous development and characterized by non-linearities (constructivism - Wikipedia). Therefore, it is not surprising that the Food System concept alludes to a wide variety of views on the interactions between the different aspects of a system, and that different definitions have diverging views on which components, dynamics and emerging properties are characteristic for food systems (Brouwer et al. 2020, de Vries et al., 2022).

3.1. Concepts and definitions of Food System Approach

The Food System approach as conceptualized by Ericksen (2008) has been elaborated on in the ESF-COST action "Forward Look on European Food Systems in a Changing World" (Rabbinge and Linnemann, 2009). In the latter publication, a wide range of FS approaches were covered such as the food processing technology angle (de Vries et al 2009), distribution and packaging (Watkiss 2009) as well as retailing and consumer choices (Barling et al 2009). Since then, the FS approach has risen to popularity among researchers, politicians and actors working with or within the Food System. In the literature, the work on life cycle analysis (Sonesson et al., 2010) has received much attention, regarding the environmental dimension. Only in recent years the social dimension has gained more attention. Contributions from the literature on food security to shaping food systems approaches are exemplified in the "Nutrition and Food Systems" report by the High Level Panel of Experts on Food Security and Nutrition (FAO, 2017).

However, questions regarding who, what and how a FS approach is defined and operationalised remain (Brouwer et al. 2020). According to Halberg & Westhoek (2019), a Food System model is one that incorporates all elements related to production, processing, distribution, preparation, consumption, and disposal of food. This approach underlines the 'fluxes' between the elements in terms of biomass, but also money, workforce and hence, power-relations. This represents a movement from a linear conception of food production and consumption, to a complex system thinking (den Boer et al, 2021). Likewise, other reviews of key findings in the literature underline the need to move from linear value chains to dynamic "food webs" (e.g. Lillford and Hermansson, 2020; Knorr and Augustin, 2021).

Food systems approach from the viewpoint of constructivism

From the onset we should acknowledge that Food Systems are not considered to be a natural phenomenon, but they are abstract models or concepts defined for a specific purpose. Thus, from a constructivist viewpoint, what is included in a Food System and how the elements are represented is a choice made by the modeller and based on purpose, values, knowledge and other characteristics [2].

The real value of a FS approach is the focus on **interactions between the key elements of the system** (Olafsdottir et al., 2018) and the desired and un-desired **outcomes** in terms of food security, dietary health, environmental and climate impacts etc. An important aspect is to understand to which degree these outcomes are interdependent due to related consequences of activities (interactions) by the agents. From a

[2] In the SRIA and also FOODPathS partnership, we have for example chosen a very simple representation of a food system, namely the structure of a game. The reason behind is that all different food system actors are familiar with the structure of a game in terms of playing field, players, see e.g. FOODPathS Deliverable D2.1, and below

Food Systems transformation perspective, the advantages should be to better identify and consider systemic lock-ins, feedback loops, butterfly effects, and trade-offs, that characterise the true "complexity" of a system. Moreover, the FS approach should be able to identify synergies in terms of changes in one part of the food system, which may reinforce positive changes in other parts or outcomes.

SAPEA (2020) used a comparable definition: *Complex systems, like the Food System, are by definition non-linear, interconnected, multivariable, self-evolving, and dynamic, making it difficult to predict and control. Intervening requires continuous re-assessments, readjustments, adaptations and iterations to counter biases, unexpected consequences, unforeseen reinforcing feed-back loops and other perverse effects (SAPEA 2020, shortened).*

According to the constructivist approach to studying Food Systems one should acknowledge at least three perspectives on the Food Systems approach: the Ontological, the Functional, the Historical/genetic (Le Moigne, 1977; see Figure 1).

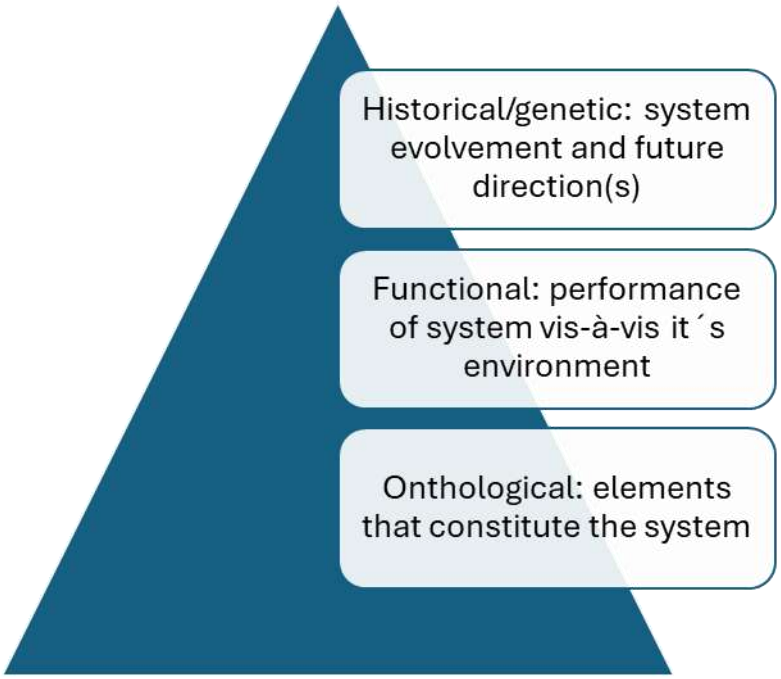


Figure 1. The three perspectives on the Food Systems approach to be acknowledged; after Le Moigne, 1977.

According to Le Moigne (1977), using the ontological perspective, Food Systems will be described according to the bio-physical and socio-economic elements (farming, food processing, logistics, human nutrition, consumer attitudes, etc.) in a static representation. While this has its purpose, adding a functional perspective will include assessments of the system purposes including different actors' objectives and their interactions with other actors – e.g., the exchanges along value chains. This includes individual people's reactions that ultimately must be considered part of feed-back loops, hereunder blocking or reinforcing developments that are initiated in other parts of the Food System (Olafsdottir et al., 2018; Gaitán-Cremaschi et al., 2018). The functional perspective may also include determinants of e.g. food choices, recycling of residues and food waste, and power relations across the food system. Moreover, this perspective focuses on a wide range of outcomes: e.g. product amounts and quality attributes, nutrition, environmental impacts, resilience, reproduction of key system nodes, and food/biomaterials/energy self-reliance. Finally, the historical/genetic perspective address the systems from the question of why and how it has developed into the current form and status and how it may be changed. Obviously, this is important in relation to objectives for Food Systems transition towards increased sustainability (E.g. Food 2030; EU, 2020 a, b).

Funded by the European Union

Thus, in the perspective of FS transition/transformation, the functional perspective requires the FS model to include driving forces for FS fluxes. These include e.g. policies, economic transactions, power relations, technological and innovation inputs, and social relations and interactions. The responses include positive reinforcements between systems elements, e.g. consumers increased demand for innovative products or diets based on radical food innovations. Contrary, blockings or lack of response may occur due to path dependencies of cultural, economic or technological elements. According to Meadows (2008), in order to change a system, the intervenors look for leverage points as places within a complex system where a small shift in one element can produce big changes in the system.

Thus, the search for leverage points should build on an understanding of how drivers of change may impose new objectives on Food Systems; or lead to a larger diversity of alternative food systems via niche initiatives in agriculture and food provisioning (Gaitán-Cremaschi et al., 2018). Also, it should address how new technologies or social innovations may change power structures, reflective learning and interactions between actors, as well as the resulting systems outcomes and sharing of benefits. And, importantly, one should not forget identifying barriers to change, such as lock-ins, negative feedback loops, or simply lack of ideas and motivation (Le Moigne, 1977).

Based on decades of applying this concept in many contexts Meadows ordered the types of leverage points in terms of their potential influence – and degree of changes they would require in each system (Figure 2).

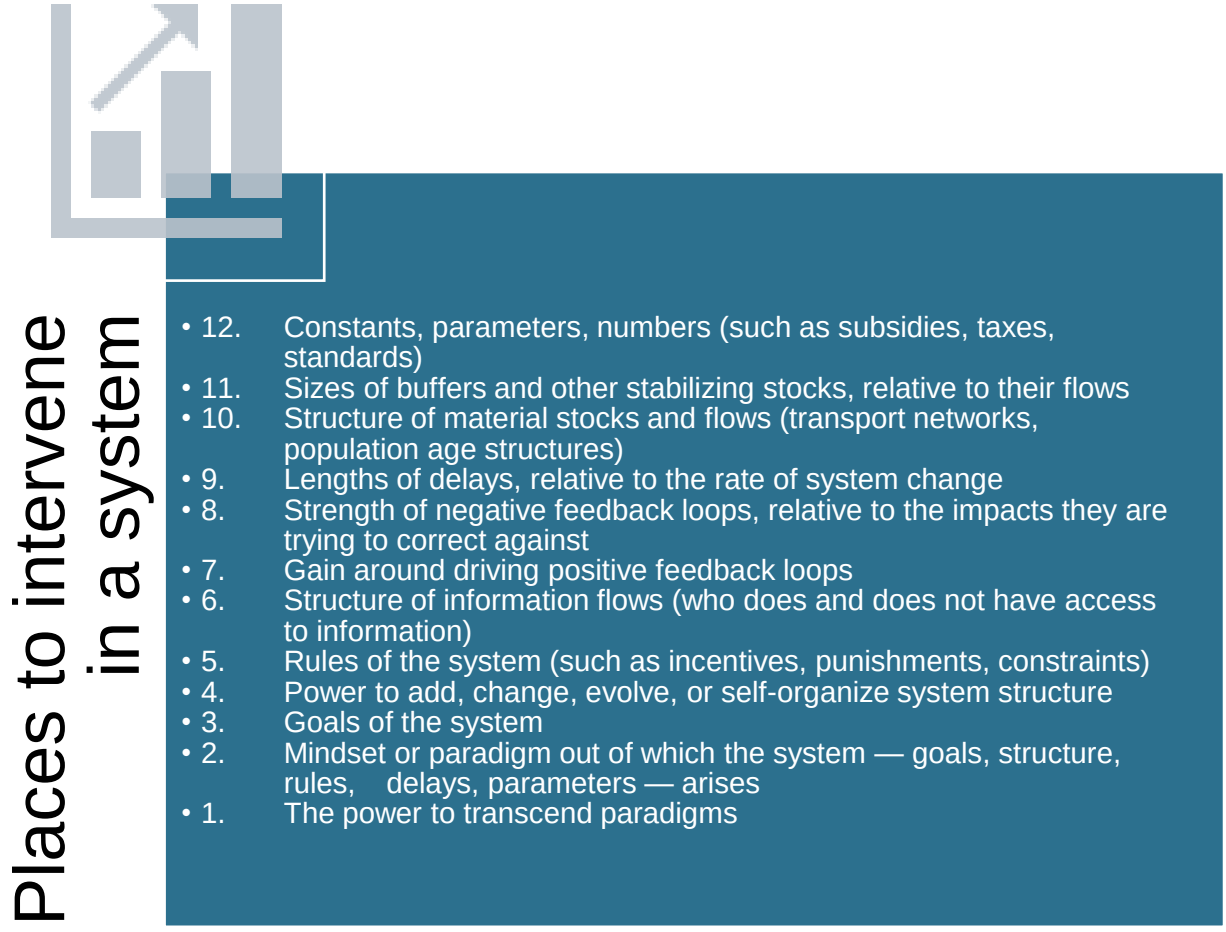


Figure 2. Places to intervene in a system; decreasing number means increasing order of effectiveness (Meadows, 1999)

The idea of identifying leverage points in a food system demands a rigorous analysis of functions, actors, objectives, power relations and other aspects of specific Food Systems, which again may even be a part of

dedicated research projects under the open calls of FutureFoodS. Following this ordering of leverage points, (12) collecting data in the form of parameters and indicators will not in itself be a powerful leverage for changing the Food Systems. But carefully selected data may play an important role as they change the transparency of the data and information flows (6), contribute to identify system interactions and feedback loops (7) and potentially contribute to defining the rules (5, e.g. regulation of food product labels) and power balances (4) in Food Systems. Thus, in developing ideas for a FS observatory this perspective may add an important insight to structuring and prioritizing the indicators for monitoring and evaluation. The idea could be that this may eventually lead to policy initiatives, where food systems regulation may radically influence e.g. information flows, structure and power relations across the FS. By that, it would overcome dependencies of current economic and social mechanisms among certain actors (Meadows, 2008). In the longer run, a holistic and transparent FS Obs may act as a catalysator to transcend the FS current paradigms, and facilitate the establishment of new norms and structures.

DPSIR conceptual approach to modelling of Food Systems

In addition to the understanding of leverage points and feed-back loops in systems theory, the DPSIR approach is relevant to mention in the context of Food Systems approach. DPSIR - Drivers, Pressures, State, Impact and Response model of intervention - is a causal framework developed by the European Environment Agency (EEA) in 1999 and OECD in the 1990s, with the specific aim to evaluate environmental/ecosystem changes in relation to socio-economic influence and pressures.

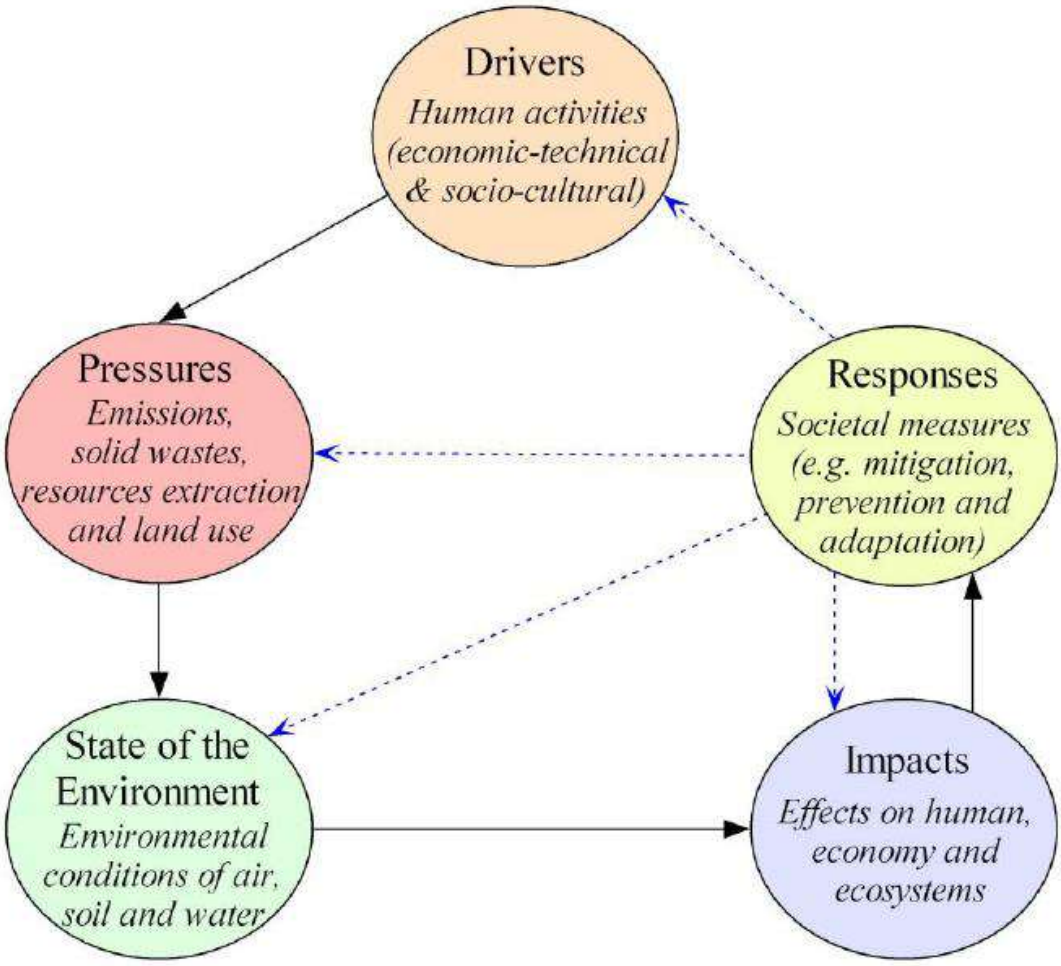


Figure 3. Schematic representation of the European DPSIR framework (source: Song 2012)

The DPSIR approach has been widely used by research and government studies, most of them with the aim to support policy-decision making on the basis of scientific research projects. A review of 21 studies by Tscherning et al (2012) concluded that the framework model is widely used due to its ability to integrate multi-disciplinary knowledge from different stakeholders and for its ability to show solid data-based evidence, and its ability to provide for alternative decision options. More recently, the framework has been used in a wider range of contexts and with modifications as to improve the effectiveness for policy implementation (e.g. Carnohan et al 2023). The DPSIR framework may add functional and genetic descriptions to Food Systems models and to interpretations of data and the expected impact pathways of research project outcomes and policy impacts.

Computational approaches to modelling of FS

More recently, computational approaches have triggered food scientists to consider the complexity and dynamics of food systems. Van Mil et al (2014) and Perrot et al. (2016) presents a computational perspective with guidelines to develop a holistic approach, linking system interactions at different scales, as to gain insights in the complexity of agri-food systems. In de Vries et al (2009), Food Systems are regarded as open thermodynamic systems, meaning a system that converts heat and temperature into other forms of energy. Included in this system are their building blocks: playing field, rules, pieces, wins, players, moves, time. The building blocks create a game metaphor for the different interactions and outcomes, thus underlining that one can consider food systems as intelligently navigated complex adaptive systems in which the notion of observatories has been considered crucial (INCAS, de Vries et al., 2018). Here, observatories were defined slightly different, namely with a focus on understanding and steering complex systems (quote): *'....should provide the means to detect emergent properties, non-linear interactions, fractals and even consequences of butterfly effects (i.e. minor changes in the environment that may have huge impacts, especially in cascade processes), and measure various impacts (e.g. effects on health) at different scales. These observatories must be knowledge management-driven, collecting, linking, analysing and representing different data sources…'*.

To bring back the complexity, several attempts have been made to describe complex food systems as complex adaptive systems (e.g. Chapman et al., 2017), following unique set of forces (de Vries et al., 2022). The use of a game metaphor allowed a variety of food system actors to present their highly different cases in a similar and consistent way (FOODPathS Deliverable D2.1[3]; de Vries et al 2024).

3.2. Use of FS approach in R&I partnerships

To ensure a Food Systems approach is practical in fx. R&I partnerships, and can bring about positive change, Braun et al. (2021) posit two criteria; 1) the definition should be suitable for the purpose at hand, and 2) it should be sufficiently precise to define domains for policy and programmatic priorities, without excluding any aspects of social, economic, or environmental sustainability.

Within the future partnership, a Food Systems approach will be needed to guide the work done within several key activities. Namely in R&I itself, in R&I policy advice, transnational funding via joint calls and strategic programming, portfolio management, observatories, and living labs. To ensure that a Food System approach is both fit for purpose and specific enough to guide activities and work within these four areas, we will discuss the opportunities and needs of stakeholders within the sub-activities of Calls and Strategic Programming and the FS observatory (see section 6.1)[4].

[3] Hyperlink reference: https://cordis.europa.eu/project/id/101059497/results

[4]The FS approach for science-advice has been addressed in FOODPathS D6.1. (SRIA 2.0 and Science-Policy Interface). A first conceptual scheme for RIPE, linking R&I, Policies and Education, has been presented in FOODPathS D6.2; this may need further reflections in FutureFoodS partnership.

4. Methods

Through a cooperative link to FOODPathS WP7, the authors received input and feedback from the Mirror Groups on FS Obs. There were meetings about the observatory starting in December 2023 at a joint workshop in Brussels, in online meetings in May 2024, and during two online meetings in November 2024. FOODPathS MS13 has references to this input.

We then collected data on food system approach and observatory primarily through two sources: the first through a literature- and web-search during the autumn 2024, the second through a sequence of workshops and interactive sessions with stakeholders during workshop events and focus groups meetings. The methods used are described below in the section 4.1 and 4.2, respectively.

4.1. Literature review of publications and projects related to Food Systems & FS Observatory

A literature search was conducted based on search terms 'Food Systems Approaches', 'Food Systems', 'Food Systems Concepts', and 'Observatory', and included both grey and academic literature. We used the following databases: Google, Google Scholar, Scopus, and EU databases. The publications identified in those initial searches were then screened based on titles, abstracts, and keyword searches, bringing us up to a total of 111 publications. The publications included policy reports (30), peer reviewed research articles (50) and reviews (11), books and thematic issues (7) and other grey literature including editorial, comments, project pamphlets (14). The bibliographic data and overall classification are listed in appendix 1.

In the following literature review, we have chosen to focus exclusively on the 50 peer reviewed articles, thereby excluding reviews, book chapters, policy reports, and grey literature. The reason for this that papers and reviews build upon the current state of art in the scientific literature, thus representing a synthesis of knowledge rather than new ideas and concepts about food systems (Figure 4).

Funded by
the European Union

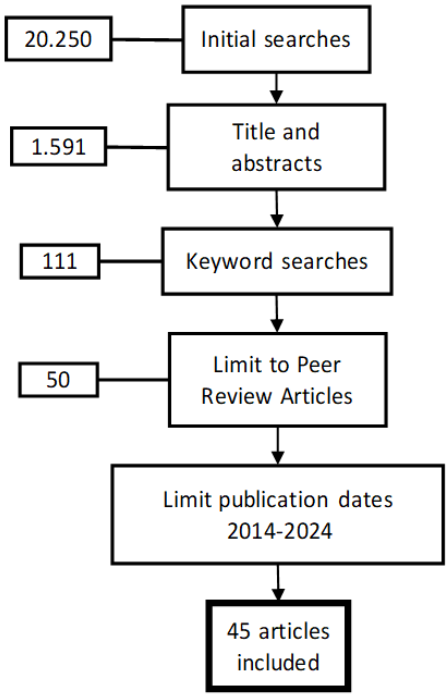


Figure 4: The search strategy used to identify relevant articles

An analysis of thematic research areas was carried out based on content in peer-reviewed research papers in the period 2014-2024, thereby excluding a further seven publications. In the 45 selected papers we screened for keywords and original contributions as original concepts and/or data, and then classified the research papers based on content of one or more of the following 16 food research themes:

- Socio-Economic:
  - Resilience, security and availability
  - Livelihood, poverty, justice, democracy
  - Population growth; Urbanisation
  - Policies and governance
  - Trade, circular economy, food-loss
  - Economics, market power and employment
  - Technology and innovation
- Bio-physical:
  - Food life cycle analysis
  - Diet, health and consumer
  - Agronomy and crop science
  - Land use and production
  - Climate change, greenhouse gas (GHG) emissions
  - Biodiversity, nature-based solutions, agroecology
- System & Data sciences:
  - Systems theory
  - Monitoring, indicators, observatory
  - Conceptual models
  - Stochastic models
  - Modelling approach

The research themes and articles where then grouped and ranked according to the total sum of articles covering each research theme. Vice versa, we counted the number of research themes covered by each

Funded by the European Union

individual article. “Coverage” meaning here that the article included/presented and/or modelled **original research data** in one or more of the above themes.

While we do not regard the current literature review as exhaustive, we do assume that the list is sufficiently representative to do a thematic analysis on the state of research within food systems.

4.2. Dialogues and interactive sessions with MS and EC representatives, scientists, and stakeholders

A part of the deliverable is informed by knowledge gathered during forums, such as the WP3 Funders Forum, and workshops such as the one with consortium members during the Annual Meeting 2023, as well as organised several focus groups with various stakeholders (Table 4.2.1).

Table 4.2.1– Overview of interactive workshops, participants and reference to sections in this report

Workshop Venue	Workshop Date	Participants	Outcome & section ref
Food2030, Bruxelles	December 2023	50 participants	Main outcomes for observatory: mapping, harmonising and building on existing data, ensure transparency and open data.
Seinajoki, Finland	June 2024	34 Participants	Concrete input from FOODPathS partners on issues and challenges in aligning/streamlining science policy advice services across MS.
Focus Group	October, November 2024	15 participants in 3 online focus group sessions	See section 5.3 and appendix 4 for full report.
Budapest, FOODPathS Workshop	3 December 2024	36 Participants	“Fishbowl” interactive session on draft observatory; see section 5.4 and appendix 5

Together with FOODPathS T6.1 and WP3 we organised a series of focus groups with experts and project coordinators with experiences in addressing systems approaches and inter- disciplinarity. Results were used for WP3 (recommendations alignment of funding strategies) and for FS approach – and where relevant – for the FS Observatory recommendations. Specifically, the three online focus groups were organised primo April 2024 in time to give input to a joint T6.1-WP3 workshop within the WP3 Funders Forum event on 23/24 April 2024 in Brussels (section 4.1).

At the FOODPathS annual event back-to-back with ERIAFF annual meeting in Seinajoki, Finland, June 12-13, 2024, we presented and discussed a systems approach for science to policy advice, call requirements, FS observatory and options for further development and use of (elements of) gaming with stakeholders. Inspiration and results from this guided the finalization of D6.1, D2.2, and the current delivery D2.4.

Funded by the European Union

First ideas of using a Food Systems approach to define the needs and focus of a Food Systems observatory were presented to the SCAR FS SWG at a workshop September 12, 2024. Responses from this mini-workshop with members of SCAR FS guided further use of focus groups towards this D2.4 and ensure continued dialogue and collaboration with SCAR FS “Priority Action: Monitoring and Accelerate FS Transition”.

A series of three focus groups were carried out in October and November of 2024, as online sessions with scientists and stakeholders in the food sector. Finally, during the FOODPathS workshop in Budapest, December 3-4, we presented recommendations for an FS Obs, followed by a fishbowl discussion with the stakeholders in the audience. During a fishbowl discussion five participants are placed in the middle of the room and asked to discuss views and ideas in front of all the participants. The sessions are short, thus allowing most, or all, of the participants at the workshop to enter the fishbowl. A key part of this methodology is that only the participants in the fishbowl are allowed to speak, all other participants are to observe the discussion. For more information, please refer to Appendix 5.

5. Results and discussion

The present section presents results from the different project activities throughout the FOODPathS project life. In section 5.1 we start with a literature review of scientific literature that relates to the keywords “Food system” and/or “food observatory”. In section 5.2 we give an overview and analysis of currently established observatories and food systems related databases that were found through the web- and literature search. In section 5.3 we then report on the results from interactive sessions and focus groups that were held in 2024.

5.1. Literature research on FS approach

The objective here is to assess to what extent and how the “food systems approach” is practiced in the scientific literature, and to identify if and how the current research in food systems relates to FS observatories.

As we aim to characterize, how “food systems approach” is practiced in the selected peer- reviewed scientific articles – we chose the approach of a thematic mapping and ranking of research themes in the literature. Also, we assess to which degree the current research literature follows a holistic- or “system approach”. Finally, and most important, for the scope of the current task, we address whether the selected publications have direct or indirect connections with FS observatories. Therefore, we limited ourselves (see also Section 4.1, Figure 4) to primarily examine original scientific research articles that:

- Cover several research themes within individual publications; the research terms combined are assumed to be representing a holistic approach.
- Cover food system theory, data science, and different mechanistic or statistic modelling approaches. The evaluation to what degree the literature takes a “data-science” or modelling approach, is important because we do assume that such an approach will link towards the relevance and use of FS observatories.
- Develop, or reference to development of FS observatory initiatives in the scientific literature

Note that this approach excludes all grey literature as well as review articles, opinions, and a vast range of conceptual research-papers where a clear FS data angle is missing (see Figure 5). We recognize that the food systems area is extremely broad, and most likely we have missed domains that are relevant and impacting food systems.

Thematic coverage with Food System literature

Referring to the introduction (see section 3.1) we acknowledge there is no single definition of a “food system”, and we anticipated various interpretations and research themes in the literature. While examining the selected papers, we identified different research themes among the three major domains of food systems: socio-economic, bio-physical and data- & system-related research themes. The frequency of these research themes within the selected papers are shown in Figure 5 below.

Funded by
the European Union

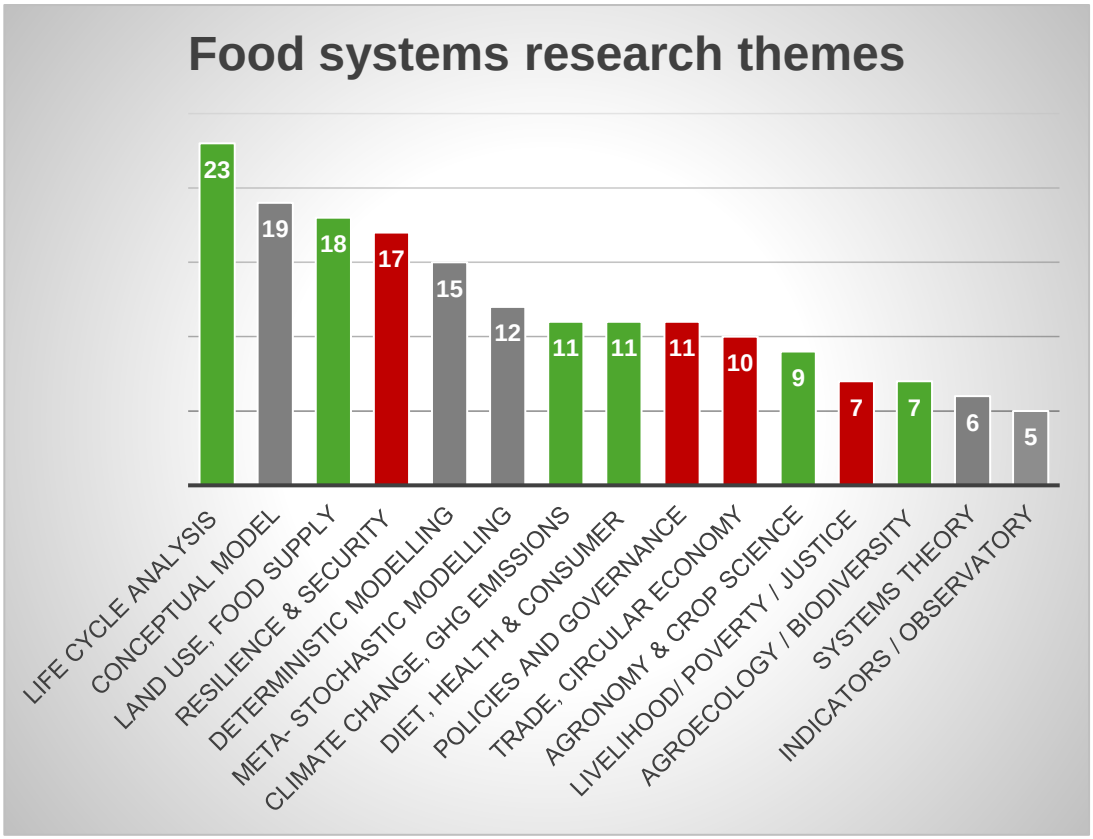


Figure 5. Overview of research themes identified in 45 peer-reviewed food system articles in the period 2014-2024. Three major areas of food systems are considered: socio-economic (red), bio-physical (green) and data-science & system related (grey). See Appendix 1 and 2 for bibliographic data and classification.

The research themes are ranked in decreasing order in Figure 5. In the bio-physical domain, life cycle analysis is the most frequent research theme, followed by land-use & food production. Lower down the ranking order we find climate change – predominantly in the context of GHG emissions – health & consumer choices, and agronomy & crop science. A relatively low number of articles covered the transition of agriculture to more sustainable practices such as nature-based solutions, agroecology, regenerative agriculture, or biodiversity. The socio-economic research themes were less frequently found. Within this domain, food resilience & security rank highest, followed by food trade & value chain approaches, policies & government, and social themes covering livelihood, poverty & justice[5].

Within the domain of data- and system science, reference to conceptual models is ranked as the highest. Also, modelling and stochastic modelling were both found with relatively high frequency. On the contrary, we found fewer references to systems theory, and few papers that contribute to food system indicators or with direct reference to FS Obs.

Summarizing from Figure 5, the subthemes among the three major research domains show a rather steep gradient from more the popular "mainstream" food system research themes towards less frequent or "isolated" research themes. Inclusion of data- and systems approaches is evident primarily in the form of modelling, and less so a systems theory and/or data observatory approach. Clearly, modelling tools are commonly relied on for studying the interconnections in food systems. Life cycle analysis of foods – ranked highest in Figure 5, represents by itself a model approach, although in a static form. On the other side, the systematic study of indicators or direct reference to observatories occurred rarely, and few isolated system theory references were found. Yet, the concept of FS observatories and its connection to theoretical concepts, appears as relatively new to the scientific community.

[5] We may add a comment here on the lack of research themes we found in FS management and marketing sciences; for a review of this subject see Donner et al (2023)

Funded by the European Union

Going from the research theme level to the article level, figure 6 shows an overview of the thematic classification on a paper-by-paper level, as number counts of different research themes within each article.

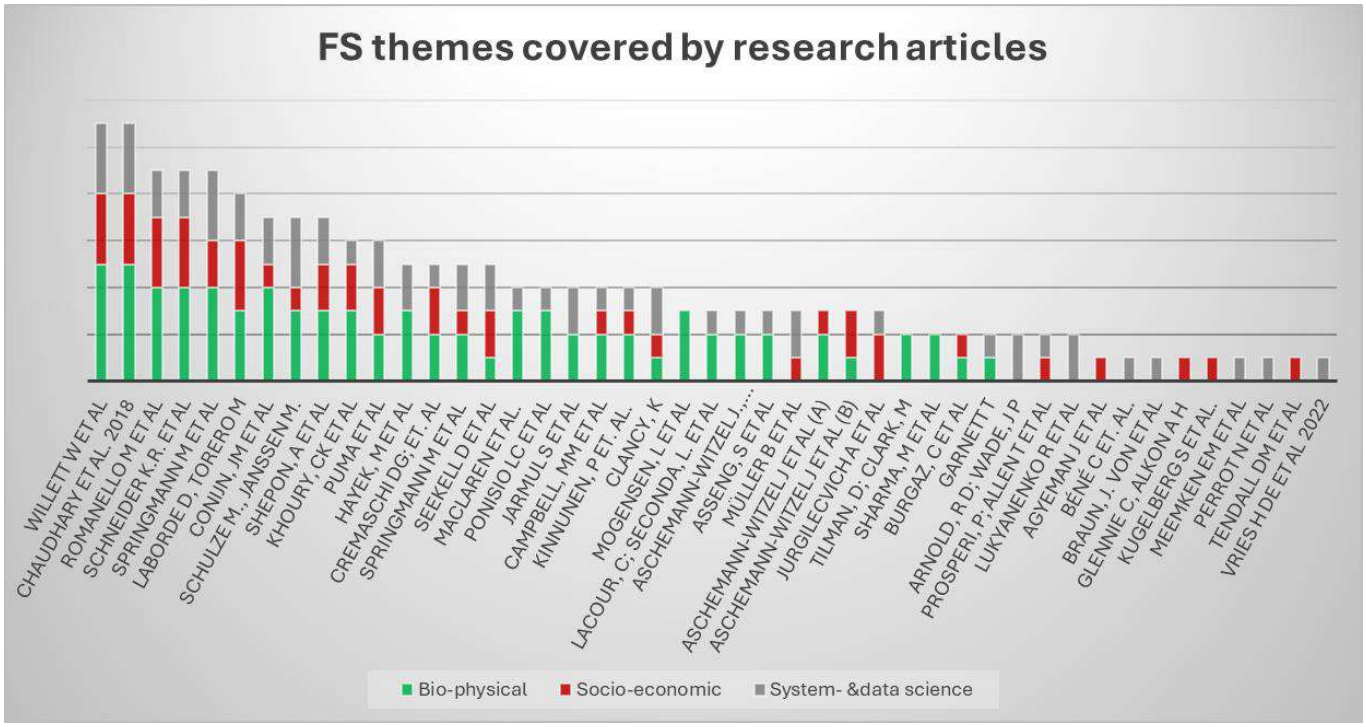


Figure 6. Research themes identified within each of the 45 peer-reviewed food system articles in the period 2014-2024. Three major areas of food systems are considered: socio-economic (red), bio-physical (green) and data-science & system related (grey). See Appendix 1 and 2 for bibliographic data and classification.

The number count in Figure 6 can be interpreted as a proxy for the interdisciplinary character of the individual papers. Note that the counting was done based on **original data or research inputs** covered in each of the papers. For instance a conceptual, theoretical paper describing a holistic theory of food systems would still have one single count only if no original data were presented in this paper. The highest ranked papers include original data or other research inputs from each of the three research domains and can be conceptually regarded as holistic or trans-disciplinary with respect to food systems, while the papers with lower rankings gradually go towards interdisciplinary, multi-disciplinary, and mono-disciplinary papers.

We should off course keep in mind that the papers listed here represent only the "top of the iceberg" in relation to total amount of papers related to food systems, as literally hundreds of thousands of articles are published within the domain of food research [6].

Review of a subset of key-articles

Going a bit deeper into the actual contents and contributions from individual papers, we can elaborate here on the above-mentioned topics such as the holistic character of the research papers, the approach towards system thinking and modelling, and the reference and contributions towards FS observatories. An overview of some of the key-papers and their research themes are given in table 5.1.1. Key-papers have been identified as papers that are based on data modelling. It should be noted that table 5.1.1. represents a more granular look at research themes covered in the articles, compared to figure 6.

[6] A web of science search for "food" in the title: 331,805 results. Search result for "food systems": 12,427 results

Table 5.1.1: Overview of food domains covered in the 10 key articles

	Research Themes					
Article	Diet, health and consumer	Land use & production; Climate change, GHG emissions	Trade, circular economy, food-loss	Population growth; Urbanisation	Policies and governance	Resilience, security and availability
Schneider et al. 2023	*	*	*	*	*	*
Chaudhary et al. 2018	*	*	*	*		*
Springmann et al. 2016	*	*	*			
Springmann et al. 2018	*	*	*			
Willet et al. 2019	*	*				
Puma et al. 2015	*	*				*
Khoury et al. 2014	*	*				*
Conjin et al. 2017	*	*				
Tillman & Clark, 2014	*	*				
Romanello et al. 2024	*	*	*			

Schneider et al. (2023) cover research themes that relate to both socio-economic and bio-physical themes. The article focuses on identifying indicators (or drivers) of the food system, to set up a framework for monitoring food system performance. Schneider et al. (2023) is a methodological paper describing the rationale behind the indicators chosen, and the rankings completed as part of setting up the Food Systems Countdown to 2030 Initiatives (FSCI) observatory. The FSCI is further described in more detail in section 5.2. The indicators of the FSCI have been chosen based on consultations with multiple stakeholders, experts and policymakers. Furthermore, the article presents data on all the different indicators, to set up global benchmarks and rankings. The article concludes that no region, country or income level exhibit desirable outcomes on all rankings, that there exist problems with the alignment of data to countries, and finally that there are considerable data gaps still present.

A novel multi-indicator methodology was introduced and analysed by Chaudhary et al. (2018), consisting of seven different indicators of food system performance; nutrition, environment, food affordability and availability, sociocultural well-being, resilience, food safety, and waste. The rationale and methods underlying the indicators are described in this paper, and the indicators were used to quantify the status of the food system performance across 156 countries, as well as in a scenario analysis on the impacts of dietary changes. Overall, the indicator analysis shows that food system performance varies greatly between countries. High-income countries tend to score well on most indicators, save environmental impact, food waste, and diet related health. While the scenario analysis showed that a transition from animal-based diet toward plant-based diets would improve indicator scores for most of the countries used in the analysis.

While Chaudhary et al. (2018) work with multiple indicators of food system performance, they are not the only article to look at the dietary change scenario. Springmann et al. 2016 and 2018 both focus on the

interplay between diets, environmental impacts, and health outcomes, mediated by economic measures. Springmann et al. 2016 set up a conceptual model where climate change leads to changed consumption patterns and changed health outcomes, mediated by yield and market mechanics. As part of the model, they create a "business-as-usual" reference scenario, where climate change does not happen, and compare this to their scenario with climate change, and the subsequent changes in yield and consumption. Finally, they look at the additional (diet related) deaths present in the climate change scenario compared to the reference scenario. As such, this model presents a first, simple model of the relationship between climate change and related health outcomes.

Springmann et al. 2018 sets up three different dietary scenarios, to better understand what changes to global diets perform best on environmental sustainability and health. The three scenarios are as follows: Changing diets based on environmental concerns, changing diets based on food-security objectives, and finally changing diets in relation to public health objectives, which led to the creation of 12 distinct dietary-change approaches. The analysis showed that the diets that were in line with public health objectives performed better across environmental, nutrient, and health parameters. However, it was also evident that this performance was affected by income and region. This second model, while also investigating diets and environmental impact, does so from the starting point of the diet themselves, making it clear that there are several ways to look at the interplay between even the same thematic areas in the food system.

In Willet et al (2019) we find one of the earliest direct references to the FS observatory – and we suspect this is one of the first original contributions to the establishment of an FS Obs. In Willet et al (2019), a proposal is outlined for a multitude of institutions that would promote, steer and monitor changes in the food systems. Such institutions would bear resemblance to e.g. the Intergovernmental Panel on climate change (IPCC) that constantly "champion" on narrowing the gap between scientific evidence and policy making. A specific reference is made to a FS Obs with a very specific definition (see textbox). Much like Springmann et al (2018), Willet et al (2019) models the relationship between diets, here a specific healthy diet, and environmental impacts. The logic being that dietary change is an avenue for food system transformation.

> *"Global Food Systems Observatory"*
> *Purpose: Consortium of scientists providing high quality evidence on interventions"…*
> *.. a global working network of Universities and scientists to refine evidence-based policy*
> *…Monitor regional and national performance in line with agreed targets and criteria"*
>
> *From: Willet et al. 2019*

Puma et al. 2015 and Khoury et al. 2014 both work on modelling the relationship between diets, agriculture, and resilience. Puma et al. (2015) set up a network analysis of the trade networks of wheat and rice, as these are staples in most diets in the world. Once the networks are established, they look at different types of disruptions to trade, such as tariffs and weather events, to assess fragility. They find that the global food system is fragile and vulnerable to self-propagating disruptions, that could lead to global systemic disruptions of the food supply.

Khoury et al. (2024) look at changes in the genetic diversity of crops across the global food supply from the 1960ties to the 2010s to better understand food security and resilience. In this article food supply acts as a proxy for diets. They find that there has been a global move towards a more westernized diet, with less diversity in the different species globally. That has led to a rise in non-communicable diseases, as these crops are more energy dense. Further, this shift toward more global crop commodities implies that there is less genetic diversity, and potentially less resilience toward diseases and climate change.

Conijn et al. 2017, Tillman & Clark, 2014, and Romanello et al. 2024 all look at climate change, albeit in very different ways. Conijn et al (2017) set out to test if food demand can be met within planetary boundaries, by modelling the flow of nutrients (N and P) between five components of the food system: the human population; food balance supplying non-food items (such as crops for livestock); organic fertilizer; and finally agricultural and grass lands for food production. This model was used to model for the year 2010 and a possible scenario for 2050. They find that food production within the planetary boundaries is not possible in 2050, unless there are significant changes in agricultural practices and diets.

Tillman and Clark (2024) look at Life Cycle Assessments, a measure of the environmental impact of a product or service, of four different diets, and their related health outcomes. Like earlier articles looking at the relationship between diets, health and environmental impacts, they find that diets consisting of less animal product have positive outcomes on both health and environmental measures. Unlike previous articles, Romanello et al (2024) do not look at links between diets and health. Rather they focus on how climate change affects human health directly, through heat waves and pollution, setting forth different ideas for mitigating these effects.

Within the scope of the papers here, the data analysis and modelling broadly falls into six categories; Modelling analysis both with and without a conceptual model; Scenario analysis; Descriptive statistics; Literature reviews; and finally, some articles employ a combination the above. Of the 11 articles, Springmann et al. 2016 and Conijn et al.2017 are the only two articles that show a conceptual model of the food system in their methodologies sections and use this model to inform their data analysis. However, scenario analysis was the methodology used by most of the articles, i.e. to show how changes in consumption patterns influenced changes in agricultural practices and environmental outcomes, or vice versa (Tillman and Clark 2014; Puma et al. 2015; Conijn et al. 2017; Chaudhary et al. 2018; Springmann et al. 2018; Willet et al. 2019). The scenario analysis was often accompanied by the more static modelling of the variables used. Three articles employed descriptive statistics as their main data analysis (Khoury et al. 2014; Schneider et al. 2023; Romanello et al. 2024). Finally, Bené et al. 2019 article was based on a literature review.

Overall, the articles in question represent important firsts step toward looking at, how different parts of the food system interact with one another, and how changes in one may affect others, e.g. diets affecting environmental factors and health. However, there is still a need to develop methodologies and computational skills across disciplines, to be able to better represent and respond to the challenges and complexities of food system, and address questions of sustainability at the different scale of the food system. According to Perrot et al. (2016), this challenge creates a huge need for research in the area of mathematical modelling, integrative models and decision support tools. According to Perrot et al. (2016), three avenues to explore would be (1) defining an overarching conceptual scheme such as mathematical resilience, with reference viability, (2) sharing knowledge and expertise, and finding ways to include expertise from different actors in models and computations, and (3) using augmented phenomenology, for model construction and decision making. According to the authors, this will better enable scientists and governments to understand the food system at different scales, actors and their behaviour, and allow for better identification of leverage points and feedbacks across these.

Rutten et al (2018) set out to develop a toolbox of multiple methodologies, to be used in the analysis of, how to strengthen food and nutrition security outcomes in the EU and, how to improve the performance of the food system in the EU from the perspective of social, environmental and economic sustainability. They start by developing a conceptual framework of a sustainable food system. Secondly, they operationalise the different elements of their framework, by turning them into drivers and indicators. Finally, they bring together several different analytical models in their toolbox, to enable benchmarking and forecasting of EU food systems. However, this methodology development is complex, and any methodological development within a future FS Obs should also be guided by the aims and objectives set out in the governance of such.

5.2. Review of currently established observatory initiatives

In this section we report on results from a literature- and web-screening for the current occurrence of FS Observatories. We found that several concrete initiatives have indeed transpired over recent years that are conform with our conceptual definition and understanding of Food System Observatories.

Firstly, the observatory should include data on all or most of the thematic areas present in the complex systems thinking, including production, retail, consumers, economics, and governance. Secondly, it should include some attempt at looking at feedback loops or interactions between different thematic areas. Finally, it should include data on the European region.

Nine initiatives have been identified, that fit with our definition of a food system observatory at to include data on most of the thematic areas of the food system (see table 5.2.1). Of the nine initiatives, the European approach is expected to be fully covered by JRC's Food System Monitoring Dashboard, probably fuelled by data from EuroStat and European Projects. This initiative was recently launched in 2024, hence it is too early to make a full analysis. However, the approach is very promising, and **we do recommend that FutureFoodS join forces with JRC and verify if indicator sets are corresponding with the preferences of FS actors**.

When it comes to operational initiatives, the FSCI observatory would be considered state of the art, as it includes data on all the thematic areas in the food system approach, and it includes a first step at looking at feedbacks between different areas, through its focus on several cross cutting issues.

The FSCI is "*...a collaborative effort to monitor global Food Systems. It brings together indicators that span Food Systems and provides annual analysis to inform policy, business, and NGO priorities and actions. It supports the transformation of Food Systems, so they become equitable, sustainable, and resilient and positively contribute to achieving the 2030 SDGs and other global goals*" (quote is taken from the FSCI website www.foodcountdown.org). The FSCI is also responsible for the Food Systems Dashboard (www.foodsystemsdashboard.org), a web-based data interface that gives access to a wide range of indicators of global Food Systems from multiple sources.

A total of 50 Food System indicators were selected from five different themes or domains: (1) diets, nutrition and health; (2) environment, natural resources and production; (3) livelihoods, poverty and equity; (4) governance; and (5) resilience. As such, these indicators together provide for a baseline assessment of the world's Food Systems, while each specific indicator reflects a specific aspiration for healthy, sustainable and just Food Systems (Fanzo et al 2021, Schneider et al 2023). With the initial architecture launched in 2021, FSCI is producing annual publications to monitor the performance of global Food Systems toward 2030, specifically aiming on tracking the progress towards the conclusion of the UN Sustainable Development Goals. While FSCI has a strong holistic focus on providing insights into the global food systems, there are ways to improve the FS approach. Firstly, a stronger focus on the interconnection among the different themes would strengthen the FS approach, further it would allow for better exploration of feedback loops and leverage points. Secondly, while the global perspective is important, the FSCI is incomplete as it does not include data on all European countries.

The Cities2030 Observatory is a good first step towards a food system observatory with a focus on the EU. While the Cities2030 project ostensibly is focussed on city-region food systems, their observatory is based on data that is aggregated at country level and include most of the thematic areas present in a FS approach, such as econometrics, sustainability, socio-economics, nutrition and health. Further, it allows you to see an overview of European policies on the food system. However, the database is based on FAO numbers and lacks sufficient methodological documentation. Also, it does not include cross-cutting issues, or the ability

to view the data in a more interconnected way. Finally, the data visualizer is unfortunately set up in a counter intuitive manner.

Generally, several of the nine observatories identified are a good first step towards setting up food systems observatories, and they show that there is a wealth of data available. This makes it possible to monitor food systems both globally, and in the EU region. However, while the data are available, most observatories lack sophisticated embedded modelling. Embedded modelling in an FS obs would allow to say more on the interactions between different areas in the food system. Further, the identified observatories lack the ability to help us identify leverage points, do forecasting, and generally do more than simply monitor food systems as individual indicators.

Funded by
the European Union

Table 5.2.1: Observatories with fully or partly holistic food system approach

Name	Thematic focus	Geo-graphy	Current state	Public Data/ Platform	Description	Strengths	Weaknesses	Downloadable data	Link
JRC EU Food System Monitoring Dashboard	Holistic food system model	EU	Operational (launched 27/11/24)	Yes	The Dashboard is a tool to monitor the sustainability of the EU food system from an environmental, economic and social perspective, based on a set of indicators. The dashboard aims to give a comprehensive and cross-sectoral overview of the food supply chain.	Methodological foundation in a food system model that accounts for the three major domains of sustainability (social, economic, and environmental) as well as the horizontal sphere of governance and resilience.	Data visualizer does not allow for more holistic viewing of data. Data missing for individual countries across several indicators.	xlsx	EU Food System Monitor
Food Systems Countdown Initiative (FSCI)	Holistic Food Systems approach	Global	Operational	Yes	Global monitoring of food systems across five thematic areas that cover health, production and environment, livelihoods, governance and resilience. Data goes back to the 2010s.	Large datasets, including first steps toward a food systems approach, such as named drivers of change, outcomes and cross-cutting issues on governance and resilience. Ability to filter data.	FSCI indicator data is not available for all EU countries.	CSV	FSCI
Eurostat	Agriculture Economy and finance Population and social conditions Environment and energy etc.	EU	Operational	Yes	Database of statistics describing the EU at national and EU level.	Includes data on agriculture, health, socioeconomics, economics and more focused on EU	Statistics are aggregated within predefined pillars and does not allow for more holistic viewing of data.	Yes Several formats available	Home - Eurostat
Cities2030	City Region Food Systems (CRFS) Urban Food Practices	EU	Operational	Yes	Observatory aimed at collecting data on CRFS, to enable cross-disciplinary research and consultation on sustainable urban food practices.	Database of statistics aggregated at national levels, including data on GDP, Environmental factors and socio economics. Aside from this there is also an overview of policies, literature and EU projects, and a SDG tool.	Methodologies behind certain numbers in the database are unclear, and the visuals are counterintuitive. Not possible to look at data in a holistic manner.	No (based on FAO data)	Cities 2030 Observatory
SUSFANS	Holistic Food Systems approach	EU	Operational	Yes	The SUSFANS visualiser includes data on how EU countries food systems perform against several dietary and sustainability benchmarks based on policy and sustainability goals.	Benchmarking against policy and sustainability goals.	There is no real data visualiser, data is only available for download.	zip xis	SUSFANS

Funded by the European Union

Name	Thematic focus	Geo-graphy	Current state	Public Data/ Platform	Description	Strengths	Weaknesses	Downloadable data	Link
Food and Agriculture Organisa-tion Database	Data on 16 thematic areas including agriculture, nutrition and sustainabil it	Global	Operational	Yes	The data portal of the FAO is a free platform that includes food, population and agriculture data going back to the 1960ties. It allows users to make rudimentary comparisons and visualise data.	Includes indicators of country performance in relation to SDGs.	Statistics are aggregated within predefined themes and does not allow for more holistic viewing.	XLM CSV JSON	FAO Data
ECO-Ready Observator y	Socio economics Consu-mers Agriculture Biodiver-sity,	EU	New initiative	No	The project will develop an Observatory offered as an e-platform and as a mobile application. This will function as the necessary singular source of information, provide real-time assessments for the food system, and update forecasts frequently and consistently. The Observatory will be available to society, policymakers, the scientific community, and the agri-food industry, and integrated with a network of 10 Living Labs.	Includes a variety of stakeholders from the food system. Stated outcome is data-driven policy changes. Integrated with Living Labs, which has the potential to engage a wide array of stakeholders, as well as consumers in regions. Stated food system perspective	Unknown	No	Eco-Ready
Agri-Food Chain Observator y	Economic: Food Value-chain	EU	New initiative	No	The objective of the initiative is to exchange information and take stock of the situation in the food supply chain and, in the medium-term, developing methodologies to assess and monitor the structure of costs and the distribution of margins and added value.	Includes a variety of stakeholders from the food system.	Project has a stated food chain view of the food system, rather than a more holistic view.	No	Agri-Food Chain Obs
Food Sustaina-bility Observator y	Holistic food system approach	Italian and Internation al	Operational	No	Observatory conducts empirical and multidisciplinary research on the opportunities and impacts of technological, supply chain and business model innovation on food systems, with a focus on multi actor approaches.	Holistic and multi actor approach to FS research and development	Data are not public	No	Food Sustainabilit y Obser vatory

Funded by the European Union

Aside from the 9 holistic FS observatories in table 5.2.1, a total of 13 more observatories were identified that, while covering important aspects of the food system, cannot be said to have a truly holistic food systems approach to the food system. Often these observatories have a holistic approach within their own area of the food system, but they lack the cross cutting and holistic approach of those in table 5.2.1. Further, not all of these observatories necessarily cover or gather data pertaining to the EU or the European food systems.

The Observatories in the table below have been classed, based on their main focus, starting with three databases that cover two or more of the thematic areas inherent in the food system approach. One such observatory is the data-platform on agriculture and food-systems, an initiative from the EU commission published as the "Agrifood Data Portal". This data platform does not use the term "observatory", however it meets several if not all, of the criteria as mentioned above. Within the data platform, one can find, analyse and abstract comprehensive data on Agro-Food markets. The data that can be found here include prices, production volumes, imports and exports, and CAP (Common Agriculture Policy) indicators. Together this comprises an extensive set of data on different aspects of the European Agro-food industry. However, despite the wealth of data on the agrarian side of the food system, it lacks data from retailers and wholesalers, and data on health and socio-economic data, that would qualify it to be a holistic food systems database.

Next comes the EIT consumer observatory, the only observatory identified, which focusses entirely on consumer behaviour with food. The focus is on tracking attitudes towards food, purchasing behaviour and consumer trust in the food system.

Four observatories have been identified under the heading health and nutrition (FABLE Database; Global Dietary Database (GDD); Global Health observatory (GHO); Global Nutrition Report (GNR)). One such observatory, is the Global Health Observatory under the WHO, that tracks the health and well-being of global citizens across 36 different themes, where several of these themes relate to the food system, such as food borne illness, nutrition, health and the environment, and the sustainable development goals.

Under the heading of farming [7], production and economics, there are three observatories (Farm Sustainability Data Network; OECD Agriculture Statistics; European Market Observatories). Respectively these three focus on economic sustainability of farms, agricultural production (yield) and the environmental impact of farms, and finally the performance of several markets related to production.

Under the final heading food waste in table 5.2.2, a single observatory has been identified, the Italian Observatory of Food Surplus, Recovery and Waste. The observatory is aimed at collecting data on food waste across agriculture, food service and consumers, to inform policy and intervention strategies.

[7] We have not included "blue environment" due to the focus of FFS where the SRIA specifically excludes this, and the existence of the partnership for blue economy

Table 5.2.2 Table of observatories covering one or more food system areas

Name	Thematic focus	Geography	Current state	Public Data/ Platform	Description	Strengths	Weaknesses	Downloadable datasets	Link
Observatories 2 or more aspects of food systems									
Agrifood Data Portal	Agro-Food Markets, CAP indicators, Farm Economics	EU	Operational, updated	Yes	The data portal includes several databases on different specs of EU agriculture and food supply, including CAP indicators, Market data, Farm econometrics, EU financing and Food security.	Wealth of data on EU farms, markets and sustainability (as CAP indicators).	Data is fragmented into different dashboard. Focused on farming and imports/exports rather than the full food food system.	Yes Format depends on dataset	Agri-Food Data Portal
ATTER Observatory	Food system transformation	Global	Operational	Yes	Observatory of territorial agrifood systems transitions is structured around the portfolio of 16 case studies gathered in the project and network and the cross analyses carried out on these territories.	Focus on comparative analysis.	Based on 16 comparative case studies.	No	ATTER Obs
Humanities for the Environment	Impact on agriculture (asia) Food Futures (new initiative) Climate Change (circumpolar)	Global	Operational, but different observatories and projects are at different stages	Depends on the observatory	8 different observatories in different regions of the globe, each with their own focus and output, incl. several projects, and some accessible data	Observatories cover a wide range of sustainability aspects. For the topic of Food Futures, a broad array of disciplines are covered in the statement of intent	Observatories are at very different levels, some are newer initiatives, while some have accessible data.	Depends on observatory and project	HFE Observatories
Jameel Observatory	Food Security	East Africa	Operational	No	Observatory using big data, co-creation and dialogue to recognise early warning signs of disturbances to food systems and to increase resilience of food supply.	Dataset includes a broad range of data on economics, sustainability, and environment.	Unclear how holistic the approach to the food system is. Focus is East Africa rather than EU data.	No	Jameel Obs
Consumer Observatories									
EIT Food Consumer Observatory	Food Consumer surveys	EU	Operational	No	Observatory combines research and sector knowledge about the green transition within food systems and aims to maximise the availability of consumer insights on agrifood topics, delivering greater knowledge, strategy and guidance to agrifood stakeholders.	Data on consumer behaviour and their trust in the food system, based on consumer surveys and panels.	Not focussed on the food system as a whole.	Account required Potential paywall	EIT Consumer Obs
Nutritional Databases									

Funded by the European Union

Name	Thematic focus	Geography	Current state	Public Data/ Platform	Description	Strengths	Weaknesses	Downloadable datasets	Link
FABLE Database	Nutrition: healthiness of Food Systems	EU	Operational	Yes	FABLE includes data collected on branded foods and beverages through EU-funded projects. At the moment, FABLE hosts data collected during EUREMO and the Joint Actions Best-ReMaP and JANPA.	Allows you to access data aggregated on products within each study.	Does not contain actual information on diets, only aggregated nutritional information for product categories.	Contact FABLE team for data	FABLE
Global Dietary Database (GDD)	Nutrition: dietary intakes and impact on health	Global	Operational	No	The GDD is a database of estimates on world-wide dietary intake, with a focus on poor and vulnerable populations. Current aims of the database: estimate individual food and nutrient intakes worldwide. Estimate disease burdens to find leverage points for change	Data spans at least a decade and includes socio-economic data on populations. Includes dietary-data on individual level, and aggregated.	Is focussed on intake.	Some data available Some require account	GDD
Global Health observatory (GHO)	Health monitoring Nutrition Sustainable development goals Food borne diseases Environment and health Etc.	Global	Operational	Yes	Observatory of global health across 36 themes, several that could be considered in relation to the food system.	Explores several themes related to health, environment and food. Good methodological documentation provided on classifications in data etc.	Not all data is accessible, often data is available as an aggregated factsheet.	Yes	GHO
Global Nutrition Report (GNR)	Nutrition Crisis Accountability Health targets	Global	Operational (updated 2022)	Partly	Report on global nutrition crisis, with data on how countries and regions are doing compared to different benchmmarks for health outcomes among the population. Set up to help governments and others commit to SMART targents for health.	Overview of nutrition performance at the level of individual countries.	Unclear if this data is updated, or at what intervals. Some of the data provided is already outdated, by almost a decade.	No Based on secondary data	GNR
Agriculture- and Farming Data									
Farm Sustainability Data Network	Economy, sustainability	EU	New initiative	No	The Farm Sustainability Data Network (FSDN) is set to replace the Farm Accountancy Data Network (FADN). The FSDN will build on the FADN's legacy, expanding its scope to cover not only farms' income and business	In so far as it builds on FADN database, there will be good data on commercial farms economics within the EU.	Focussed primarily on farms and their sustainability, and not on other aspects of the food system.	.xlxs	FSDN

Funded by the European Union

Name	Thematic focus	Geography	Current state	Public Data/ Platform	Description	Strengths	Weaknesses	Downloadable datasets	Link
					activities but also information on their environmental and social sustainability performance.				
OECD Agriculture Statistics	Agricultural performance Nutrient balance Environment	Global	Operational	Yes	Repository of data going back to the 1980ties on agricultural performance on nutrient balances and the environment, across several indicators.	The database includes data on farm economics, including forecasting on the main agricultural markets. There is further a database on the nutrient balances with regards to the input and output of N and P.	Data is limited, especially the environmental data is limited to N and P balances.	CSV	OECD Agri Stat
European Market Observatories	Economic Market data on Agri-Food products	EU	Operational	Yes	Observatories on the price, avaliability and trade of various goods within the EU common market, including Milk, Meat, Crops and Fertilisers etc. Observatories were established to better cope with market volatility and read market signals.	Data aggregated at national and EU level. Includes data on price.	Data is fragmented across different products, includes only economic/trade data. Crossover with Agri-Food Data portal	Yes Format depends on dataset	Market Obsevatories
Food Waste									
The Italian Observatory on Food Surplus, Recovery, and Waste	Food surplus, waste and redistribution	Italy	Operational	No	Observatory aimed at collecting data on food waste across agriculture, food service and consumers, to inform policy and intervention strategies	Holistic approach to food waste that includes numbers from farm to fork, redistribution efforts, and is meant as a tool for policy and redistribution efforts.[8]	Only covers food waste issues, and not broader food system topics. Language barrier as the observatory is in Italian.	Unknown	Italian Food Surplus Obs

[8] Grant F and Rossi L (2022) The Italian Observatory on Food Surplus, Recovery, and Waste: The Development Process and Future Achievements. Front. Nutr. 8:787982. doi: 10.3389/fnut.2021.787982

The second review of existing observatories identified 13 new initiatives, focused on either the whole or parts of the food system, bringing the total up to 21 initiatives. Another six observatories were identified during the course of our search. However, these observatories fell short on several of the criteria established, had a paucity of data, or were not accessible due to language barriers. These observatories have been listed in Appendix 3.

Of the 21 observatories listed in table 5.2.1 and 5.2.2, 11 initiatives were focused on the European region, making it clear that there is already a wealth of monitoring data available on EU food systems. However, all the observatories were set up in a way that broke the food systems down into different thematic areas. Thus, the observatories, while collecting data on food systems, did not attempt looking at interactions and feed-backs between different areas, and thus lack the more complex view of the food system exemplified by the food system approach (see 5.1). As such, the observatory that will be established in the FutureFoodS partnership could add value to the existing initiatives, by focusing on more complex modelling of data required to identify interactions and feedback loops between the different areas of the food system, and thereby help identify leverage points for interventions, do forecasting of different interventions, and provide insights on the performance of the food systems of Europe.

5.3. Focus group interactive sessions

This Focus Group summary reflects the discussions with participants in three different online sessions, with a total of 15 participants, representing stakeholder groups from EU-wide “clusters”, academies, NGOs, research funding and programming, and global public bodies. Their domain area of work was mostly food, followed by health (food), environment, bioeconomy, urban systems and aquaculture/marine. The primary field of work was mostly research but also innovation, policy, and education.

There was no doubt that the participants in these focus groups, primarily people involved in the FOODPathS project, believe that there is a need for a Food System Observatory (FS Obs). Yet, when considering what it is needed for, the opinions diverged. Despite diverging opinions, participants agreed that the FS Obs is primarily a tool for monitoring and an accelerating for transition.

According to participants, a FS Obs can be used to collect a wide variety of quantitative and qualitative food system data, organize these data, by harmonising measurements and methodologies, and use them to monitor changes and their impact. The selection of these data needs a common understanding of what the FS Obs is looking for, so that we avoid it ending up as a huge server for collecting data, with no avenues for using this data. The information should be collected, not as raw data, but by indicators used for monitoring food system transition, carefully selected and from reliable sources.

The FS Obs can have the additional role to offer opinions and advice based on the evidence gathered by the indicators. This means aiming to guide decision makers, shift public opinion, and improve the food system.

To make the FS Obs operational, it is essential to choose the right monitoring points, levels, and indicators as well as make the monitoring results available. The FS Obs should be built by looking to successful and unsuccessful cases, and the dynamics behind implementation of different measures should be taken into consideration as well as the resistance from different groups, not forgetting that Europe exists in the context of the world. Also, since governance plays an important role in a food system transition, it is important to know, how policies interact and how their effects are measured.

Monitoring transition in the food system can include the evaluation of myriad indicators, which cover the varied perspectives of the food system, turning indicator selection into a very complex task. Indicators already in use were suggested as a place to start which should cover (1) knowledge base, (2) implementation and (3) predicted scenarios. Suggestions from the participants included choice of indicators based on stakeholder roles in the food system (many of these examples were provided in the SLIDO session), linkage indicators, correlations between indicators, and indicators that measure long-term impact.

The results from the SLIDO session showed that half of the participants worked with food system transition indicators. In line with what participants discussed related to working with indicators and indicator

selection, it was suggested that the partnership proceeds as follow: divide the subsystems, select the right questions with the relevant stakeholders and for each question select the indicators by consulting experts in each discipline. Once the indicators are defined, ensure that they can be measured reliably.

An FS Obs could have many users including scientists from several disciplines and with different expertise, governments operating at different scales, private businesses, people working within the field of communication, and the public. There was general agreement that an FS Obs should have a European focus, though input at the national and regional levels, and a global view were also proposed. Scales were also considered from geography, including scaling at sector-specific levels, and socio-economic perspectives.

To make it valuable for the users, the information shared by the FS Obs should be not only relevant and up-to-date, available, and accessible, but also digestible.

The task of identifying, monitoring, and assessing leverage points and barriers for change will not, for some focus group participants, be best done by the FS Obs. This is primarily due to time constraints, the amount of data, modelling needed, and because some of these accelerators and barriers may come from outside of the food system. However, this task can be done by collaborating with others who have more expertise - politics, governance, media, industry and investors - as these are the ones more likely to influence accelerators and barriers for change in food system transition.

5.4. Budapest workshop interactive session

During the workshop “Have your say: What would you expect from a “European Food System Observatory” in Budapest, a draft concept for a European FS Obs was presented, including a review of existing datahubs, the stakeholders feedback results collected so far, and a presentation from the FutureFoodS partnership. This fed into the interactive Fishbowl session, and the session concluded with a SLIDO questionnaire. The aim of the session was to promote discussion and provide input on the focus and function of an FS Obs, as well as the data needed. The following is based on a synthesis of the results of the session, for more information, please refer to Appendix 5.

Functionalities

To list the main functionalities of an FS Obs, we first need to know what we need the FS Obs for. It was clear by the end of the session that it needs to connect the information that is already available for monitoring the transition of food systems. However, how to measure and what to monitor is still unclear.

It was agreed upon, by most participants, that an FS Obs basic function is to collect and analyse data, which will allow it to provide a broad range of basic information on what is known already. But it should also quantify and qualify the transition of food systems based on available data. To ensure that focus is not lost when observing, collecting, and analysing data, it was suggested that the observatory should follow a clear and stated aim, targeted at and focused on the transition to SFS. This will ensure that the data are not static but allow for a transparent representation of an FS transition, for identifying barriers, and for an assessment of the consequences of this transition. However, it is fundamental to clarify the definition of transformation and transition, because participants struggled to understand the difference between the two concepts. Finally, the need for a definition of what sustainability means for the transition toward SFS is also important.

The information provided by the FS Obs may bring awareness and understanding of the FS approach, as well as showing, how to work systemically. The food system approach is still considered somewhat novel in the broader society. Furthermore, participants underlined the importance of considering the different perspectives of actors within food systems, when observing, collecting and analysing data.

Data hubs

For observing and collecting the data, the FS Obs should define a strategy of collaboration with actors and stakeholders within the food system, to avoid lack of interoperability and knowledge gaps in the data coverage. While the participants only spoke of strategy in relation to the observatory, it could be applied more broadly to the FutureFoodS Consortium.

The overall view of the participants is that there is a lot of data available already, that should be used in a more efficient way. However, others pointed to the lack of interoperability in the data available and the knowledge gaps in the private sector, responsible for the distribution and retail. The FS Obs needs to be able to engage with these actors, to ensure knowledge gaps are filled, in a responsible way.

Interactions and interdependencies

The interactions between actors and the interdependencies between outcomes was agreed upon by all as are fundamental to the understanding and monitoring of the food system. According to participants interactions and interdependencies will enable the FS Obs to show the effect of changes in one part of the system to other parts of the system. "Dynamic modelling" was proposed to facilitate this process. Unfortunately the participant did not elaborate on what was meant with dynamic modelling, rather they continued to list potential benefits. Specifically, they discussed the possibility that modelling could be used to give predictions on the transition, the reality of the transition, possible emerging risks, and what may be done to mitigate them at the right stage of transition. These interactions should include the whole economy and government, to assess both the economic impact of transition and the impact of the policies adopted, throughout the system.

Exactly, how to measure transition and interactions is still unclear. Participants agreed that indicators need to be used, but what indicators to use is still a grey area that needs to be discussed. Many did, however, agree with the suggestion, that measurement of food system performance at country level should be done using SDG indicators, among others that were not identified. The discussion on indicators, should start with the idea provided in the discussion by one of the speakers:

> *… find a simple indicator that start to give us an idea that something happened, this top-level indicator that fits with a legal framework and then categorise others according to the values this indicator gives …. a partnership should look to the specific outcomes".*

Further, several participants argued the importance of reporting findings. These reports should consolidate findings, but it was important that they did not include information on everything. Instead, they should be focussed on specific aspects of food system transition, including barriers to and facilitators of this transition as well as the interconnectedness of outcomes.

Governance structure

Implicit in all the discussions was the understanding that an FS Obs provides scientific interpretation of the data with the addition of understanding the interdependencies between the outcomes, but this was never discussed in depth. Further, there seemed to have been some confusion regarding the differences between governance and operational processes for the observatory. In the end, it seems that the governance or operational process should include four steps: (1) to define the aim and strategy and develop pertinent questions to guide data collection and analysis; (2) to observe data and collect indicators; (3) to analyse the interactions and interdependencies using the indicators; (4) to report the results based on the interpretation of indicators.

Objectivity

Finally, participants discussed, how an FS Obs may ensure objectivity in findings, specifically they discussed, how to the food system, a phenomenon they felt was very subjective, could be measured objectively. Participants found that whether the FS Obs can achieve the expected objectivity for measuring the

transition to SFS was a question they could not answer but building the FS Obs with objectivity in mind might be a way to achieve it.

SLIDO session

The last part of the session consisted of a set of 5 SLIDO questions: 1) Which food system policies should a food system observatory (FS Obs) relate to? 2) In one word, if you would use an FS Obs, what would you use it for? 3) Mention a question in a food system (FS) context that a future FS Obs should be able to answer. 4) Which knowledge format/data format would you prefer on specific FS topics in the FS Obs? 5) In one word, list data areas that are obviously missing in the already existing observatories related to FS. The answers provided often related back to the previous fishbowl session and will be discussed in that context.

Food System policies that an FS Obs should relate to was not directly discussed in the fishbowl session, but health and sustainability were intrinsic in all the discussions and repeated. Interestingly, when participants were focused on this question food security and safety policies were the most important to an FS Obs, followed by health, nutrition, agriculture, environment, procurement, sustainability, waste, economy, social, trades and funding policies.

According to the answers given in the SLIDO session, a FS Obs should be used for monitoring, learning and analysis. The strength given to policy making in the SLIDO session, suggests participants' awareness of the importance of policies for the expected transition in the FS. Other answers given in the SLIDO session stated that an FS Obs should be used for a holistic approach, sustainability, objectivity, connectivity and transparency. This aligns with, what had been discussed in the fishbowl session, specifically, that the information provided by the FS Obs may bring awareness and understanding of the FS approach, and, how to work systemically, which was seen as fundamental for observing, collecting and analysing data, and the different perspectives of actors within the food system.

Participants listed many different questions, that they felt were important for an FS Obs to answer, in the SLIDO session. These were aligned with what have been discussed in the fishbowl session. The questions were divided into general questions, the ones needed when building the FS Obs, specific questions to the FS Obs related to the top-level indicators discussed in the fishbowl session, and specific questions to different stakeholders and topic areas that may help uncover the secondary indicators.

The knowledge format/data format preferred was not discussed directly in the fishbowl session, but it was mentioned that the measurement of food systems as data on, what's going on at country level in terms of SDG indicators should be consider by the FS Obs, and that indicators needed to be used. The SLIDO results were very aligned with this view, with a clear preference for the indicators, followed by the creation of consolidated reports. Further, it is clear that participants felt that simply collecting raw data and creating indicators is not enough for the FS Obs, it needs to be able to interpret and communicate findings.

What is missing in the existing data hubs/observatories was never discussed very deep in the fishbowl session. It was discussed in the light of the lack of interoperability in the data available and the knowledge gaps in the private sector, responsible for the distribution and retail. The SLIDO results included references to the knowledge gaps referred to in the fishbowl, but expanded these to include, food consumption, food losses and waste, food environment, energy efficiency, bioeconomy and others. The most agreed areas missing was food processing, followed by profit margins, circularity and procurement.

Funded by
the European Union

6. Consolidated recommendations for a Food Systems Observatory

The consolidated recommendations for an FS Obs in this chapter builds on three steps as identified in the review process (section 5.1 and 5.2) and from dialogue with stakeholders (section 5.3 and 5.4). In section 6.1, we start with an analysis of the main stakeholders and their anticipated user profiles, needs and interest in FS transformation:

- Policy makers and civil servant's goals and visions, as referenced in official policy advice documents, food based dietary guidelines, and expert group reports
- Food industry: demand from the increased pressure on food systems, and focus on sustainable food chain with reduced GHG impacts
- NGOs and interest groups: proposals and demands for transformation of food systems.
- The research community working within the FS research areas

In section 6.2, we outline how the proposed thematic areas and indicators are covered by existing data sources – referring to the review of the existing FS observatories (section 5.2) – and which areas would need development of data.

In section 6.3, we give examples of themes and narratives for consolidated reports, that could cover the main challenges and ideas for alternative food systems identified by policy and organisations.

6.1. Stakeholder groups and their expected needs for an FS Obs

Policy makers and civil servants

Less than one decade ago, it was reported in 2016 by FAO in a broader international perspective that only 4 out of 83 countries included sustainability criteria in their food based dietary guidelines (FAO, 2016). This has been changed since then (Genevieve et al, 2022), and while national policy objectives often not are formulated in an explicit FS approach, it is clear that today in most countries in Europe there are clear policy goals for healthier diets and for sustainable agriculture[9].

Considering e.g. the UN Food summit 2021 and its focus on Food Systems, some countries have explicitly formulated their policy objectives in a FS approach. In France, the Ministry for Agriculture and Food has taken the SFS concept as a major task of changing the populations' diets (Fosse et al. 2021) and performs assessments of the links between supply and demands for a sustainable food system (Evain & Nairaud, 2023). As an example from Denmark, policies include specific objectives for healthy and sustainable diets and reducing food waste. These policies include the footprint of the Danish food system on a global scale, such as "Deforestation free value chains" (with reference to FOODPathS D6.1).

A recent overview from the EU Knowledge4Policy initiative also demonstrates that most EU countries - together with Iceland, Norway, Switzerland and UK - now have added specific sustainability aspects to their Food-Based Dietary Guidelines (EC, 2025b). These aspects include (authors selection):

- Eating plant rich-diets that are considered beneficial for health
- Reducing meat intake, especially red meat, considered to have a higher climate and environmental impact
- Choosing sustainable fish

[9] Sustainable agriculture mostly understood here as reducing use of pesticides and antibiotics, regulating nutrient inputs and losses as well as climate impact

- Consume fresh vegetables, in season and preferably locally sourced
- Reducing rice and dairy consumption as to reduce climate impact due to methane emissions
- Reducing food waste
- Reducing nutrient eutrophication, and GHG emissions
- Preserving/restoring biodiversity
- Promoting food diversity and animal welfare e.g. by labelling

These policies and guidelines are also well anchored within international global organizations building on decades of work of FAO and WHO (e.g. FAO &WHO, 2019; FAO, 2023). Also, specific food targets are included in the SDG Action platform of the United Nations, addressing food security, nutrition and sustainable agriculture (UN food security and nutrition and sustainable agriculture). The FAO has formulated these as FOUR BETTER's: better production, better nutrition, a better environment, and a better life – They are the overarching integrated principle of FAO's Strategic Framework, in support of the 2030 Agenda for Sustainable Development.

These policies have also been embraced in a European context under the farm-to-fork strategy (EC, 2020), which aimed at accelerating a transition to a sustainable food system by developing initiatives targeting four elements in a food system: Sustainable Production, Processing and Consumption of food respectively and prevention of food loss and waste. The EU's research and innovation policy itself, FOOD2030 (DG research, 2023), has formulated a clear vision aimed to (quote): *"support the transition towards sustainable, healthy and inclusive food systems".* To address the pressing global issues, clear goals and pathways there to have been formulated, notably 1) nutrition for sustainable and healthy diets, 2) supporting a healthy planet, 3) circularity of resources, as well as 4) innovation and empowering communities. This is one of the explicit references for the Horizon Europe partnership FutureFoodS (FutureFoodS), as laid down in the previously defined SRIA (SCAR, 2023) serving as basis for FutureFoodS R&I programs and transversal actions. Tóth et al. (2024) provide a thorough overview of -and rationale behind - thematic areas and domains relevant to the Environmental, Economic and Social dimensions of Food systems sustainability assessment and propose in addition eight sub-domains to describe the horizontal aspects, Governance and Resilience.

Both at EU- and global levels, several expert groups have expressed needs for data integration to tackle the "triple challenge" while ensuring policy coherence (OECD 2021; SAPEA/SAM 2020). An expert panel (HLEG) was established by the European Community to provide recommendations on improved science policy interfaces in a global food systems perspective. The panel recommends facilitating the delivery of independent assessment reports that focus on a holistic FS policy evaluation as well as a debate on future development trajectories and forecasts among policy makers and multiple stakeholders (Singh et al., 2023). Without proposing specific science-based indicators or focus areas, the HLEG encourages a strengthening of awareness of political economy issues, specifically the trade-offs between economic and environmental objectives and path dependencies in Food Systems.

The basic message of the HLEG may be interpreted as a need for better observations and data interfaces to enable a dialogue on goal setting and policy development which integrates different stakeholders' views and experiences. In the context of a FS Obs, this points to a need to cover a broad range of observations and objectives for sustainable food systems, and to engage stakeholders in the definition of relevant data and indicators. Singh et al (2023) explicitly highlights food producers and food processors, in other words, more focus on the FS actors in between primary producers and consumers.

In any case, from a policy perspective it seems clear that a FS Obs should include data on outcomes regarding primary production, food processing, trade/retail, food waste recycling, and consumer diets. Also, it should try to establish relationships between the elements, activities and the multiple outcomes. Furthermore, a FS obs would be beneficial for assessing policy coherence as to address the success rate of different policies as applied in different countries (OECD, 2021; iPES, 2019; UK house of Lords, 2024).

In this overview of policy-oriented stakeholders, it should be noted that increasingly governments at regional levels and city levels seek to formulate coherent FS policies. Such policies aim at linking the dietary health of regional populations with ambitions and requirements to sustainable food production and

agricultural practices ((Blay-Palmer et al., 2018; refer to D6.2). A notable driver for this regional policy development is the Milan Urban Food Policy Act that was launched by the Milan Municipality in 2015, following the World Food Expo. As of today, this act is signed and supported by no less than 290 cities with in total 490M inhabitants (Milan Urban Food Policy Pact).

At EU level the Committee of the Regions (CoR) adopted an opinion suggesting a that a Sustainable EU food policy should build on food systems terminology and include agriculture food production, processing and diets, thus embracing a holistic approach. The opinion underlines priorities of stimulating and sustaining small-scale farming systems also in peri-urban and vulnerable areas. The CoR links this with promoting the availability of local, fresh and seasonal food as a tool for addressing obesity and food related diseases (Committee of the Regions, 2017). The CoR opinion also stresses the need for a standardized methodology for collecting and reporting data on the environmental impacts of food products.

In the context of a future FS Obs, this policy trend is an opportunity to monitor the FS changes that are achieved at the urban (Sonino, 2023) and regional level (Blay-Palmer et al 2018).

Food industry sector

In response to increasing regulations and global pressure on food systems, the food industry increasingly engages in the development of sustainably sourced raw products, energy- and water-efficient product lines and food production processes, as well as efforts in the marketing and retail sectors. The concept of sustainability expressed by food industry actors does - among other - embrace the life-cycle and climate footprint of foods, the search for plant-based food as alternatives for meat, increased focus on dietary health, and reduction of food-waste.

The industry perspective is firstly reflected in food-research environments with a focus on processing and product development such as healthier processed and ready-to-eat food. Research in this area aims to develop plant-based meat replacements and food products based on in-vitro growth and precision fermentation (e.g. Knorr & Augustin, 2021).

To drive and support innovation in the food industry, the EU co-founded EIT Food program, partners large companies and SME food companies with knowledge institutions under a vision for a sustainable food system (EITFood, 2025). The vision – and the funding programs – build on three missions addressing respectively:

- “Net Zero Food System”: regenerative agriculture, reducing food waste, protein diversification
- “Reducing risk for a fair and resilient food system”: food safety, sustainable and resilient production, shorter supply chains in urban integration, LCA based sustainability indicators for transparency
- “Healthier lives through food”: product supply and choice for a balance diet, diverse protein and nutrient density.

The EIT Food “Consumer Observatory” (section 5.2) seeks to provide insights into consumer behavior to support activities across the three missions.

Knowing that often a very high proportion of climate foodprint from food products is from primary production, multinational companies such as Nestlé, Carlsberg and Pepsico are actively adopting and promoting the concept of “regenerative agriculture” with the aim of procuring their raw food materials from more sustainable primary production. Other companies have their own procurement policies based on objectives for reducing climate footprint. An example as currently practiced by farmers in seven European countries (BE, DK, DE, L, NL, UK, SE) is “Arlagaarden”. This farm management programme builds on requirements, checkpoints and compliance criteria for Arla’s dairy producers to implement and document sustainability efforts in four focus areas: milk quality, animal welfare, climate & nature and people (ARLA, 2025). Under this audited program, the long-term climate ambition is to reach a net zero carbon dairy production in 2050. Each farmer under this program must uphold specific requirements to reduce their climate footprint per kg milk, in order to report collectively under the science based targets initiative (How it works - Science Based Targets Initiative).

Other multinational food companies have made similar commitments, a notable example of this being the "Planet Pledge" initiative. In parallel, 38 multinational companies hereunder several global food companies – including Arla, Carlsberg, Danone, Nestlé, Pepsico, Unilever, Mondelez and Groupe Bel - are members of this initiative led by the World Federation of Advertisers. The planet pledge framework aims to support "the global Race to Zero" campaign, and to drive consumer behaviour towards sustainability by trustworthy marketing communications. One of the pledges also is to "reinforce a trustworthy marketing environment in which sustainability claims can be easily substantiated" which unambiguously points to trustworthy data in the FS domain. Hence, we presume that such industry initiatives will be able to provide valuable data on sustainability and marketing of food products, data that can be of great relevance for FS Obs when given the right incentives and regulations.

Besides these voluntary reporting initiatives, major food companies are from 2025 required to present so-called ESG data in compliance with the EUs Corporate Sustainability Reporting Directive (EC, 2025a) if operating within the EU. The main objective is that companies disclose data on the impacts of products on people and the environment, while informing on risks and opportunities from this impact. Although it is premature to evaluate the precise type of data reported under the CSRD, the existing forms of current voluntary ESG reporting may give an indication. These voluntary reports often consist of data regarding resource use, emissions of GHG (divided by scope 1,2,3 according to the "Greenhouse Gas protocol"), waste in the environment section, social characteristics i.e. human rights, and occupational health and safety of the companies' staff.

Aside from food companies, large retail chains within Europe also have stated sustainability aims as part of their business agendas, such as the *Acting Ahead*[10] strategy of the Schwarz Group, which owns Lidl, and Tesco's *Our Planet Plan*[11] part of their corporate social responsibility impact. Retailers will often self-report numbers on different sustainability aspects of their stores, such as food waste and/or carbon emission in distribution and store operations. Further, retailers collect data on their customer base through loyalty programs, as well as provide an avenue for collecting data on consumers choice in store and point of sale data. However, to the knowledge of the authors, most of these data are yet not publicly available in a format that is useful in a FS Obs context.

Overall, the point in bringing the industry perspective into this discussion is that - on the one hand – available data in FS Obs should reflect the food companies' ambitions as to monitor their path towards healthier and sustainable food systems. To some extent these ambitions are equivalent to government policies. On the other hand, it is vital to ensure that relevant data in the company records are made available to a public FS Obs in a way that creates transparency (Scheifer & Deiters, 2013) without compromising commercial interests of individual companies. As mentioned before, data embedded in the value chain in-between the food processors to the retail sector are often not easily available and make a blind spot in the assessments and understandings of food system current state, interactions and outcomes. The explicit ambitions regarding increased transparency as claimed by individual companies, together with the future mandatory CSRD reporting requirements represent a new opportunity for providing FS Obs relevant data across the whole food system. The recently signed Code of Conduct may guide this process in Europe (https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy/sustainable-food-processing/code-conduct_en).

NGO organisations

A group of trans-European NGOs (including well-reputed environmental, animal welfare and alternative food movements) have in a joint open letter proposed a Sustainable Food Systems law (Foodpolicycoalition, 2023), with recommendations for transition towards more sustainable food systems based on European and national regulation and "sustainable food plans"(NGO 2022 joint_letter_on_food.pdf). In this letter, the NGOs explicitly recommend a food systems approach with a focus on "the food environment", demanding for accountability, corporate responsibility and fairness. This requires EU level regulation of procurement and marketing, as well as enforcement mechanisms to

[10] https://gruppe.schwarz/en

[11] (https://www.tescoplc.com/sustainability/planet-plan

mitigate the concentrations of power in food systems ("actors in the middle of the food chain") and enhancing "food democracy".

The letter with policy recommendations also proposes setting up "a robust policy monitoring and evaluation framework" with indicators of progress vis-à-vis the wider goals and targets for those policies. A clear purpose from the NGO perspective would be to hold EU- and MS governments accountable for setting targets, execute corrective measures, and monitor the progress. The focus with this approach is on power imbalances, fairness, just diets, social and environmental harm and the food environment. Hence, the monitoring framework proposed would demand rigorous and hard to obtain data reporting from the private sector. Such data would necessarily include the linkages between actors in food processing industry and the marketing/retail sector.

The NGO´s, which includes also Euro Coop and IFOAM Organics Europe, also request a change in livestock production. Such a change would – according to the paper - necessarily include redistributing animal farming to a mixed farming system in balance with local regional carrying capacity, carbon and nutrient circularity, and at the same time a conversion to more organic and regenerative agriculture. From the perspective of FS Obs, the monitoring of such changes would require data on distribution of livestock across Europe at (sub-)regional level. The data needed would have to be stocking rate, production types, and animal welfare. The latter could be based for example on labels, percentage livestock with outdoor access or similar.

In addition, the idea of improved circularity – which is in line with policy objectives and the industry's goals – requires data on recycling of carbon and nutrients throughout the entire food chain: starting in the primary production by proper use of animal manure and crop residuals, followed by cycling between food processors, bio-energy production and farms, and finally the reuse of household food waste and sewage sludge on farmland. Similar messages appear in the iPES FOOD report proposing a common food policy for the EU (iPESFood, 2019). The report, stresses the need to account for the food consumptions' environmental footprint outside Europe, including land and water.

The iPESfood report -which was undersigned by a long list of NGO's - covering food quality, rights and access, alternative and small-scale agriculture, social justice and biodiversity/environment topics - stresses the importance of "Food" as a key item for integrated polices. The aim should be to ensure policy coherence, and a governance framework aiming at transition, which is needed to overcome barriers for change, in the form of so-called "path-dependencies". The IPESFood describe what is understood as lock-ins in the current food system, in the form of policies, technologies, infrastructure, power concentration and market mechanisms reinforcing each other in favouring specialised mass-production of cheap and abundant calories with little consideration for the negative externalities. Such factors determine to a large degree the most likely pathways for FS development as long as current power relations based on market forces and concentration of food industry and retail remain. These actors– according to the report – strongly influence the innovation and uptake of new technologies in support of large-scale, specialised food production and processing. According to iPESfood, to overcome lock-ins and path dependency there is a need for integrated policies addressing the whole FS. Moreover, the report finds that supporting diversity of actors in local and regional initiatives, including so-called local food systems, may provide alternative pathways and contribute to breaking out of the lock-ins. This overall understanding of the relation between dominant and alternative (niche) regimes is supported conceptually by Gaitán-Cremaschi et al., 2018).

Thus, from this perspective, a FS Obs would require data to document policy coherence, indicators for transition and alternative pathways that "break" lock-ins and power structures in food systems.

For decades, other NGO reports have documented negative consequences of current food systems on animal welfare, non-communicable diseases, climate, environment and social costs. Substantiation of these claims and the monitoring of progress would again point to the need for a FS Obs allowing for integrated assessments of these FS interactions and their outcomes. Recent reports from a - self claimed - youth activist movement challenging the current food system point to the negative role of certain large and dominant food companies in promoting the consumption of unhealthy convenience food and beverage products. According to this report, these products are too high in fat, sugar and salt, rely on ultra-

processing production formats, and are too high in energy content for fitting in healthy, balanced diets (Bite Back, 2024). However, the youth group – supported by researchers – find that these products are designed and marketed with the effect of sustaining too high consumption, which is a view shared by the Food, diet and obesity committed of the UK House of Lords (House of Lords, 2024). The same youth group used the selected large companies' own reporting of climate emissions under scope 1-3 to analyse the total climatic impact of their production vis-à-vis various targets. These initiatives are inspirational in terms of how data on large food manufacturers may be relevant to a FS Obs when it comes to documenting interactions in the food system and interdependencies in food systems outcomes. Also, this confirms the need for assessments that goes beyond presenting mono-thematic data or indicators.

The research community

From a scientific perspective, a main research focus is on the bilateral relationship between secure, and healthier diets/consumer choices versus sustainable production. This includes the question of whether there are synergies between these objectives, and whether trade-offs can be avoided. This is covered in several papers mentioned in section 5.1. Also this includes the research question to what extent alternative production forms, or food systems may improve overall sustainability and food sovereignty (e.g. Springmann et al 2016, 2018; Perignon et al., 2017; Vaarst et al, 2018; Bené et al., 2019;; Willet et al., 2019; Romanello et al 2024). The main hypothesis behind this vast amount of literature is that normative assumptions regarding changes in the current European and global diets may lead to nutritionally adequate diets with significantly less livestock products, and subsequent reduced GHG emissions (Vieux et al., 2018; Trolle et al 2022) and are within the earth's carrying capacity and other sustainability requirements.

Less focus is on how such relatively profound dietary changes can be achieved by voluntary consumer choices, whether it be due to market mechanisms or specific targeted food policies, and which specific interactions in a food system this would require. However, these ideas and challenges point to important demands to the content and usability of an FS Obs.

From another viewpoint, there is increasing focus on how climate change will impact – the options for and availability of – healthy diets, how food systems may change, and how it affects their degree of resilience (Romanello et al., 2024). Thus, a FS Obs may also be relevant for following the responses across food system elements to climate change, and to access how extreme climatic events over longer periods impact specific crop production. Such impacts may include availability and prices of certain crop products, changes in processed food and ultimately in diets of different consumer groups. A current example is the challenges in sustaining the production and supply of cocoa from west African countries due to climate stress. According to news agencies, leading chocolate producers need to look for alternative raw material (Reuters, 2024; Food Manufacture, 2025).

Moreover, a relevant scientific debate argues whether so-called "real-cost pricing" (Braun and Hendriks, 2023; Seidel et al., 2023), labelling (Asiolia et al, 2020; Grunert et al., 2014.), and information campaigns (Piracci et al., 2023; Kraak & Aschemann-Witzel, 2024) may change consumer behaviour towards healthier as well as more sustainable food choices. Such choices include animal welfare, climate mitigation, biodiversity, soil health, and responsible aquaculture/fisheries. Thus, besides requiring a long list of indicators building on multiple data sets to describe main-stream and alternative food systems and their outcomes, this approach would also need a FS Obs capable to demonstrate or interpret possible interdependencies in outcomes building on linkages between actors (Béné et al., 2019).

Overall, the stakeholder analysis confirms that from the scientific community point of view, a FS Obs should take a SFS approach as defined by UNEP, FAO, UNDP (2023). This means that the delineation and choice of themes and data should cover all relevant elements in the chosen food system as defined in Chapter 3. This includes considering the interconnections and trade-offs among the different elements of food systems, as well as their diverse actors, activities, drivers and outcomes. Moreover, the FS Obs should be able to support assessments of societal outcomes across environmental, social and economic dimensions. Besides, an FS Obs need also to present – and allow linkages to – the policies implemented at the scales relevant to the food systems in focus. This ought to consider "driving forces" - e.g. agricultural support schemes; dietary campaigns - and the "response elements" hereunder environmental and climate regulation in a

DPSIR framework. This overall objective, focus, content and function of a FS Obs was confirmed by the focus groups and the stakeholder workshop reported in 5.3 and 5.4.

6.2. Recommendations for main focus areas in a FS Obs: Data needs for assessment of transition to "healthy sustainable diets".

The importance of defining a clear and transparent purpose and aim for a new FS Obs was one of the major outcomes of the Focus groups and the Budapest workshop (section 5.3, 5.4). Overall, recommendations from the workshop are that from a governance point of view, developing a new FS Obs should include four steps: (1) define the overall aim and strategy, and formulate the pertinent questions that the FS Obs should be able to answer; (2) observe and analyse existing data sources, then choose and collect indicators that together have an added value compared to existing databases/observatories; (3) analyse the interactions and interdependencies within the food system, that address the pertinent questions to be asked, using the indicators and based on a a modelling approach; (4) report results based on the interpretation of indicators e.g. in the form of consolidated reports (see 6.3).

Overall aim and defining the boundaries and elements of the Food Systems in a FS Obs

The stakeholder's needs for and possible use of a FS Obs, as elaborated in section 6.1, together represent a starting point to the define overall FS Obs aim and strategy. In short the stakeholder needs includes: 1) deliver on visions on the future of European food systems from policy makers; 2) create transparency of FS data relevant to track the transition in the commercial food sector, 3) address clear societal needs and targets as defined by NGOs, and 4) enable and address pertinent research questions from the scientific community.

Recognizing these needs, a next step for the establishment of an FS Obs in response to the required needs as described above, is to define the elements and system boundaries of the food system to be represented by the data. Starting with boundaries, the first boundary that comes to mind is indeed the physical/geographical boundaries. Several of the existing observatories in Table 5.2.1 have clear geographic focus, ie. SUSFANS and JRC EU food system with a European focus, and Cities 2030 with regional cities as their geographic domain. Even though the geographic boundaries of these observatories are sharp, they maintain their holistic character because the relevant thematic dimensions – environment, economic, social, and governance - feed into the indicators of the FS Obs (see e.g. Tóth et al 2024).

With respect to a future FS Obs to be developed in the FutureFoods consortium, we anticipate that the geographic focus also will be Europe, with a view also to functionalities and data at national scale. However, we recommend that for certain proposed themes and assessments (see below) data may be integrated into the FS OBS at other scales, e.g. regional-, city-, or other local levels. This would have true added value to the existing FS Obs that are typically homogeneously in their scale of data density at either country- or city level (see table 5.2.1, 5.2.2). Moreover, one of the important outcomes of the focus groups was that a thorough delineation of the "geographic boundary conditions" of the food system - quantification of food mass, calories, nutrient content, and economic import/export value – is crucial. For instance, the import of fish and livestock fodder into Europe vs. the export of meat products represent major contributors to economic value streams and nutrient balance. While the economic data of food import- and export are very well covered in for example FAO and trade union databases, the nutrient flow and underlying carbon footprint of imported/exported foodstuffs cannot be directly observed from databases and would be subject to data development or intermediate calculations as discussed by Tóth et al. (2024).

This type of conceptual FS model with geographical and administrative (national, regional) boundaries is a challenge to delineate in terms of comparable data sources, since primary production, processing, retail and consumption are not limited to the same, well-defined geographic or economic unit. Any delineation of a FS, which attempts to cover the food on consumers plates in a specific geographical area (European,

national, regional), would face the challenge of deciding how to account for imports and exports as well as (indirect) land and water use and related outcomes, because contemporary diets include products that are not produced in the same area as consumed. Besides these bio-physical, geographical scale discrepancies there will also be social and economic implications of European FS and FS transitions, which - according to at least some EU MS pledges and NGS should be accounted for (sect 6.1).

As described above, it is considered important that policies supporting the transition to sustainable food systems in Europe also recognize the environmental, climate and social impacts in other parts of the world. How to reflect this in a FS Obs is a challenge by itself.

Defining the FS elements

Once the outer scale boundaries and boundary conditions are defined, the next logical step is defining *the elements* (actors, transactions) to include in the conceptual model – and to be described by data representing the ontological systems view (sect. 3.1). Some observatories have explicitly documented the delineation of the elements included within their definition of a food system. Since the focus areas identified above from a sustainable diet perspective relate to outcomes in terms of dietary composition, land and resource use and environmental and climate impact, a FS model should include the elements of consumers and primary production as well as food handling. Obviously, the FS elements in between are relevant and as mentioned by Singh et al. (2023) and SAPEA (2020), there should be a stronger focus on the processing and retail elements and their role in shaping consumption and primary production. Linked to this are the input providers and logistics. Moreover, because an increasing part of food is consumed outside home and/or is based on processed food, the conceptual model must include the elements of preparation of convenience food and large-scale kitchens ("horeca" sector, workplace canteens and public institutions). Bock et al. (2022) provide a longer list of actor groups to potentially include in a FS model, which - besides confirming the above mentioned - suggest advisers, finance, and media.

Thus, with all these elements, there are a high number of interactions to account for, exchanges between the elements: flows of goods, capital/money and communication/ideas including feedback loops. These should -from a functional FS view- ideally be considered in the selection of data input for a FS obs. Important issues are linked to these interactions or influencing them. Such issues include power relations due to size, ownership and concentration of food and retail industry vs. primary producers and consumers as well as local food procurement.

Defining the relevant Outcomes

Parallel to delineating and populating a Food Systems model for the observatory, there is a need to negotiate and define which *outcomes* should be included in the FS Obs indicators, such as – but not limited to:

I. Environmental aspects (land use, climate impact, nutrient loads/eutrophication, water quality, pesticides use, biodiversity in agricultural landscapes)

II. socio-economic indicators (food prices, farmers income, consumer satisfaction, employment, empowerment and power balances, food security, food cultural heritage)

III. Indicators for dietary health (access to food, non-communicable diseases or food composition assumed linked to health outcomes).

While many of these outcomes are covered by one or more of the existing observatories shown in table 5.2.1 and 5.2.2, other aspects are less well documented, or data are not available. Though it may be tempting to define a minimum set of data for indicators of outcomes in the environmental, dietary health and socio-economics themes, we do not consider this the role of this report. Bock et al. (2022) suggest a set of indicators divided by sustainability dimensions as defined by SAPEA (2020). Here among are listed food security, safety & nutrition, environment, resilience, economic viability, fairness, inclusiveness, ethical, and crosscutting (i.e. investments in R&D and policy coherence).

However, several reports recognise significant data gaps for a full transparency and analysis of food systems, especially as regards food processing and retail and suggest that provision of data regarding

sustainability performance for a transparent system should be made mandatory for all relevant actors (SAPEA/SAM 2020; Bock et al., 2022). OECD analysed the availability of data related to – among others – the indicator sets developed under the SDGs and found that many important aspects under the responsibility of FAO were not reported sufficiently across countries globally including food losses, land area under sustainable agriculture and income of small-scale producers. Other indicators, hereunder freshwater withdrawal, food price anomalies and land cover, had a higher degree of reporting (Deconinck et al., 2021). In Europe, modelling studies have demonstrated that necessary dietary changes to reduce GHG emissions vary between European countries (Vieux et al, 2018). There is ongoing work on alignment of national nutrition surveillance, and more data exists on food consumption and diets at household level. Yet a harmonised data collection across MS is far from achieved (EC, 2025; Trolle at al., 2022).

Just as important as defining the specific FS outcomes in terms of indicators for dietary health, climate impact etc., the FS Obs should clarify and demonstrate how these outcomes are coupled through the activities of FS actors and, thus, become **interdependent** (Deconinck et al., 2021; Singh et al., 2023; SAPEA, 2020). This seems to be an added value which a new initiative could provide beyond the existing observatories (Table 5.2.1) – or building on some of these. This focus on FS development or transition, which is of particular interest from policy, industry and NGO perspectives (see Section 5.3 Focus groups and 6.1) would add a more dynamic element to FS Obs, thus including the "historic/genetic" FS view (Sect. 3.1, Figure 1).

For example, the broadly shared hypotheses (in literature, see 6.1) that climate impact of food production may be reduced by changing diets towards less consumption of animal products should be tested considering current FS transformations. Thus, a FS Obs could enable following such -potentially - interdependent developments and allow documentation of to what extent the data in the FS Obs support this hypothesis. This requires consistent data in terms of representing time and FS level (Deconinck et al., 2021).

Moreover, from a scientific perspective, the confluence of two or more statistical developments over time is not sufficient to prove a dependence (cause-effect relation). Therefore, the interdisciplinary data analysis should be based on transparent models (conceptual or mechanistic/mathematical), which may explain the connections between outcomes by an improved understanding of the dynamics of specific food systems. This again, requires **data, analysis and modelling** of the interactions between activities in the food system. The question is to which degree do, for example, the composition of food production in Europe, MS, or region depend on/react to changes in diets, either as average consumption or by consumer segments. If model empowered data demonstrate shifts in diets, one could ask the question whether this results in changes in price signals or regulation along the value chains. Also, one could investigate to what degree the composition of commodities changed in different nodes of the Food System.

Data availability and scale in existing FS Obs

The review of existing observatories (Chap 5.2) shows that most holistic FS Obs initiatives make data available at national levels. None of the holistic observatories focus on regional and city levels, notably Cities2030, while being a city-region initiative, still presents data aggregated at national level. While this demonstrates the challenges in providing data of sufficient quality covering comparable timelines and scale within a delineated food system, at the same time it is a good starting reference points as to how the food system can be approached at different scales. Also, it shows how this gives rise to different types of data, that can be mapped as methodologies how to uncover FS interrelationships at different scales in the FS.

With respect to the current state of data availability, the fishbowl session gave us clear feed-back on the data areas that are currently missing in existing data-hubs according to the participants (Appendix 5). The most important among those are food processing, profit margins, procurement, and circularity. A further thorough mapping and analysis of data included in the FS observatories that we identified in table 5.2.1 and 5.2.2 would provide a more detailed overview of the current data formats and indicators that are currently publicly available. Especially of relevance are the two observatories that are considered state of art, notably JRC EU Food System Monitoring Dashboard and the Food Systems Countdown Initiative (FSCI). Even though both are of true holistic character, inevitably choices were made both in the selection of indicators, and

their data- and visualization format. Such choices highlight their priorities and focus, but at the same time limit their scope and content. In our analysis, we found for example that several EU countries were missing in the FSCI observatory. Another example is that data visualization is often limited to single indicators, and limited to predefined pillars that does not allow for describing holistic system interactions (e.g. JRC EU Food Monitoring Dashboard). A further analysis from these to benchmark FS Obs's, and other data hubs will then further guide as to identify the data gaps that would need additional research and interactions with stakeholders.

The FS Obs data requirements and availability

We acknowledge that several of the observatories in section 5.2 already share visions and ambitions of accounting for entire food systems and many sustainability outcomes, but yet face limitations in their current data content. This probably reflects a dilemma between the ideal requirements for a comprehensive, holistic assessment of the sustainable food systems aspects and the current data availability – especially due to the need to be consistent across scales and time. To describe the FS elements in a holistic way, including their interactions and outcomes as described above, requires a very substantial set of data. Many of these data would be difficult to acquire in harmonized form across EU Member States.

In the next chapter 7.1 below, we present a summary of both existing data as found in FS Obs´s, together with a list of new candidate data that we suggest are relevant to address the questions and knowledge gaps that were identified in our workshops with stakeholders (Section 5.3, 5.4) and in our stakeholder analysis (6.1). In tables 7.1.1 to 7.1.4 we present a set data that we believe represent a comprehensive assessment of transition towards sustainable Food systems in Europe. Clearly from these tables , there are currently many major data gaps. However, this should not make discussion of the most relevant concept, functions and data needs for a future FS Obs futile.

A comprehensive EU "**Legislative framework for sustainable food systems"** that was foreseen as a major initiative of the Farm to Fork strategy for a sustainable food system, was not adopted during the previous commission as originally intended (EC, 2022). The draft text did include requirements for sustainability labelling for food products and reporting requirements by the food industry, which potentially could have contributed to an FS Obs. Nevertheless, other recent developments may lend optimism that more comprehensive data across the food systems may be made available in the future. Thus, the more than 50-year-old EU Farm Accountancy Data Network (FADN), will from 2025 develop into a FSDN. In this new approach, traditional economic farm accounts in statistically representative samples from EU MS, will be supplemented with more data on the sustainability aspects of primary production (EC, 2025a). Also, the EU Corporate Sustainability Reporting Directive (CSRD) will over time require all large companies and selected SMEs to report important aspects of their resource use and sustainability impact, by using common sector-specific European Sustainability Reporting Standards (ESRS), (EC, 2025b). While the deadline for companies' broad CSRD reporting was postponed by the EC and EP until 2026, and only GHG emission accounting is required from 2025, the CSRD/ESRS efforts may in time become a valuable source of information for assessments of data and crucial linkages across the food system. Moreover, a soil monitoring law is expected to be endorsed by MS. This will require substantial monitoring and reporting of soil health (EP, 2024), thus improving the data availability of a crucially important natural resource for the food system sustainability.

The understanding of the complexity of food systems also received an impulse from work done in the wider bioeconomy. The indicator sets as developed by the FAO, helped regional food systems to get insights in their bioeconomy – including food – systems in detailed manners. Based on their studies, national and regional strategies have been adapted. It is beyond the scope of this Deliverable to list all work done in the Bioeconomy area. However, we strongly recommend the future food Partnership to exchange with the Circular-BioBased Europe Joint Undertaking (CBE-JU) and the International Strategic Working Group on the Bioeconomy. Such cooperation can help to develop stakeholder- and context-specific indicator sets.

Data vs. indicators

So far, we have discussed the FS data, relevant and required for assessing and documenting food systems transitions towards sustainability objectives, with emphasis on data availability. However, there is a need to discuss how available data may be presented in terms of indicators as found in several of the existing observatories, notably the JRC and count down initiative as well as Susfans. Indicators may be considered as selected, pre-digested data that are aggregated across several datasets. They may represent a status or development vis-à-vis specific objectives or outcomes, which are considered relevant and important from a policy objective, or an economic-, social- or ethical interest (FAO, 1997; EEA, 2025).

The selection of indicators is a long process building on an expertise on its own. This is especially the case for aggregated and composite indicators (JRC, 2023), combining and weighing multiple data sets. It will be of high importance to map and document data- and indicator transparency, which is notably true for selection and documentation of aggregating FS indicators. A good example for a thorough documentation of indicators is found in the report by JRC EU Food System Monitoring Dashboard (Toth et al 2024). In this report, we will not go beyond the question of the data requirements and assessment needs. But while our review of existing observatories provided ample examples of indicators (Chapter 5), it is important to note here that the process for selection and aggregating of data was not always transparent or well-documented.

Another question of relevance for the data requirements is how to present FS climate and environmental impact. This can be done either 1) separately by each part of the food system and aggregated over farming systems, or 2) per produced unit aggregated across the value chain. The latter approach would require LCA assessments of multiple individual foods and aggregation for specific diets (Mogensen et al., 2009; Deconinck et al., 2021; Trolle et al,2022; Furrer et al., 2024), which would be relevant to access whether healthier diets become more environmentally sustainable over time. While these data may not be available now, they may become gradually more available from the commercial sector: as demonstrated by examples in our stakeholder analysis (Section 6.1), food companies increasingly claim sustainability and climate goals, which will require documentation on product level. Therefore, LCA-based data on trends in environmental- and climate footprint may soon be included in FS Obs (Sunesson et al., 2010).

The use of conceptual models in FS Obs

The above sections describe different stages from definition and formulation of FS Obs overall aim, the boundaries, elements, and relevant outcomes, as well as choice of data and indicators. A further step on this scale could be to include simulation- and visualisation of interactive, data-driven models as an embedded, integrated part of the FS Obs. The choice of model is open, as this could be LCA models, DPSIR conceptual models, but also statistical models. The purpose of this would be to explicitly visualize the FS systems transition approach and show the interactions between underlying FS elements. An inclusion of models in the FS Obs would serve several purposes, such as research-, educational- as well as communicative purposes. The strength and impact of the models to FS Obs users is to study and integrate current knowledge, visualize interactions and feed-back loops, and study future scenarios with different outcomes depending on the system boundary conditions, certain economic or policy changes, and so forth.

6.3. Recommendations for consolidated assessments: Which stories should an FS Obs tell?

Input from stakeholders and the literature above suggests that an FS Obs not solely should present data on the activities and outcomes of the European food systems. Some observatories reviewed (5.2) transform data into “indicators”, chosen to describe the state of important outcomes or activities as interpreted from policy objectives or normative sustainability criteria. The Observatories vary in how explicit the process of selecting indicators is described. Thus, in addition to selected indicators, we recommend that the FS Obs should include consolidated reports focusing on specific questions and challenges considering long-term FS

Funded by
the European Union

transition objectives. The EU HLEG suggests producing rigorous science-based assessments at different scales with interpretations and recommendations for policy pathways (DG Research, 2022). Bock et al. (2022) suggests developing a "Sustainability assessment dashboard", which has been published recently by JRC (EU Food System Monitoring Dashboard). However, so far this was done with little verbal interpretation or consolidated assessment reports. The enormous complex aspects of Food Systems as mentioned several times include interactions between actors, interdependencies between outcomes, reinforcing feed-back loops, leverage points or hindering factors (lock-ins, blockings, pathway dependency). Due to this complexity in the assessment of pathways to a sustainable transition, we suggest this should be subject to dedicated expert analyses in the form of consolidated assessments. Such analyses may also involve use of conceptual models, DPSIR approach and/or semi-quantitative models demonstrating outcomes and consequences across a FS.

An excellent example of consolidated reports is the EEA environmental outlook. For decades, EEA has given consolidated reports on specific environmental challenges vis-à-vis EU policy objectives and their implementation at national and regional levels (ref). Besides overall assessments of the development based on a set of environmental indicators vis-à-vis EU contemporary and future policy targets, the Environment state and outlook report (EEA, 2019) provides in-depth analysis of 10 specific topics such as biodiversity & nature; land & soil; Marine environment and Air pollution. The sections include overview of policy targets compared to data supported analyses of trends and challenging pressures and impacts as well as state indicators using a DPSIR approach (see 3.1). Using a systems lens the report suggests how on the one hand environmental objectives cannot be pursued in isolation from broader sustainability objectives and on the other hand, how such goals are linked. Thus, focus needs to be also on the interactions between activities in pursuit of the different objectives. This is also the case from a food systems perspective, and reinforces the requirements for accounting for interactions in food systems activities and policies when analysing and explaining the interdependent outcomes. As indicated by the literature review (5.2) and knowledge needs assessment (5.4; 6.1) a wide set of consolidated assessments of European food systems would be relevant – and different narratives would be preferred by different stakeholders.

Assessing the transition to sustainable food systems under the dominant paradigm

The first selection could be focused on informing society in broad on the progress and state of the FS vis-à-vis specific national policies and EU agendas within the broad objectives of sustainable healthy diets. This should be linked with the global agendas as spearheaded by WHO/FAO/UNEP. An obvious example would be to follow how diets are changing, possibly towards healthier food, and to which degree this is linked with less climate- and environmental impact in other parts of the food system. Such a broad analysis would combine the data describing *the outcomes* in terms of environmental indicators on land use, climate impact (divided by land use, primary production etc.), nutrient loads, pesticides use, biodiversity, water quality; socio-economic indicators (food prices, farmers income, consumer satisfaction) and indicators for dietary health, hereunder non-communicable diseases or food composition that are assumed to be linked to health outcomes.

To interpret the interdependencies of the outcomes the analysis could attempt linking to data on *activities* of the actors/elements within the food system versus consumers diets (food group composition, nutritional aspects), eating outside home, retail, product diversity and development, plant based foods, healthy convenience food, unhealthy products/confectionary, processing, new plant based products, reducing added fat, sugar, use of resources (primary production, processing, ..), food waste generation and recycling, and data on retail and menus offered in large scale kitchens.

The main questions to be addressed are to which degree changes are ongoing, what are the reinforcing positive developments towards a sustainable healthy food system and are there activities and elements blocking certain sustainable outcomes. This type of overall, generic assessment will be challenging in terms of ensuring access to necessary data across the selected food system, which are comparable in time serious and scale (6.2). Obviously, caution should be taken to avoid simplistic interpretation of cause-effect relations, and the analysis could initially focus on relations that were previously documented or discussed in the literature (Section 5.1 and 6.1), and those that are anticipated as a basis for implemented policies.

As mentioned, few studies have so far reported in-depth data-based assessments of interactions between actors and the linked outcomes of specific food systems. Literature cited above either stipulate conceptual/potential correlations between changing diets and reduced climate impact from primary production. Alternatively, the literature interprets relations between diets (e.g. meat consumption) and land use and climatic impact of agriculture, as documented by large scale data. Our hypothesis behind a FS Obs in this context is the following: the data representing elements across food systems at European scale but with key data available at regional and national levels such as FADN/FSDN (EC, 2025), would facilitate improved understanding of how the actors/elements interact in positive and/or negative feed-back loops. In other words, we should be able to understand where changes in production, marketing and consumption reinforce each other towards achieving goals of sustainable healthy diets. Or alternatively, where do lock-ins or negative feed-backs in the food system hinder such change, and block a positive impact of policy or commercial initiatives? One main objective is to identify potential leverage points (Meadows, 1999; Fischer & Riechers, 2018), where such interventions would create positive feed-back loops, and to understand better which elements may reduce or block developments towards sustainable healthy food. A related perspective is the pertinent challenge of the resilience and adaptation abilities of food systems towards the inevitable future climate changes or future pandemics (Vittuari et al., 2021) or other shocks creating large-scale impacts (Tendall et al., 2015; Ujjwal et al., 2024). As reviewed by Ujjwal et al. (2024) this concept requires further work to assess on specific scales, especially as regards national, regional and city-region levels.

The alternative FS narratives

Focusing on hard, quantitative data series may not cover sufficiently broad aspects compared with aims/objectives from civil society, NGOs, and some policy makers. These actors may wish to include aspects of food sovereignty/access and power structures, as well as an understanding of the role of the food environment in reinforcing or blocking change (see Section 6.1). For such aspects such as food sovereignty, it may be relevant to use additional data as ad-hoc qualitative data. One example is social innovation processes in innovation hubs and living labs (LL), which has been supported by the FOOD2030 programs and in the future via FutureFoodS partnerships LL hub. With their local or regional focus, FS LLs may focus on improved involvement and integration of all relevant stakeholders in the local food system including consumers (citizens, local institutions, schools, hospitals), local food producers, politicians, and NGOs (Vittuari et al., 2021; see also Repository of examples on Cleverfood - Food2030).

One idea of the LL hub would be to record a set of “standard data” from a range of supported FS LLs that could be used for a wider assessment of the role of LLs in FS transition. By analyzing which sustainability challenges and success criteria they focus on, and how they address systemic interactions to implement innovations, the “standard data” can be used as a template for improved FS performance. The data recorded in this LL context could include the number and type of FS elements and actor types involved, the interactions covered, the implemented innovations that the LLs implement, and how successful the LL's consider their results. This will then be starting point to access to what extent these outcomes are transferable to other regions, so that they may lead to large scale food systems transition.

As to underline this: this perspective is supported by the NGO initiatives iPESFood, 2019, Foodpolicycoalition, 2023, and the iPESFood report (Section 6.1). The NGO´s argue that initiatives for a joint European food policy/law should support “systematic coordination, practice sharing and learning at EU level on local and territorial food initiatives, including urban and regional food policies”.

Other types of specific assessments might focus on e.g. how technological innovations impact the food industry. Such innovation including food processing, new types of raw materials from crop diversification, recycling of residues, cell-based food or precision fermentation. Also, how these innovations impact other parts of the food system, such as land use and production in primary sector, consumer satisfaction, food prices, and dietary climate impact.

Besides the mentioned examples of food systems transition analyses relevant across most stakeholder groups, other issues are more specific and relate to challenges and values specifically by e.g. NGOs and segments of food systems building on alternative approaches. Examples of this, are proponents of local

food systems and alternative food systems building on specific practices from primary production to processing to consumers/large kitchens. Some are labelled - as for example the organic food industry - while others represent ideas and communities that are not labelled such as Agroecological FS (Vaarst et al.; 2018; Anderson et al., 2019; 2021) and currently also regenerative food (Newton et al., 2020; see also 6.1).

Vaarst et al. (2018) propose exploring how food systems based in agroecological practices and principles may improve the integration of agriculture and food provisioning by shorter supply chains. This would also include recycling of municipal waste and improved dialogue and understanding between the actors (farmers, consumers, intermediaries). Section 6.1 refers to alternative views on the future food systems from a large group of NGOs proposing that organic and local foods should play a significant role in ensuring safe and sustainable diets and food sovereignty. The iPESFood report stresses that while Agroecology in many contexts have been seen as a set of discrete technologies, it should rather be considered a systemic alternative as part of a food systems transition (iPESFood, 2018). From this perspective, the ideas of promoting Local FS and a City-region FS approach as part of a more diverse set of parallel or interweaved European Food systems, calls for a set of targeted assessments. These assessments may be part of the overall FS Obs and their consolidated reports, but it might also require a different and separate approach to consciously assess the importance, role, and perspectives of these alternative localized pathways.

Thus, a FS Obs should not focus on the dominant regime only, but also be instrumental in supporting and leveraging a diversity of development pathways and objectives for FS transition (Anderson et al., 2019; Gaitán-Cremaschi et al., 2021). In this respect, the choice of focus in data and indicators included in a FS Obs, and the choice of narratives to assess in the form of consolidated reports, may become part of a competition between different discourse (Howarth, 2010). This discourse has characterized the debate of sustainable agriculture and food at least since the Brundtland report on sustainable development in 1988 (Halberg 2012; Knorr and Augustin, 2021).

As reviewed by Halberg et al. (2015), approaches to sustainable agricultural development that are more or less integrated in a FS approach are manifold: e.g. sustainable intensification, organic agriculture and organic food, agroecology (see Vaarst et al., 2018). The different approaches express "*different discourses competing for hegemony"* (Howarth, 2010). In other words, they all claim to be the "right" development pathway for agriculture, and they all want to gain political and economic support in the form of development funding, research and innovation funding, and subsidies. Thus, when comparing the proposed pathways towards SFS between the industry and NGOs as presented in sect 6.1, it appears that they seek to promote very different solutions, which are to some degree incommensurable. Since the stories they tell vary, the solutions do not include the same type of changes or success criteria – and therefore not always point to the same indicators of data for a FS Obs. For example, the lock-ins mentioned by in the NGO iPESFood report, to some extent point to FS actors and solutions represented by the food industry as represented by EIT food. As another example, the solutions proposed by the FoodPolicyCoalition is contradicting the mainstream pathways, thus requiring different data and indicators for monitoring progress in a FS Obs (Gaitán-Cremaschi et al., 2021). In a similar approach, Knorr and Augustin (2021) provides an overview of the different ways the sustainability of FS has been framed. Thus, they conclude that a diversity of interests has led to different definitions, requiring more work to understand how a unified definition may recognize how central FS challenges are viewed through various stakeholder lenses.

Therefore, the final choice of data and topics for consolidated reports assessing sustainable food systems transition cannot claim neutrality but should be based on stakeholder dialogues and transparency. With regard to the processes and the framings chosen, this requires utmost transparency and scientific integrity (Turnhourt et al., 2021; Waylen et al., 2023).

The consolidated reports may be seen as a type of science advice – for policy makers as well as other stakeholders (D6.1; Turnhout et al., 2019; Heinzelin et al. , 2023). Hence, it needs to undergo a transparent process including rigid quality assurance and follow principles ensuring integrity as discussed in FOODPathS D.6.1 (Chp5). A FS Obs capable of producing this type of consolidated reports needs a governance structure (not to speak of funding), the organisation of which is beyond this deliverable. The above-mentioned topics for Food Systems analysis are indicative of pertinent topics starting from literature (scientific, political,

NGOs) and should be defined within the FS Obs governance in consultative processes with a range of stakeholders. Some of the proposed topics, e.g. on power relations, food sovereignty or the impact of new processing technologies, may require specific, research initiatives. This is especially the case when data will not be available on a wider scale matching the national or European delineation of food systems. Such analyses should still be within a FS approach, and accounting for interactions and interdependencies in the sub-system in focus as explained above. Therefore, they could be dedicated projects under a FS Obs structure.

7. Concluding chapter

7.1. Qualitative review of FS Obs data coverage

According to Béné et al (2024), building a food system observatory is a 10-step process, including involvement of stakeholders, listing indicators, and developing narratives around data and indicators, to better facilitate dissemination of information. In the above section, we have provided a starting point for this. However, another important part of building a FS Obs, is choosing or developing indicators for data collection. This process should, according to Béné et al (2024), be done in collaboration with stakeholders. Given the scope of this paper, we have not begun to develop indicators. Instead, we have carried out a qualitative review of the data and indicators present in the nine currently established observatories from table 5.2.1. This was done by mapping the amounts of indicators and variables available for each observatory onto the three sustainability spheres, as well as governance and resilience (See appendix 6). Here in this concluding chapter, we make a qualitative assessment and overview of, how well these existing observatories cover the four thematic research and development areas identified in the SRIA for the FutureFoodS partnership, as key for driving change:

- *1. Change the way we eat,*
- *2. Change the way we process and supply food,*
- *3. Change the way we connect in the food system, and*
- *4. Change the way we govern the food system (SRIA 2023).*

Based on the input from experts in 5.3 and 5.4 and the data needs for a FS Obs identified in sec 6.1 and 6.2 the tables below propose a wide set of data and indicators. We compared these with the data available in the existing observatories as reviewed in sect 5.2.

For each thematic area, the key actors, phenomena, indicators, and variables were extracted, and compared to variables and indicators in existing observatories. Thus, the following tables includes both variables and/or indicators found in the existing observatories, as well as those identified in the SRIA (2023). Moreover, the tables demonstrate data needed with no indication of unit or scale in order not to complicate them further. The specific data should be assigned unit, proportion, scale according to availability and the specific purpose. The following review is non-exhaustive.

Table 7.1.1 shows the coverage of thematic area 1 *Change the way we eat*. It should be noted that when it comes to consumers, such things as diet related health, and economic factors related to food (i.e. food insecurity), are relatively well covered. However, when it comes to consumer behaviours and skills, such as food literacy, purchasing patterns, and food wasted in the home, little or no data is currently available. This is not surprising, as data on consumer behaviour is collected through self-reported surveys, such as food intake diaries, that are often resource intensive. However, some measures were available in the FAO observatory, that has recently launched several consumer surveys to supplement their data. With respect to retailers, no data was found pertaining to food environments in stores, and as will become apparent, data on retailers and wholesalers were sparse.

Table 7.1.1 Coverage of thematic area 1 for the nine holistic observatories from table 5.2.1

THEMATIC AREA 1: CHANGE THE WAY WE EAT			Covered by Existing Observatories*
Consumers			
	Dietary patterns		
		Use of convenience/take away	+
		Intake of ultra processed foods[12]	-

[12] Ultra processed foods are becoming more available and are linked to adverse health outcomes; Ravandi, *et al.* (2025) Prevalence of processed foods in major US grocery stores. *Nat Food*. https://doi.org/10.1038/s43016-024-01095-7

Funded by the European Union

THEMATIC AREA 1: CHANGE THE WAY WE EAT			Covered by Existing Observatories*
		Intake of Organic products	-
		Dietary preferences	+
		Adherence to dietary guidelines	-
		Cooking at home	+
		Meals consumed out of home	+
		Skipping meals	-
	Food Literacy		
		Cooking skills; shopping skills; undestanding of labels;	-
	Capabilities and affordances when it comes to food behaviour		-
	Purchasing patterns		-
		Pct food products in season	-
		Pct food from (local) region	-
		Food miles	-
		Pct food from supermarkets vs local markets, speciality shops etc.	-
		Pct food with certified labels climate, sustainability, organic	-
		Pct livestock products under certified welfare label	-
		Pct using box schemes	-
	Diet related health		
		Nutritional makeup	+
		Diet related health	++
		Obesity and other non-communicable diseases	+++
	Food waste and recovery		-
	Link between dietary preferences and sustainability		++
	Economic factors		
		Pct food insecure	++
		Expenditure on food	+
		Cost of healthy diet	+
		Using food banks or community kitchens	-
		Low income paid school lunches	-
Retailers			
	Labelling		-
		pct processed food w official health labels	-
	Store Environments		-
		Pct processed foods available[9]	-

*Notes: *Qualitative measure of if/how well the thematic area is covered in the current observatories. +Included only in one observatory or measured only by one variable/indicator. ++Included in more than one observatory or measured by more than one variable. +++Covered well, both across observatories and with multiple indicators. - Not covered.*

When it comes to thematic area 2. *Change the way we process and supply food* (table 7.1.2), it is apparent that the agricultural side of production is moderately well to very well covered across areas like emissions, production and economic impact. We found a few notable exceptions on biodiversity, animal welfare, food waste and employment, as well as horticultural farming. However, for areas such as processing, transport and retail, little to no data is available, aside from economic measures. At least in Europe, this divide can be explained by the more stringent reporting regulations for farms receiving EU support, compared to

other actors in the system. Finally, the more social aspects of processing and supplying food are also missing.

Table 7.1.2 Coverage of thematic area 2 for the nine holistic observatories from table 5.2.1

THEMATIC AREA 2: CHANGE THE WAY WE PROCESS AND SUPPLY FOOD			Covered by Existing Observatories*
Environmental impact			
	Agriculture		
		pesticides	+++
		nutrient load	+++
		soil health	+++
		biodiversity	+
		GHG	+++
		Water usage	+
		Energy	+
		Use of antibiotics/antimicrobials in husbandry	+
		Food loss and waste	+
		Recycling organic waste	-
		Food recovery[13]	-
		Food reuse[15]	-
	Processing		
		GHG	+
		Water usage	-
		Biodiversity	-
		Energy	-
		Food loss and waste	+
		Food reuse	-
		Food recovery	-
		Recycling or upcycling side streams and waste	-
		Pct companies reporting according to CSDR/ESRS standards	-
	Wholesale and retail		
		GHG	-
		Energy	-
		Food loss and waste	-
		Food reuse	
		Food recovery	-
	Transport		
		GHG	+
		Energy	+
		Food loss and waste	-
Production			
	Agricultural		
		Average farm size	++

[13] According to the EC 2030 priority goal to reduce food waste, Food reuse is the reuse of edible food waste (surplus) for human consumption through redistribution or repurposing it as animal feed. Food recovery is using food waste in energy production, such as incineration or Anaerobic Digestion.

THEMATIC AREA 2: CHANGE THE WAY WE PROCESS AND SUPPLY FOOD				Covered by Existing Observatories*
		area		++
		amounts		++
		yields		+++
		degree of specialisation/crop rotations		++
		mixed farming		++
		organic/alternative farming		++
		regenerative		+
		Horticultural production		+
		Animal welfare		-
			Pct animals with outdoor access	-
			Pct farms under welfare schemes, certified	-
	Processing			
		pct food processed		+
		pct products with high SSF content		-
		plant based meat replacements		-
		in-vitro and precision fermented food		-
		pct companies with procurement policies…		-
Wholesale and Retail				
	Promotions			-
	Sales by product/product category			+
		Pct product sold under certified climate or sustainability labels		-
		Pct livestock products with certified animal welfare label		-
		Pct food with certified health label		-
		Pct Convenience food (confectionary) high in SFS and energy dense		-
		Pct Convenience foods for health meals		-
		Sales of pulses, vegetables, fruits		+
		Diversity in vegetables		-
		Origins of seasonal product throughout the year		-
Economic Impact				
		Price Indices		+++
		True cost versus actual cost		+
		Income distribution		++
		Trade		+++
	Agriculture			
		Size and ownership of farms		++
		Average income (farmers)		+
		Employees		++
			Relationship to owner	+
			Pct under age of 18	-
			Gender	+
			Pct migrant[4] workers	-
			Pct short term/ zero hour contracts	-

THEMATIC AREA 2: CHANGE THE WAY WE PROCESS AND SUPPLY FOOD				Covered by Existing Observatories*
			Wages	+
	Processing			
		Size and ownership of company		-
		Employees		-
			Pct under age of 18	-
			Gender	-
			Pct migrant[14] workers	-
			Pct short term/ zero hour contracts	-
		Pct market share Overall per product category		-
		Wages		
	Wholesale and Retail			-
		Size and ownership of retailers		-
		Employees		-
			Pct under age of 18	-
			Gender	-
			Pct migrant[4] workers	-
			Pct short term/ zero hour contracts	-
		Pct market shares		-
		Wages		-
Social impacts				
	Access to social protections			+
	Democratic rights			-

*Notes: *Qualitative measure of if/how well the thematic area is covered in the current observatories. +Included only in one observatory or measured only by one variable/indicator. ++Included in more than one observatory or measured by more than one variable. +++Covered well, both across observatories and with multiple indicators. - Not covered.*

Area 3. *Change the way we connect in the food system*, is not covered well. Little is known about, how consumers connect with the food system, aside from a measure of trust, and digitalization is measured only sparingly, either using access to the internet as a proxy, or using a digital intensity index. No other measures are mentioned in the observatories.

Table 7.1.3 Coverage of thematic area 3 for the nine holistic observatories from table 5.2.1

THEMATIC AREA 3: CHANGE THE WAY WE CONNECT TO THE FOOD SYSTEM			Covered by Existing Observatories[1*]
Consumers			
	Trust in the food system		+
		Consumer trust in government to enforce food safety	+
		Consumer trust in producers	-
		Consumer trust in labels	-

[14] It should be noted that the term migrant, refers to the dictionary definition of a migrant worker, as a person who moves temporarily or permanently to find work, **not** as the colloquial/political term for refugees and asylum seekers fleeing violence, disasters and persecution.

Funded by the European Union

THEMATIC AREA 3: CHANGE THE WAY WE CONNECT TO THE FOOD SYSTEM			Covered by Existing Observatories[1*]
	Consumer choices		-
		Willingness to pay for climate, sustainability, or welfare labels	-
		Willingness/intention to convert to more plant-based diets	-
		Willingness to eat novel foods (i.e. insect proteins)	-
	Consumer engagement in		
		Food policy	-
		Product development	-
		Citizen led food initiatives (i.e. urban farming)	-
Digitalisation			
	Digital intensity Index		+
	Access to broadband		+
	Digital transparency labels (and use)		-
	Digital/SoMe marketing (including use of influencers etc.)		-
	Consumers using online supermarkets		-

*Notes: *Qualitative measure of if/how well the thematic area is covered in the current observatories. +Included only in one observatory or measured only by one variable/indicator. ++Included in more than one observatory or measured by more than one variable. +++Covered well, both across observatories and with multiple indicators. - Not covered.*

Table 7.1.4 shows how well the existing observatories cover the area "Change the way we govern food systems". Most observatories included some form of overview or repository of policies related to the food system, but they were only very sparingly included as measures in the digital dashboards. Furthermore, the question of power (im-)balances was never an overt part of indicators, although a few observatories included some proxies. Generally, the question of governance is one that seems to require more development and is another area where the social and political sciences should be utilized.

Table 7.1.4 Coverage of thematic area 4 for the nine holistic observatories from table 5.2.1

THEMATIC AREA 4. CHANGE THE WAY WE GOVERN FOOD SYSTEMS		Covered by Existing Observatories[1*]
Policy		
	Degree of policy coherence across food systems	+
	Legal frameworks	+
	Policies regulating unhealthy foods (sugar, energy density, fats, salts , additives)	-
	Sugar and/or fat taxes	+
	Food Safety	+
	Marketing regulations and consumer protections (false marketing claims, health or green washing)	-
	Regulations on digital/SoMe marketing	-
	Regulations on marketing junk food to children	+
	Employment regulations for each sector	-
Power (im) balances		
	Market shares	-
	Lobbying activities	-
	Consumer protections (i.e. regulating health claims)	-
	Research spending	+
	Political stability and absence of violence	+
	Civil participation	+

THEMATIC AREA 4. CHANGE THE WAY WE GOVERN FOOD SYSTEMS		Covered by Existing Observatories[1*]
	Recognition of voices	+
	Labour practices	-

*Notes: *Qualitative measure of if/how well the thematic area is covered in the current observatories. +Included only in one observatory or measured only by one variable/indicator. ++Included in more than one observatory or measured by more than one variable. +++Covered well, both across observatories and with multiple indicators. - Not covered.*

Overall, it is very clear that most of the data and knowledge currently available on the food system is centred on farms and farming practices, apart from animal health and welfare. However, with the launch of the Partnership on Animal Health and Welfare in 2024, this is expected to change.

When it comes to consumers, some data is available, specifically around health status, but areas such as consumer behaviour are severely lacking. For Europe, however, a partnership with the EIT Consumer Observatory could be a step towards rectifying this.

More problematic is the lack of information and data on producers, wholesalers, and retailers, as they play a key role in the way food systems operate, thus they are important actors to engage in transformation. Further, for issues such as food waste and recovery, that occurs along the full food value chain, or power (im-)balances, these actors represent major players. But they are not the only actors missing. No data has been found pertaining to food provisions in hotels, restaurants, or cafes (HoReCa), despite being a significant contributor to countries GDP15, with the use of take away, among other convenience products, being on the rise among consumers[16]. However, it remains unclear, how FutureFoodS may gain access to more data on the private sector, but potential avenues to explore could be engaging them as stakeholders and looking into mandatory and optional reporting schemes, such as the WRAP Food Waste Reduction Roadmap, which includes self-reported data capture on food waste for retailers[17]. Further, there should be an emphasis on engaging NGOs, professional associations (i.e. farmers associations), and civil society associations (i.e. consumer councils), for insights into behaviours, interests, and phenomena related to different actors.

The analysis of data coverage further underlines the need for a more complex understanding of the food system. The more complex issues around non-environmental sustainability, such as power (im-)balances, equity, and access to social protections, are not covered within the observatories, and several aspects regarding governance and resilience need development. As mentioned, this may in part be due to low engagement with the social sciences. Also, the more complex issues often require resource-intensive methodologies to gather data.

7.2. Final concluding remarks

There is a need to further develop a concept and prototype for an FS Obs, which may enable comprehensive, holistic assessments of transition to sustainable healthy food systems in Europe and MS. A FS Obs should account for the main outcomes relevant under the objectives for a healthy, sustainable European food system and, importantly for how they are interdependent. This holds for mutually dependant interactions between the FS elements all the way from primary production, via processing and retail/large scale kitchens, to consumers as well as a large number of other functions.

A review of existing observatories identified important examples with a holistic food systems approach using available data on European and Global scale to develop mostly indicator-based assessments of food production, diets and environmental aspects. It appears that there is a need for further development of methods to account for specific characteristics inherent to a Food systems approach, notably the interdependencies between outcomes resulting from interactions between actors across the food system.

[15] https://horeca-online.com/the-horeca-sector-between-growth-and-innovation/
[16] https://www.cognitivemarketresearch.com/regional-analysis/europe-takeaway-food-market-report?srsltid=AfmBOopXRO_7HuJ4I6Wt0864JNYL1uX7naGbf4PMM7syctT0I4Q4LM5O
[17] https://www.wrap.ngo/taking-action/food-drink/initiatives/food-waste-reduction-roadmap

Moreover, data are lacking on important elements and activities of food systems, especially as regards food processing, retail, and out-of-home eating. Thus, the data hubs are yet missing the impact of actions and development in these FS areas regarding the transition to healthy sustainable diets. Therefore, systematic and critical assessments of policy initiatives and identification of leverage points, and implications of positive and negative feed backs and lock-ins for transition to sustainable and healthy food systems are significantly hampered. For other outcomes such as food sovereignty, power relations, resilience, among others, further conceptual and methodological development is required before inclusion in a FS Obs is possible.

Our results presented from focus groups, expert workshops, and a literature review all confirm a strong interest to continuously assess the transition towards sustainable food systems. The FS Obs data hub should be complemented by a governance, which allows and enables consolidated assessments of the FS transition pathways. It is, however, an additional challenge, that the visions for what this transition should look like and what role large scale industry-based FS vs. alternative FS should play will require a different focus, additional data and indicators to monitor FS transition. Therefore, the final choice of data and topics for consolidated reports assessing sustainable food systems transition cannot claim neutrality but should be based on stakeholder dialogues and transparency. With regard to the processes and the framings chosen, this requires utmost transparency and scientific integrity.

Nevertheless, continuous interdisciplinary and multi-stakeholder collaboration is recommended to further develop, delineate and parameterize a European FS Obs with a focus on broad user needs. Moreover, a FS Obs should include a facility – and governance – to produce consolidated assessment reports vis-à-vis national and EU (global) policy objectives for transition to a healthy sustainable food system, as well as for more specific objectives for alternative development pathways. The transition assessments should include, besides timeseries-based development of outcomes, an overviews of stakeholder initiatives, hereunder policies, NGO initiatives, industry initiatives, and R&I.

Funded by
the European Union

8. Appendices

8.1. Appendix 1. List of references

Authors	Title	Year	Publication	Publication type
Achterbosch, TJ et al	Synthesis of existing food systems studies and research projects in Europe	2019	EU Directorate-General for Research and Innovation; SCAR - Standing Committee on Agricultural Research	Policy brief / Policy report
Agyeman J et al	Trends and Directions in Environmental Justice: From Inequity to Everyday Life, Community, and Just Sustainabilities	2016	Annual Review of Environment and Resources. Vol 41	Research article
Allen, P	Realizing Justice in Local Food Systems	2010	Cambridge Journal of Regions, Economy and Society - 2010 vol. 3	Research article
ARLA	https://www.arla.com/sustainability/arlas-climate-ambition/	2025	Self-published	Corporate/NGO Strategy
Anderson, C.R et al.	From transition to Domains of Transformation: Getting sustainable and just food systems trough Agroecology	2019	Sustainability (11)	Research article
Anderson CR, Bruil J, Chappell MJ, Kiss C, Pimbert MP	Conceptualizing processes of agroecological transformations: from scaling to transition to transformation. I	2021	Agroecology now! Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-61315-0_3	Book Chapter
Arnold, R D; Wade, J P	A Definition of Systems Thinking: A Systems Approach	2015	Elsevier, Procedia Computer Science, vol 44, 2015	Research article
Aschemann-Witzel J., Jannsen M.	The role of policy actions to accelerate food consumer behaviour change	2022	Agric Econ, 10	Editorial / Comment / Viewpoint / opinion
Aschemann-Witzel J et al (A)	Tipping the next customer on the shoulder? A segmentation study and discussion of targeted marketing to further plant-rich dietary transition	2023	Cleaner and Responsible Consumption, Volume 11, December 2023, https://doi.org/10.1016/j.clrc.2023.100154	Research article
Aschemann-Witzel J et al (B)	Outside-in and bottom-up: Using sustainability transitions to understand the development phases of mainstreaming plant-based in the food sector in a meat and dairy focused economy	2023	Technological Forecasting & Social Change. Volume 197, December 2023	Research article
Aschemann-Witzel J., Schulze M.	Transitions to plant-based diets: the role of societal tipping points	2023	Current Opinion in Food Science	Review article
Asioli et al	Sustainability-Related Food Labels	2020	Annual Review of Resource Economics Volume 12	Review Article
Asseng, S et al	Wheat yield potential in controlled-environment vertical farms	2020	PNAS, vol 117, no. 32	Research article
Barling et al	Current trends in food retailing and consumption and key choices facing society	2009	*ESF/COST Forward Look on European Food Systems in a Changing World*	Research article
Béné C; Oosterveer P et. al	When food systems meet sustainability – Current narratives and implications for actions	2018	Elsevier, World Development, volume 113, januar 2019	Review article
Béné C; Prager S D et. al.	Understanding food systems drivers: A critical review of the literature	2019	Elsevier, Global Food Security, volume 23, 2019	Review article
Béné et al	Why building participatory dashboards is key for sustainable food system transformation.	2024	Front. Sustain. Food Syst. 8:1405670	Research article
Benedikter, R; Fathi, K	What is a Resilient Society?	2017	World News, 17. september 2017	Editorial / Comment / Viewpoint / opinion

Authors	Title	Year	Publication	Publication type
Berkum, S v: Dengerink, J; Ruben, R	The food systems approach: sustainable solutions for a sufficient supply of healthy food	2018	Wageningen University and Research, Wageningen Economic Research, Juni 2018	Policy brief / Policy report
Bhunnoo, Riaz	A food systems approach to policy for health and sustainability		Global Food Security	Policy brief / Policy report
Bite Back	Fuel us, don't fool us: Are food giants rigging the system against children's health? (Manufacturers).	2024	Report	Editorial / Comment / Viewpoint / opinion
Blay-Palmer et al.	Validating the City-Region Food Systems approach: Enacting Inclusive, Transformational City Region Food Systems	2018	Sustainability (10)	Research article
Bock AK et al	Concepts for a sustainable EU food system, EUR 30894 EN,	2022	Publications Office of the European Union, Luxembourg; ISBN 978-92-76-43727-7, doi:10.2760/381319, JRC126575.	Policy brief / Policy report
Bite Back	Fuel us, don't fool us: How far can we trust the food giants with planetary health?	2024	Report	Editorial / Comment / Viewpoint / opinion
Bizzo G et al	FOOD 2030. Research and Innovation – Pathways for action 2.0. Research and innovation policy as a driver for sustainable, healthy, climate-resilient and inclusive food systems	2023	DG Research Report	Policy brief / Policy report
Bornemann B, Weiland S (eds.)	New Perspectives on Food Democracy	2019	Politics and Governance, 2019, Volume 7, Issue 4	Book, thematic issue
Bradbear C, Friel S	Integrating climate change, food prices and population health	2013	Food Policy	Research article
Braun, J. von, AFS approachna, K., Fresco, L.O. et al	Food system concepts and definitions for science and political action	2021	Nature Food, vol 2, 2021	Research article
Braun, J., AFS approachna, K., Fresco, L.O., Hassan M.H.A. (eds.)	Science and Innovations for Food Systems Transformation	2023	UNFSS Scientific Group	Book, thematic issue
Brouwer et al.	Food systems everywhere: Improving relevance in practice	2020	Global Food Security Volume 26, 100398	Review article
Burgaz, C., Gorasso, V., Achten, W.M.J. et al	The effectiveness of food system policies to improve nutrition, nutrition-related inequalities and environmental sustainability: a scoping review	2023	Food Sec. 15, 1313–1344 (2023). https://doi.org/10.1007/s12571-023-01385-1	Review article
Campbell, MM et al	Reducing risks to food security from climate change	2016	Global Food Security, vol 11, https://doi.org/10.1016/j.gfs.2016.06.002	Research article
Carnohan et al	Next generation application of DPSIR for sustainable policy implementation	2023	Current Research in Environmental Sustainability Volume 5	Research Article
Chandler, C et al	Food systems: Research and innovation investment gap study	2023	European Commission, Directorate-General for Research and Innovation	Policy brief / Policy report
Chapman et al	5 Key Challenges and Solutions for Governing Complex Adaptive (Food) Systems	2017	Sustainability, 9(9), 1594; https://doi.org/10.3390/su9091594	Research Article
Chaudhary, A et al.	A. Multi-indicator sustainability assessment of global food systems.	2018	*Nat Commun* **9**, 848	Research Article
Clancy, K	The origins, definitions and differences among concepts that underlie food systems modeling	2022	In: Peters C, Thilmany D: Food systems modeling, chapter 2	Research article
Cedric et al	Interlinking environmental and food composition databases: An approach, potential and limitations	2024	Journal of Cleaner Production 470	Research article

Authors	Title	Year	Publication	Publication type
Conijn, JM et al	Can our global food system meet food demand within planetary boundaries?	2018	Agriculture, Ecosystems and Environment, Vol 251	Research article
Committee of the Regions	Towards a Sustainable EU Food Policy	2017	Towards a sustainable EU food policy | European Committee of the Regions	Policy brief
Cremaschi D G; Klerkx L et. al.	Characterizing diversity of food systems in view of sustainability transitions. A review referring to indicators and an illustrative example on FS in Chile	2018	Agronomy for Sustainable Development, vol. 39 - 1	Review article
Deconinck, K. et al.	Overcoming evidence gaps on food systems	2021	OECD Food, Agriculture and Fisheries Papers, No. 163, OECD Publishing, Paris, https://doi.org/10.1787/44ba7574-en.	Policy brief / Policy report
de Vries et al	Early economic recovery in fragile states: Priority areas and operational challenges	2009	*The Hague: Clingendael Institute*	Policy brief
de Vries et al	Sustainable food systems science based on physics' principles	2022	Trends in Food Science & Technology Volume 123, Pages 382-392	Review Article
den Boer ACL et al	Research and innovation as a catalyst for food system transformation	2021	Trends in Food Science & Technology, vol 107	Editorial / Comment / Viewpoint / opinion
DG Research	Everyone at the Table: Transforming food systems by connecting science, policy and society,	2022	Publications Office of the European Union, Luxembourg	Policy Report
Dijk, M van Lange, T de; Moghayer, S	Towards a modeling framework to support national and local food system transformation	2023	Third global foresight4food workshop, 8-8 March, Montpellier	Workshop / Project presentation
Donner M, Vries H de	Business models for sustainable food systems: a typology based on a literature review	2023	Front. Sustain. Food Syst, 7	Review Article
DIVERSIFOOD	9 Key-Concepts of Food Diversity	2017	Diversifood	Workshop / Project presentation
EASAC	Opportunities and challenges for research on food and nutrition security and agriculture in Europe	2017	EASAC Policy Report 34, december 2017	Policy brief / Policy report
E.C. Food Directorate-General for Research and Innovation, Lüth, D., Vandrich, J. and Fabbri, K.	*Urban food system transformation in the context of Food 2030 – Current practice & outlook towards 2030*	2023	Publications Office of the European Union, 2023, **https://data.europa.eu/doi/10.2777/507125**	Policy Report
EITFood	https://www.eitfood.eu/missions	2025	Selfpublished	Funder Strategy
El Bilali, H	Research on agro-food sustainability transitions: where are food security and nutrition?	2019	Food Security (2019) 11:559–577, https://doi.org/10.1007/s12571-019-00922-1	Review article
Ericksen, P.J.	Conceptualizing food systems for global enviromental change research	2008	Global environmental change, Vol 18	Research article
European Environment Agency (EEA)	Food in a green light. A systems approach to sustainable food	2017	European Environment Agency - report nr. 16, 2017	Policy brief / Policy report
European Environment Agency (EEA)	Europe's state of the environment 2020: change of direction urgently needed to face climate change challenges, reverse degradation and ensure future prosperity	2019	European Environment Agency - report	Policy report
European Environment Agency (EEA)	Indicators | European Environment Agency's home page	2025	European Commision	Own publication
EC 2025a	Corporate sustainability reporting - European Commission	2025	European commission	Own publication

Authors	Title	Year	Publication	Publication type
EC 2025b	Food-Based Dietary Guidelines - Guidance on sustainability | Knowledge for policy	2025	European commission	Own publication
European Union	FOOD 2030 Pathways for Action	2020	Publications Office of the European Commission, Directorate-General for Research and Innovation; ISBN 978-92-76-18121-7 doi:10.2777/104372	Policy brief / Policy report
European Union	Commission communication – A farm to fork strategy for a fair healthy and environmentally-friendly food system	2020	Publications Office of the European Commission, Directorate-General for Research and Innovation	Policy brief / Policy report
European Commission	Towards a sustainable food system: moving from food as a commodity to food as more of a common good	2020	Publications Office, Directorate-General for Research and Innovation, Group of Chief Scientific Advisors, DOI 10.2777/282386	Policy report / independent expert report
EP	**on Soil Monitoring and Resilience (Soil Monitoring Law)**	2024	European Commision	Policy Directive
Evain & Nairaud	Systèmes alimentaires durables - Le poids de l'offre et de la demande	2023	Ministère de l'Agriculture et de la Souveraineté alimentaire	Policy brief / Policy report
Fanzo, J. , McLaren R. et al	The Food Systems Dashboard is a new tool to inform better food policy.	2020	Nat Food 1, 243–246 (2020)	Editorial / Comment / Viewpoint / opinion
Fanzo, J. et al	Viewpoint: Rigorous monitoring is necessary to guide food system transformation in the countdown to the 2030 global goals	2021	Food Policy	Editorial / Comment / Viewpoint / opinion
FAO	Land Quality Indicators and Their Use in Sustainable Agriculture and Rural Development,	1997	Own publication	Own Publication
FAO	Plates, Pyramids, Planet - Developments in national healthy and sustainable dietary guidelines: a state of play assessment	2016	FAO, The Food Climate Research Network at The University of Oxford	Policy brief/ Policy Report
FAO	FAO's work on climate change. United Nations Climate Change Conference 2017	2017	FAO	Policy brief / Policy report
FAO	Sustainable Food Systems – Concept and Framework	2018	FAO	Policy brief / Policy report
FAO & WHO	Sustainable healthy diets – Guiding principles	2019	ISBN 978-92-5-131875-1 (FAO) ISBN 978-92-4-151664-8 (WHO)	Policy brief / Policy report
FAO	FAO Action Plan 2022–2025 for the implementation of the FAO Strategy on Climate Change	2023	FAO	Policy brief / Policy report
Foodpolicycoalition	OUR FOOD, OUR HEALTH, OUR PLANET	2023	Manifesto	Editorial Comment
Julien Fosse J et al	Pour une alimentation saine et durable - Rapport pour l'Assemblée nationale | France Stratégie	2021	fs-2021-rapport-pour_une_alimentation_saine_et_durable-septembre.pdf	Policy brief / Policy report
Foodpolicy coalition	Sustainable Food Systems Law. Policy recommendations for a meaningful transition	2023	WORKING SPACE - EU Food Policy Coalition SUSTAINABLE-FOOD-SYSTEMS-LAW-Recommendations-for-a-meaningful-transition.pdf	Policy brief
WHO	The state of food security and nutrition in the world 2022	2022	WHO, 6. juli 2022	Policy brief / Policy report
Floros et al	Feeding the world today and tomorrow: The importance of food science and technology	2010	Comprehensive Reviews in Food Science and Food Safety	Research article

Authors	Title	Year	Publication	Publication type
Fuchs, D; Kalfagianni, A; Havinga, T	Actors in private food governance: the legitimacy of retail standards and multistakeholder initiatives with civil society participation	2009	Agric Hum Values, vol 28, 2011	Research article
Furrer, C. et al.	Interlinking environmental and food composition databases: An approach, potential and limitations.	2024	Journal of Cleaner Production, (470)	Research article
Gaitán-Cremaschi, D. et al.	Chracterizing diversity of food systems in view of sustainability transitions, A review	2018	Agronomy for sustainable development	Research article
Garnett T	Three perspectives on sustainable food security: Efficiency, demand restraint, food system transformation. What role for life cycle assessment?	2014	Journal of Cleaner Production, Vol 73, https://doi.org/10.1016/j.jclepro.2013.07.045	Research article
Genevieve JM et al.	Environmental sustainability in national food-based dietary guidelines: a global review	2022	The Lancet Planetary Health, Volume 6, Issue 12, e977 - e986	Research article
Glennie C, Alkon A H	Food justice: Cultivating the field	2018	Environmental Research Letters, Vol 13 (7)	Research article
Godfray et al	The future of the global food system	2010	Philosophical Transactions of the Royal Society B: Biological Sciences	Research article
Goodman & Redclif	Refashioning nature: food, ecology and culture	1991	New Statesman & society	Research article
Grant F and Rossi L	The Italian Observatory on Food Surplus, Recovery, and Waste: The Development Process and Future Achievements.	2022	Front. Nutr. 8:787982.	
Grote, U	Can we improve global food security? A socio-economic and political perspective	2014	Food Security	Research article
Halberg, N; Westhoeck H	The added value of a Food Systems Approach in Research and Innovation	2019	European Commission, SCAR SWG Food Systems Policy Brief	Policy brief / Policy report
Halberg, N.	Assessment of the environmental sustainability of organic farming: Definitions, indicators and the major challenges	2012	Can. J. Plant Sci.(92): 1_16 doi:10.4141/CJPS2012-035	Research article
Halberg, N. , Panneerselvam, P. & S. Treyer	Eco-functional Intensification and Food Security: Synergy or Compromise?	2015	Sustainable Agriculture Research (4),	Research article
Halberg, N	Food Systems is the new black, but will it really become consumer driven?	2017	Natures, Sciences, Societes, vol. 25, nr. 1	Editorial / Comment / Viewpoint / opinion
Halberg, N	Food Systems: A research and innovation approach - what are experiences with Food Systems approach?		PowerPoint presentation	Workshop / Project presentation
Hassanein N	Locating food democracy: Theoretical and practical ingredients	2008	Journal of Hunger and Environmental Nutrition	Research article
Hassanein, N	Practicing Food Democracy: A Pragmatic Politics of Transformation	2003	J Rural Studies, vol. 19	Research article
Hayek, M; Harwatt, H; Ripple, W; Mueller, N D	The carbon opportunity cost of animal-sourced food production on land	2021	Nature Sustainability, vol. 4	Research article
Horton, Peter	We need radical change in how we produce and consume food	2017	Food Security, vol 9. 2018	Editorial / Comment / Viewpoint / opinion
House of Lords Food, Diet and Obesity committee	Recipe for health: a plan to fix our broken food system	2024	House of Lords, Food, Diet and Obesity committee	Policy brief / Policy report
Howarth, D.	Power, discourse, and policy: Articulating a hegemony approach to critical policy studies.	2010	*Critical Policy Studies, 3*(3-4), 309-335. http://dx.doi.org/10.1080/19460171003619725	Research article

Authors	Title	Year	Publication	Publication type
HPLE report 12	Nutrition and food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. September 2017. HLPE Report 12	2017	FAO HLPE Report 12	Policy brief / Policy report
Ingram, John S.I.	A food systems approach to researching food security and its interactions with global environmental change	2011	Food Security, vol 3. 2011	Research article
IPES Food	Breaking away from industrial food and farming systems	2018	IPES FOOD - International Panel of Experts on Sustainable Food Systems	Policy brief / Policy report
iPES FOOD	Towards A Common Food Policy For The European Union. The Policy Reform And Realignment That Is Required To Build Sustainable Food Systems In Europe	2019	iPES FOOD Panel	Policy brief / Policy report
Jarmul S, Dangour AD, Green R et al	Climate change mitigation through dietary change: a systematic review of empirical and modelling studies on the environmental footprints and health effects of "sustainable diets"	2020	Environ Res Lett Vol 15	Research article
Jurgilecvich A et al	Transition towards circular economy in the food system	2016	Sustainability 2016, 8(1), 69; https://doi.org/10.3390/su8010069	Research article
JRC	About the Competence Centre on Composite Indicators and Scoreboards | Knowledge for policy	2023	JRC – own publication	Policy brief
Kahl, J	Organic as a global, sustainable and healthy diet concept, taking into account regional and cultural adaptations (organic diets)	2015	ODC Initiative - 15. juni 2015	
Kraak, V. I., & Aschemann-Witzel, J.	The Future of Plant-Based Diets: Aligning Healthy Marketplace Choices with Equitable, Resilient, and Sustainable Food Systems	2024	*Annual Review of Public Health*, *45*(1)	Review Article
Khoury, C K; Bjorkman A D et al	Increasing homogeneity in global food supplies and the implications for food security	2014	PNAS, vol. 111, nr. 11, DOI10.1073/pnas.1313490111	Research article
Kinnunen, P; Guillaume, J H A; Taka M et. al	Local food crop production can fulfil demand for less than one-third of the population	2020	Nature Food, vol. 1	Research article
Knorr and Augustin	From value chains to food webs: The quest for lasting food systems	2021	Trends in Food Science & Technology Volume 110, Pages 812-821	Review Article
Kugelberg S et al.	Implications of a food system approach for policy agenda-setting design	2021	Global Food Security, vol 28	Research article
Laborde D, Torero M	Modeling actions for transforming agrifood systems	2023	In: "Science and Innovation for Food systems transformation"	Research article
Lacour, C; Seconda, L. et al	Environmental Impacts of Plant-Based Diets: How Does Organic Food Consumption Contribute to Environmental Sustainability?	2018	Frontiers in Nutrition - Section Nutrition and Sustainable Diets - vol. 5, DOI10.3389/fnut.2018.00008	Research article
Lang et al	Food, social policy and the environment: Towards a new model	2001	Social Policy and administration, Vol 35	Research article
Le Moigne	La théorie du système général : théorie de la modélisation	1977	Presses Universitaires de France	Book
Lillford and Hermansson	Global missions and the critical needs of food science and technology	2020	Trends in Food Science & Technology Volume 111, Pages 800-811	Review Article
MacLaren et al	Long-term evidence for ecological intensification as a pathway to sustainable agriculture	2022	Nature Sustainability, vol. 5, september 2022	Research article
Mariani, E. et al	How eating out contributes to our diets	2024	Nesta (nesta.org.uk)	Policy brief / Policy report
Meadows, D	Thinking in systems; Ed. By Diana Wright.	2008	Chelsea Green Publishing. 218 pp.	Book, thematic issue

Authors	Title	Year	Publication	Publication type
Meadows, D	Leverage Points: Places to Intervene in a system	1999	Sustainability Institute	Book, thematic issue
Meemken EM et al	Digital innovations for monitoring sustainability in food systems	2024	Nature Food, Vol 5, DOI10.1038/s43016-024-01018-6	Research article
Mil, HGJ van	A complex system approach to address world challenges in food and agriculture	2014	Trends in Food Science & Technology, 40	Review article
Mogensen, L et al	Life Cycle Assessment across the food supply chain.	2009	In: Baldwin, C.J. (edt), Sustainability in the food industry. Wiley Blackwell. P 115-144.	Book chapter
Mogensen, L; Hermansen, J E; Trolle, E	The Climate and Nutritional Impact of Beef in Different Dietary Patterns in Denmark	2020	Foods - vol. 9	Research article
Molly. D	Rights-based food systems and the goals of food systems reform	2008	Agriculture and Human Values	Research article
Müller B et al	Modelling food security: Bridging the gap between the micro and the macro scale.	2020	Glob Environ Change, Vol 63	Research article
Müller A, Sukhdev, P	Measuring what matters in agriculture and food systems un enivironment	2018	TEEBAgriFood Synthesis Report - TEEB for Agriculture and Food's Scientific and Economic Foundations Report. TEEB Office United Nations Environment Programme	Policy brief / Policy report
Peter Newton*, Nicole Civita, Lee Frankel-Goldwater, Katharine Bartel and Colleen Johns	What Is Regenerative Agriculture? A Review of Scholar and Practitioner Definitions Based on Processes and Outcomes	2020	Frontiers in sustainable Food Systems ((4)	Research article
Piracci et al	Identifying key attributes in sustainable food choices: An analysis using the food values framework.	2023	*Journal of Cleaner Production*, *416*,	Research article
Niles, MT et al	Climate Change and Food Systems: Assessing Impacts and Opportunities	2017	A report prepared by Meridian Institute, november 2017	Policy brief / Policy report
Nordic Council of Ministers	Cookbook for systems change - Nordic innovation strategies for sustainable food systems	2020	The Nordic council of Ministers, Copenhagen, ISBN 978-92-893-6741-7 (ONLINE) http://dx.doi.org/10.6027/nord2020-048	Policy brief / Policy report
OECD	Making Better Policies for Food Systems	2021	OECD Publishing, Paris, https://doi.org/10.1787/ddfba4de-en	Policy brief / Policy report
OECD	Agricultural Policy Monitoring and Evaluation 2023: Adapting Agriculture to Climate Change, OECD Publishing, Paris, https://doi.org/10.1787/b14de474-en.	2023	OECD Publishing	Policy brief / Policy report
OECD	Agricultural Policy Monitoring and Evaluation 2019	2019	OECD Publishing, Paris, https://doi.org/10.1787/39bfe6f3-en	Policy brief / Policy report
Olafsdottir et al	Applying System Analysis and System Dynamics Modelling In Complex Research Projects - The Case Of VALUMICS	2018	International European Forum on System Dynamics and Innovation in Food Networks > 2018 International European Forum (163rd EAAE Seminar), February 5-9, 2018, Innsbruck-Igls, Austria	Conference Paper/ Presentation
Palmer et al	OBS			
Parsons K, Hawkes C.	Connecting food systems for co-benefits: How can food systems combine diet-related	2019	European Observatory on Health Systems and Policies;	Policy brief / Policy report

Authors	Title	Year	Publication	Publication type
	health with environmental and economic policy goals?		2019. PMID: 31465160. ISSN 1997–8073	
Peters C, Thilmany D (eds.)	Food Systems modelling	2022	Elsevier, Academic press, ISBN 978-0-12-822112-9, DOI https://doi.org/10.1016/C2019-0-03225-6	Book, thematic issue
Perignon et al	Improving diet sustainability through evolution of food choices: review of epidemiological studies on the environmental impact of diets	2017	Nutr Rev. 2017 Jan;75(1):2-17	Review Article
Perrot et al.	Some remarks on computational approaches towards sustainable complex agri-food systems	2016	Trends in Food Science & Technology Volume 48, February 2016, Pages 88-101	Research article
Ponisio LC et al	Diversification practices reduce organic to conventional yield gap	2015	Proc. R. Soc. B 282: http://dx.doi.org/10.1098/rspb.2014.1396	Research article
Prosperi, P; Allen T et. al	Towards metrics of sustainable food systems: a review of the resilience and vulnerability literature	2016	Environ Syst Decis, vol. 36 - 2016	Review article
Puma et al	Assessing the evolving fragility of the global food system	2015	Environmental Research Letters, Volume10 (2), DOI10.1088/1748-9326/10/2/024007	Research article
Reilly and Dirk	Managing uncertainty: A review of food system scenario analysis and modelling	2010	Philosophical Transactions of the Royal Society B: Biological Sciences	Review article
Lukyanenko R et al	System: A core conceptual modeling construct for capturing complexity	2022	Elsevier - Data & Knowledge Engineering, 141 - 2022	Research article
Rabbinge R, Linnemann, AR	ESF/COST forward look European food systems in a changing world.	2009	Strasbourg: ESF, 2009.	Report
Romanello M et al	The 2024 report of the Lancet Countdown on health and climate change: facing record-breaking threats from delayed action	2024	Lancet, 404, https://doi.org/10.1016/	Research article
Reuters	Challenges in cocoa farming are fuelling investment into cocoa alternatives. Exclusive: African cocoa plants run out of beans as global chocolate crisis deepens |	2025	Challenges in cocoa farming. Exclusive: African cocoa plants run out of beans as global chocolate crisis deepens |	Own publications
Rutten et al	Metrics, models and foresight for European sustainable food and nutrition security: The vision of the SUSFANS project	2018	Agricultural Systems Volume 163, Pages 45-57	Review Article
SAPEA	A sustainable food system for the European Union: Evidence review report (1.2)	2020	SAPEA, DOI 10.26356/sustainablefood	Policy brief / Policy report
SAPEA/SAM	Europe needs better, more strategic crisis management, according to independent scientific and ethics advisors	2020	https://sapea.info/europe-needs-better-more-strategic-crisis-management-according-to-independent-scientific-and-ethics-advisors/	Editorial / Comment / Viewpoint / opinion
SCAR Strategic Working Group Food Systems	Sustainable Food Systems Partnership for People, Planet & Climate	2023	SCAR - Standing Committee on Agricultural Research	Policy brief / Policy report
SCAR Strategic Working Group Food Systems	FOOD SYSTEMS; R&I NEEDS AND GAPS REPORT	2022	SCAR - Standing Committee on Agricultural Research	Policy brief / Policy report
SCAR Strategic Working Group Food Systems	European Partnership on Safe and Sustainable Food Systems for People, Planet & Climate	2021	European Commission, SCAR - Standing Committee on Agricultural Research	Policy brief / Policy report
Scheifer, G. & J.Deiters (eds)	Transparency for sustainability in the Food Chain – challenges and research needs	2013	Effost critical reviews #2. Academic press, 88 pp.	book
Schneider K.R. et al	The state of food systems worldwide in the countdown to 2030	2023	Nature Food, Volume 4	Research article
Schulze M., Janssen M.	Self-determined or non-self-determined? Exploring consumer motivation for sustainable food choices	2024	Sustainable Production and Consumption; Volume 45, March 2024, Pages 57-66	Research article

Authors	Title	Year	Publication	Publication type
Schutter, O de, Jacobs N, Clément C, Ajena F	TOWARDS A COMMON FOOD POLICY FOR THE EUROPEAN UNION	2019	The International Panel of Experts on Sustainable Food Systems (IPES-Food)	Policy brief / Policy report
Seekell D et al	Resilience in the global food system	2017	Environmental Research Letters, Volume 12	Review article
Sharma, M; Kishore, A; Ror, D; Joshi, K	A comparison of the Indian diet with the EAT-Lancet reference diet	2020	BMC Public Health, vol 20	Research article
Shepon, A; Eshel G; Noor, E; Milo, R	The opportunity cost of animal based diets exceeds all food losses	2018	PNAS, vol. 115, nr. 15	Research article
Singh, B.K., Arnold, T., Biermayr-Jenzano, P. et al	Enhancing science–policy interfaces for food systems transformation	2021	Nature Food, vol. 2	Editorial / Comment / Viewpoint / opinion
Sing et al	Ensuring societal considerations are met when translating science into policy for sustainable food system transformation	2023	*Trends in Food Science & Technology Volume 137, Pages 104-108*	Review Article
Sonesson et al	Food Production and Emissions of Greenhouse Gases An overview of the climate impact of different product groups	2010	SIK-Report No 802 2010	Policy brief / Policy report
Sonino, R.	Food Systems transformation: Urban perspectives	2023	Cities (134),	Research article
Sunesson, U., J. Berlin & F. Ziegler (eds)	Environmental assessment and management in the Food industry. Life Cycle Assessment and related approaches	2010	Woodhead Publishing,	Book w review papers
Springmann M et al	Global and regional health effects of future food production under climate change: a modelling study.	2016	Lancet, Vol 387	Research article
Springmann M et al	Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail.	2018	Lancet 2(10), https://doi.org/10.1016/S2542-5196(18)30206-7	Research article
Strategic Dialogue on the Future of EU Agriculture	A shared prospect for farming and food in Europe	2024	A shared prospect for farming and food in Europe	Policy brief / Policy report
Stressner A	A sustainable food system guide	2018	Susplus EU project	Workshop / Project presentation
Tendall DM et al	Food system resilience: Defining the concept	2015	Global Food Security; Volume6, DOI10.1016/j.gfs.2015.08.001	Research article
Expert Group Global Nutrition Report Stakeholder Group	Nourishing the SDGs	2017	Independent Expert Group empowered by the Global Nutrition Report Stakeholder Group.	Policy brief / Policy report
Tilman, D; Clark, M	Global diets link environmental sustainability and human health	2014	Nature, vol. 515, DOI10.1038/nature13959	Research article
Tóth, K. et al	EU food system monitoring framework. From concepts to indicators	2024	European commision, JRC, https://data.europa.eu/doi/10.2760/94456, JRC137971	Policy brief / Policy report
Trolle E et al	Carbon Footprint Reduction by Transitioning to a Diet Consistent with the Danish Climate-Friendly Dietary Guidelines: A Comparison of Different Carbon Footprint Databases	2022	Foods 11(8)	Research Article
Tscherning et al	Does research applying the DPSIR framework support decision making?	2012	Land Use Policy Volume 29, Issue 1, Pages 102-110	Research Article
Ujjwal KC, H., Campbell-Ross, C. Godde,	A systematic review of the evolution of food system resilience assessment	2024	Global Food Security (40)	Research Article

Authors	Title	Year	Publication	Publication type
R.Friedman, L. Lim-Camacho, S. Crim				
UN environment programme 10YFP	The 10YFP Programme on Sustainable Food Systems		UN Environment Programme - Sustainable Food Systems Programme	Workshop / Project presentation
UNEP	Food Systems and Natural Resources	2016	UN Environment Programme - International Ressource Panel	Policy brief / Policy report
UNEP, FAO and UNDP	Rethinking Our Food Systems: A Guide for Multi-Stakeholder Collaboration. Nairobi, Rome and New York.	2023	UNEP https://doi.org/10.4060/cc6325en	Policy brief / Policy report
UNSCN	Urban-Rural Linkage for Nutrition. Territorial approaches for sustainable development	2020	UNSCN - United Nations Standing Committee on Nutrition	Policy brief / Policy report
Vaarst et al	Exploring the concept of agroecological food systems in a city-region context	2018	*Agroecology and Sustainable Food Systems*, *42*(6), 686–711	Research Article
Vries, H de; Boekel T van; Linnemann, A	Current systems and future scenarios in food processing	2009	In: ESF/COST forward look European food systems in a changing world. Strasbourg, ESF; pp. 65-92	Report chapter
Vries H de et al	Meeting new challenges in food science technology: The development of complex systems approach for food and biobased research	2018	Innov Food Scienc & Emerging Techn, 46	Research Article
Vries, H de; Donner M; Axelos M	Sustainable food systems science based on physics' principles	2022	Trends in Food Science & Technology, 123	Research Article
Vries H de et al	Co-creation in partnerships contributing to the sustainability of food systems: insights from 52 case studies in Europe	2024	Front. Sustain. Food Syst. 8	Research Article
Vieux et al	Dietary changes needed to improve diet sustainability: are they similar across Europe?	2018	European Journal of Clinical Nutrition volume 72, pages951–960	Research Article
Vittuari M. et al.,	Envisioning the Future of Euroean Food Systems: Approaches and research priorities after Covid-19	2021	Frontiers in Sustainable Food Systems	Research Article
Watkiss, P	Current trends in distribution and packaging	2009	In: ESF/COST forward look European food systems in a changing world. Strasbourg, ESF; pp. 93-116	Report chapter
Webb, P et al	Everyone at the table Transforming food systems by connecting science, policy and society	2022	European Union, Directorate-General for Research and Innovation	Policy brief / Policy report
Westhoeck, H	Food Systems - an introduction	2017		Book, thematic issue
Wezel et al	Agroecology as a science, a movement and a practice	2009	Sustainable Agriculture	Review article
Wheeler, T; Braun v J	Climate change impacts on global food security	2013	Science, vol. 341, issue 6145 - 2. august 2014	Research article
Willett W et al	Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems	2019	Lancet. 2019 Feb 2;393(10170):447-492. doi: 10.1016/S0140-6736(18)31788-4.	Review article
Woodward. A; Porter J R	Food, hunger, health, and climate change	2016	Elsevier - The Lancet, vol 387, issue 10031, 7-13 maj 2016	Editorial / Comment / Viewpoint / opinion
Xingqiang Song	A Pressure-oriented Approach to Water Management, 2012, Doctoral Thesis, Xingqiang Song,	2012	Royal Institute of Technology (KTH) Stockholm, Sweden, ISBN 978-91-637-0429-1)	Book, thematic issue

8.2. Appendix 2. Overview of peer-reviewed articles sorted according to number of research themes

Author Reference	Life cycle analysis / environmental footprint	Conceptual model	Land use, food supply & production	Resilience / security / availability	Modelling	Meta-analytical/ statistical data treatment	Climate change / GHG emissions	Diet: health & consumer choice	Policies and Governance	Trade / circular economy / food loss	Agronomy / crop science	Livelihood/ Poverty / Justice / Democray	Agroecology / biodiversity / nature based solution	Monitoring / indicators / observatory	Systems theory
Willett W et al	1		1	1	1	1	1		1	1	1		1	1	
Chaudhary et al. 2018	1		1	1		1	1	1		1		1	1	1	1
Romanello M et al	1			1	1		1	1	1			1	1	1	
Schneider K.R. et al	1		1	1		1			1		1	1	1	1	
Springmann M et al	1	1	1	1	1	1		1		1	1				
Laborde D, Torero M	1	1	1	1	1		1		1			1			
Conijn, JM et al	1	1	1	1	1		1				1				
Schulze M., Janssen M.	1	1			1	1	1	1	1						
Shepon, A et al	1	1	1	1	1			1		1					
Khoury, CK et al	1		1	1		1				1	1				
Puma et al		1	1	1	1					1	1				
Hayek, M et al	1	1	1		1		1								
Cremaschi DG; et. Al		1	1	1					1				1		
Springmann M et al	1	1		1	1			1							
Seekell D et al		1	1	1		1			1						
MacLaren et al.			1		1						1		1		
Ponisio LC et al			1			1					1		1		
Jarmul S et al	1				1	1	1								
Campbell, MM et al			1	1		1	1								
Kinnunen, P et. al.	1		1		1					1					
Clancy, K	1	1		1	1										
Mogensen, L et al	1		1				1								
Lacour, C; Seconda, L. et al	1					1		1							
Aschemann-Witzel J., Schulze M.	1							1							1
Asseng, S et al			1			1					1				
Müller B et al		1		1	1										
Aschemann-Witzel J et al	1							1	1						
Aschemann-Witzel J et al								1	1	1					
Jurgilecvich A et al		1							1	1					
Tilman, D; Clark, M	1						1								
Sharma, M et al	1							1							
Burgaz, C et al	1								1						
Garnett T	1	1													
Arnold, R D; Wade, J P		1													1
Prosperi, P; Allen T et al		1									1				
Lukyanenko R et al		1													1
Agyeman J et al											1				
Béné C et. al.		1													
Braun, J. von et al		1													
Glennie C, Alkon A H											1				
Kugelberg S et al.								1							
Meemken EM et al														1	
Perrot N et al															1
Tendall DM et al				1											
Vries H de et al 2022															1

Socio-economic
Biological / physical
Data science / modelling

Funded by the European Union

8.3. Appendix 3. Table of observatories that do not meet criteria for food system observatory

Tabel 5.2.3 Table of observatories that do not meet criteria for partial food system observatory

Name	Thematic focus		Geography	Current state	Public Dashboard/ data platform	Description	Strengths	Weaknesses	Link
The Observatory of Economic Complexity (OEC)	Economic growth, exports and imoports	Global	Operational	No	The Observatory is an online data visualization and distribution platform focused on the geography and dynamics of economic activities.	Economic data at the level of countries.		Data is behind a paywall, and the data that is accessible, is available from other sources with better granularity.	OEC
Askfood Observatory	Skills and innovation in the food sector	EU	Operational	Yes	Observatory promotes and develops various activities, to promote innovation and high quality higher education and training in food-related sectors.	Toolkits for learning and information on knowledge gaps within food sector.		Not a direct food system focus. No accessible data on knowledge gaps available	Askfood Obs
ObSat	Unknown	France	Operational	Yes	Observatory is a tool for action and decision-making support, and offers data to farmers and all stakeholders in agri-chains and agricultural territories wishing to develop short circuits.	Unknown		No in depth information on the observatory is accessible in English.	ObSat
AgriTech Observatory	Technology used as part of food system	Global	Operational	Yes	The observatory is a tool to monitor the rapidly evolving landscape of digital agriculture in Europe and Central Asia, identify innovative solutions to regional challenges and scale up good practices.	Potentially a source for data on how technology is used in the farming sector.		Only focussed on use of technology. Data is scarce and	AgriTech

Funded by the European Union

Name	Thematic focus		Geography	Current state	Public Dashboard/ data platform	Description	Strengths	Weaknesses	Link
								visualisations are not good.	
European Climate and Health Observatory	Impact of climate change on health outcomes	EU	Operational	Yes	Observatory aims to support Europe in preparing for and adapting to the impacts of climate change on human health by providing access to relevant information and tools. Includes literature and case studies, not statistical data. Part of Climate-ADAPT	Includes indicators on climate and health, to access impacts of climate change on health of EU citizens.		Only features literature and conceptual models, no data.	EU Climate Health Obs
World Bank Group Data Bank	Economic and health indicators	Global	Operational	Yes	Repository for data on several health, economic and development indicators. Some data goes back to the 1960ties.	Wealth of data on many different topics, especially with regards to inequality, labour markets and specific econometric indicators.		While data is global, there is a focus on the development of non-European countries. Most of the economic data is available for EU countries in other databases.	Data Bank

Funded by the European Union

8.4. Appendix 4. FOCUS GROUP SUMMARY. HOW CAN WE MONITOR TRANSITION IN THE EUROPEAN FOOD SYSTEM

Sessions and participants

FRIDAY 25 OCTOBER 2024. 10H00 to 12H00 CEST

Participants

Nine invitations were accepted, 2 invitees cancelled the day before and a total of 5 invitees attended. The domain area of participants was majority Food and also bioeconomy. The primary fields of work included research, education and policy and a variety of stakeholder groups were represented: EU-wide 'clusters', academies, NGO's and research funding and programming (Table 1).

TUESDAY 29 OCTOBER 2024. 13H00 to 15H00 CET

Participants

Eleven invitations were accepted, 4 invitees attended, 1 invitee came into the session but left again within minutes and 1 invitee tried to access the session after1 hour but was told that it would not be possible to join, since the discussion was already running. The domain area of participants was majority Health (Food) and also Aquaculture/Marine. The primary fields of work included research, innovation, funding and policy and the stakeholder groups represented were EU-wide 'clusters', NGO's and academy (Table 1).

TUESDAY 12 NOVEMBER 2024. 14H00 to 16H00 CET

Participants

Six invitations were accepted and all attended. The domain area of participants was diversified in Food, Environment, Urban Food Systems and Policy and economics of food systems. The primary fields of work included research, innovation and policy and the majority stakeholder group represented was academies, but also NGO's and global public bodies (Table 1).

Table 1. List of participants and their respective domain area and primary field of work and stakeholder group represented.

Session	Participant	Domain area	Primary field	Stakeholder group
October 25 2024	P1	Food	Research	EU-wide 'clusters'
	P2	Food	Research	EU-wide 'clusters'
	P3	Bioeconomy	Education	Academies
	P4	Food	Policy	NGO's
	P5	Food	Research	research funding and programming (national-EU-international)
October 29 2024	P6	Health (Food)	Research and Innovation Funding and Policy	EU-wide 'clusters'

Funded by the European Union

Session	Participant	Domain area	Primary field	Stakeholder group
	P7	Health (Food)	Research	Academy
	P8	Health (Food)	Innovation	NGO's
	P9	Aquaculture/ Marine	Innovation	EU-wide 'clusters'
November 12 2024	P10	Food	Research	Academies
	P11	Food	Research	Academies
	P12	Food Policy and economics	Research	Academies
	P13	Urban Food Systems	Innovation	NGO's
	P14	Environment	Innovation	Academies
	P15	Food	Policy	Global Public Bodies

Questions and discussions

Section 1

Assume that we are building a Food System Observatory (FS Obs). What can an FS OBS be used for?

FRIDAY 25 OCTOBER 2024. 10H00 to 12H00 CEST

Participants agreed that the use of an FS OBS should be to **get information:** to know where we are in the food system transition, how it is evolving and how can we improve it (P5). One participant added that an FS OBS should be used to **monitor progress, harmonizing measurements and methodologies** and making data from the member states comparable, enabling an understanding of "what is working and what is not working" and allowing regulation at the EU level (P4). Another participant (P2) added that many countries are looking at food system sustainability and transition, but they don't necessarily look at the same information (indicators). Thus, it is necessary to gather all this information about food, food system sustainability and food system transformation and see then how we can fill the gaps. For others an FS OBS should also be an **orientation**, not only to collect state-of-the-art and look at a gap analysis but also to make suggestions (guidelines) on how to improve the monitoring, the sustainability and the transition of food systems (P2).

Another perspective was that the FS OBS can help to see the trends in different aspects of food systems and knowing these trends will help to **influence attitudes** in different stakeholders, including educational programmes at different levels (P3).The discussion evolved to the first steps of building an FS OBS and the progress blocks to consider. It was highlighted that the first very important step is to agree on the definitions, get a common understanding of what sustainability is in a food system and how to define transition or transformation. This will allow **a common understanding of what we are looking for** (P2). The importance of **measuring the impact of food system transition**, particularly the economic impact, was considered by this participant as the major block of progress (P4). This participant also highlighted that we will not find the perfect way to monitor everything, but this can be accepted, and progress can be made.

Funded by the European Union

TUESDAY 29 OCTOBER 2024. 13H00 to 15H00 CET

Participants agreed that the main use of an FS OBS is to **collect relevant data** on the status quo of different parts of the food system in order to **know what can be improved** (P6, P7, P8, P9). One participant (P8) summed up: the FS OBS should be used for 1) **collecting** data, 2) **linking existing sources and databases** within the food domain, 3) **analysing** in order to 4) **draw data-based conclusions**. An existing observatory in the food systems domain, focused on food and drink products from a health perspective, was mentioned but not elaborated (P6).

Participants elaborated on the **types of data to be monitored by an FS OBS**: the volumes, values, and patterns of consumption (P9), including of locally-produced food (P8), the health and sustainability link to avoid the assumption that what is sustainable is also healthy (P6), the global flow of product volumes and values (e.g., exports of high value and imports of low value foods) and the imported production (70% of aquatic food eaten in Europe is imported) (P9) to refine the global view of a European food system, and the true costs of production and total sustainability keeping the balance between people, planet and profit (P8). It was pointed out that the food system reacts to climate-induced evolutionary changes e.g., due to warmer weather, Sicily now produces fruits and vegetables that it could not 20 years ago (P7).

The food system starts and ends by considering implications of global interconnection. Several participants agreed that **Europe is part of a global food system** (P6, P8, P9) and that for strategic food resilience, a focus on European production vs. import could be needed (P8, P9). Considering the true costs of food production, e.g., the dairy industry in The Netherlands requires export for profit, yet increased nitrogen and low quality of surface water result from dairy production, highlights sector interconnection (P8). The need for data collection throughout the value chain, primary production, import, regional consumption, is relevant to the aquatic seafood sector and here the interconnections are health and nutritional profile (P9).

An FS OBS can give an accurate understanding of food production methodology and cost analysis cross referenced with standardized environmental indexing (such as environmental footprint, LCA), which could be used for different foods. Many stakeholders would likely be interested in such a mapping and anchoring this in an FS OBS would address where this is done and who does it (P9).

TUESDAY 12 NOVEMBER 2024. 14H00 to 16H00 CET

For one participant (P12), the FS OBS should **check** and **give feedback** about food system topics. A place where users can count on **reliable data** and know about progress of the food system on sustainability and other issues.

For another, the FS OBS should assess the performance of the food system against the Sustainable Development Goals (SDG), as the fundamental method to see how the system is performing (P15). Also considering that the European food system is highly dependent on the rest of the world, that the start and the end of the food system is not linear but is an open system. The FS OBS will be important for decision makers who set policies and make investment decisions, to avoid unintended consequences by understanding how the system works and what the impacts are across different domains. The FS OBS should be used for **decision making**, to gather evidence for decision makers by looking backwards and forwards (P15).

For some, the FS OBS should provide integrated and methodologically coherent qualitative and quantitative data about food system structure and evolution towards a sustainability transition (P10). It should include a **database** (P11) for researchers with data from many collections across Europe, e.g., there are many disparate collections of consumer data (P14). New data should be systematically collected so that the FS OBS can monitor and evaluate the impact of what we are trying to do and the tools and strategies currently in place. Finish here was on a frustrated note: What are we missing, what's not reaching the people that we're trying to impact and why is the food system still like this despite so much research and so many people working? (P13)

Section 2

How can monitoring transition in the food system be made operational?

Which indicators can be relevant?

How can they be measured?

FRIDAY 25 OCTOBER 2024. 10H00 to 12H00 CEST

According to one, the FS OBS should start from the back "know what you want to know so in the end you ask the right questions". Questions such as: What do I want to answer? Which questions do I need to answer? What kind of indicators do I need? What kind of questions do I need to ask at the several relevant levels?". **Choose the right monitoring points, the right levels, and the right indicators** because otherwise you get lost "It's easy to get lost in monitoring". Then make monitoring results available to everybody so that they're usable (P5). Another participant (P2) raised the big problem of data availability that food systems face to accomplish what has been said before "not all countries, even within member states, share the information", while a third agreed and added the problem of data harmonization. Additionally, retailer databases, particularly of big chains, could allow access to consumer trends and sustainability – but there was doubt if this could ever be possible (P3, P4) – at least not without "mandatory reporting otherwise it's not going to happen" (P4).

Some agreed that **relevant indicators depend on the perspective and area of the food system** (e.g. consumers, policies, environment, food waste) and that a clear definition of a food system and its components is needed before defining indicators (P1). In any case, it was suggested indicators should contribute to (1) a knowledge base, (2) implementation, and (3) predicted scenarios. Indicators should efficiently measure what you want to know and impact through years, that is long term sustainability (P5).

Indicators were suggested for different perspectives: for consumers, indicators should give feedback on how to act in the most sustainable way, how to choose among products and supermarket chains, how trustful organic and other labels are, how to act in the most circular way and likely others (P1); for policy, indicators to measure number of policies implemented to promote healthy and sustainable food (P4); for education, indicators that assess educational measures put in place (P3); for funding, indicators that measure the impact of knowledge (P5). Finally, once the indicators are defined, there should be a unit for each one (P1): number of startups, number of companies that invest through action, number of companies that invest money, number of policy regulations, number of educational programmes, obesity rates, and many more (P1, P3, P4, P5).

TUESDAY 29 OCTOBER 2024. 13H00 to 15H00 CET

Relevant indicators for an FS OBS should come **from already existing data** e.g., national dietary guidelines and planetary heath diet (P6). Other relevant indicators could be true costs of food, financial flows and funding flows (e.g., vegetarian society of Denmark states that funding for animal-based protein was 26 times higher than that for plant-based protein); making these flows transparent can help to avoid imbalances in the food system (P6).

One participant raised **the value of linking indicators** of production, consumption and consumption patterns to socio-economic and demographic status (e.g., intakes of highly processed, organic, high nutritional quality foods, and proportion of income spent on food), non-consumption (e.g., food waste and where it happens), consumption pattern causes and effects (e.g., malnutrition, food access) (P9).

A sustainability indicator was suggested by P9, the LCA or PEF indicator, was suggested to allow cross food and feed sector comparison (animal, vegetable, synthetic). And indicators linked to food security, food sovereignty and health and nutrition, e.g. local diseases linked to nutrition suggested by (P7).

Guidance and inspiration can come from the UN Sustainability Goals, since the food system has a great impact on them, and the Green Deal (P8). A body, similar to the IPCC Intergovernmental Panel on Climate Change, could be created for Food Systems and supported by the FS OBS (P6).

A final comment was a reminder that the people giving inputs for the FS OBS do not represent most of society and this requires special and repeated attention.

TUESDAY 12 NOVEMBER 2024. 14H00 to 16H00 CET

To make food system transition monitoring operable, consider implementation in the framework documents and guidelines of the FS OBS; this includes **the dynamics behind implementation and the resistance from different groups**, not forgetting that **Europe exists in the context of the world** (P15). It was suggested to identify successful food systems demonstrating progress at different levels, analyse them in depth and understand why they were successful and what path they took (P10). Governance plays an important role in food system

Funded by
the European Union

transition and policy coherence is important, be aware of how policies interact and how their effects are measured (P15). It was agreed by some that while a lot of things can be quantitatively measured there are also a lot that cannot be, particularly in governance (P10, P15). Consumers can be mostly quantitatively measured, however the need for data harmonization suggests that the FS OBS should be a data "binding site" for Europe (P14). It was agreed that it is a big effort to gather this information and to analyse it and to keep track of what is going on, that is the challenge of the FS OBS (P15).

Relevant indicators identified included the SDGs (P14, P15) that have already been selected and piloted, data is already available, and new indicators are being proposed (e.g. to capture dietary quality: the food insecurity experience scale, the diversity dietary scale, the diversity score). This data should be included in the FS OBS and understand what policies and institutions have already been put in place and why some work and others don't, "we are not moving forward but backwards, it is clear that some subsystems move forward better than others" (P15). The selection of relevant indicators is complex because one-size-fits-all doesn't work. For every aspect of the food system there are indicators to select, each area needs to be identified, then what and how to measure and what is the impact and remembering to include both quantitative and qualitative data (P13). There are plenty of indicators already out there and the FS OBS should start with these and choose the relevant ones (P11, P12), e.g., the Tim Lang indicators for governance (P12).

Section 3

Who are the preferred, anticipated users of the FS OBS?

At which scale levels should the FS OBS be?

What makes an FS OBS valuable for the users?

FRIDAY 25 OCTOBER 2024. 10H00 to 12H00 CEST

Everyone in the food system would like to use the FS OBS because they want to know the trends and now statistical analysis and reports must often be paid for (P3) and these should instead be publicly available and accessible to everyone (P4). Specific anticipated users would be **businesses**, **policymakers** (P3) **research organisations**, **governments**, the **ministries** and the **European Commission** (P5).

Most agreed that the **FS OBS should be used at the European level**, while also agreeing that **global is the ideal scenario** (P1, P5) for impact but difficult to implement. The food system has many dimensions; to the three basics (economic, environment and social), health has been added and governance is being discussed. In each one of these, there are subdimensions related to the supply chain and the actors, which results in a huge database of indicators. Such a database should be started at the European level (P2) and built by European partners (P5). Scale is a hard discussion, "decide first on what actually can be done including that it needs to be feasible, doesn't need to be perfect, needs to have impact and it needs to be doable" (P1).

TUESDAY 29 OCTOBER 2024. 13H00 to 15H00 CET

The participants agreed that an FS OBS would be relevant for several groups of users for many different reasons and agreed that an FS OBS would be expected to work at different scales (P9). Elaborating, the FS OBS should be working at **EU**, **member state**, **regional and national levels**, with regional not necessarily defined by geography but, for instance, by type of production, e.g. a focus on coastal communities for seafood production (P9). Participant P8 broadened the meaning of scale to include socio-economic level, citing the "Giantleaps" project which found that around 20% of the population does not have the money to buy "good food" and concluded that an FS OBS should consider food access for people in different social and economic situations (P8).

A different view of scale is data, data analysis and modelling. The FS OBS would have data to base policies on and also built-in mechanisms to model effects or impacts of policies and interventions at different places in the system (P6). **Modelling could accelerate transition and influence patterns**, even on a smaller scale as a "Policy evaluation network" (P6). This could include getting public opinion on food policies to i) influence

politicians who want to get re-elected, ii) get the data politicians need to design policies, and iii) ensure public support for these policies (P8).

The anticipated, preferred users of the FS OBS include **economists, statisticians, research sector, civil society groups, the (informed) general public, opinion-formers** (P9) and **policymakers** (P6). Most agreed that **communicating the data** in an FS OBS is a very difficult task (P6, P7, P8, P9), and one mentioned reconsidering the true cost, true value, true impact and true sustainability of food as well as our messaging and understanding of food (P9). Complex data must be analyzed, including statistically, when monitoring transition in the food system. Yet such data need to be easily digestible and relevant to the users, e.g., opinion-formers that the public will listen to since most people do not consult research projects (P9). Certain methodologies may be favourable e.g., the true costs approach instead of the more complicated LCA approach (P8).

TUESDAY 12 NOVEMBER 2024. 14H00 to 16H00 CET

The preferred and anticipated users of the FS OBS were identified as **policymakers, regulators** and/or **regulatory institutions, research community, research funders** (P10), **city networks** (P13), **decision makers, private sector** (P15) and **journalists** (P14).

The discussion around scale level was controversial as some agreed on European level (P10, P14, P15) but with some restrictions since the data come from member states (P10) and data at EU level is not always available (P14). The regional level was also considered, but this point was not clearly elaborated. One participant suggested that a good overview for a food observatory would be Nation member, not Member States (P12) which it seems implied a global scale.

It was agreed that the FS OBS will be valuable for users if the information shared is relevant (P10), such as sustainability standards (P15) and available and accessible data (P13, P14, P15).

Section 4

How can an FS OBS be used to identify, monitor and assess change accelerators and barriers for change in food system transition?

FRIDAY 25 OCTOBER 2024. 10H00 to 12H00 CEST

There were two positions in this discussion: one that is possible to have indicators that can measure accelerators and barriers for change in each dimension and be used by the FS OBS - just need to find them (P3), and other that the **FS OBS is not the right place to do this measurement** (P1, P2, P5). To measure changes there's the need to have a correlation between different points; even if ideally an FS OBS could do this it would probably take too much time and need too much data, and if the correlations were not always reliable (not enough time or not enough data or both) that could raise doubts about the entire FS OBS (P5).

TUESDAY 29 OCTOBER 2024. 13H00 to 15H00 CET

Ideas for change accelerators in food system transition included innovation, measured e.g., as investment in new research at EU or national level (P8). Others suggested a VENT diagram of healthy diets and sustainable diets to find the overlap (P6) and changing consumer behaviour to change production - perhaps through citizens council processes to ask opinions on very complex systems after giving information on which to base that opinion (P6, P7).

The barrier of our fragile global interconnectedness and power relations within international trade could shock our food system (P8, P9) e.g., collapse of the Australian wine sector due to China's decision not to buy Australian wine. Changes in global socio-economic consumption patterns and (expected) lack of purchase power could be barriers, especially that Europe may not remain politically and economically dominant (P9). The framing in 'food security' dominating the narrative on food systems now could be different e.g., recommending eating more plant-based for health rather than food security (P6).

Funded by
the European Union

Some principles and processes could work as either accelerators or barriers depending on context. The emotional and cultural aspects of consumption are underestimated and sometimes outweigh logic or finance (P9). Emotions invested in food, farming, fishery, bioeconomy and agroecology could be enablers of change – but could be the reverse if people's hearts and minds are not onboard (P9). The FS OBS could monitor online advertising and influencing to find out what shapes public feelings, perceptions and opinions on food (P6). Consider the prestige tied to certain types of consumption (P9), depending on what is considered prestigious this could be an accelerator or a barrier, and people tend to not "go back" after moving to a more prestigious diet.

TUESDAY 12 NOVEMBER 2024. 14H00 to 16H00 CET

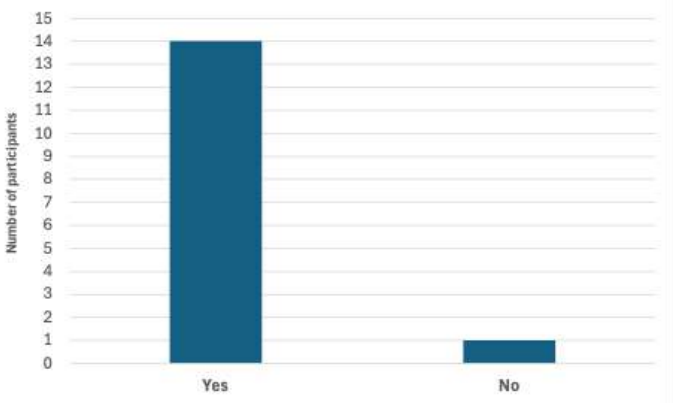
Once the data is there, the indicators, everything can be done including to identify, monitor and assess change accelerators and barriers for change (P12). This opinion was refuted because sometimes the data are not enough, and a more in-depth analysis is needed including perhaps accelerators and barriers that come from outside of the food system (P10). Several participants (P10, P11, P13) suggested that **this can be part of the monitoring from the Observatory, even collaborating with others with this specific expertise.**

In another perspective (P15), **the FS OBS itself is an accelerator because it provides evidence, but it should also track research and innovation to measure accelerators.** Politics and governance may challenge the alliances thus they should be involved in the dialogue, as should those who control the media because narratives about the food system can be different and even competing.

Among the barriers for change is the industry behind the food system and the enormous investments made to make it the way it is today, the food system is concentrated around big companies. The FS OBS needs to understand and challenge these investments, it is very important to understand these power dynamics and why the power is the way it is and why it's so resistant. **For the FS OBS to identify, monitor and assess accelerators and barriers for change it needs to include them as part of the whole dialogue** process, many people (politics, governance, media, industry, investors) need to be around the table.

SLIDO results for the 3 sessions

Do we need a Food System Observatory (FS OBS)?



The one participant who answered that we do not need an FS OBS represented the EU-Wide 'Clusters' stakeholder group, domain area Health (food) and primary field of work research. The word selected for why do not need it was "Expensive" and the one selected for why we need it was "transparency".

If we need an FS OBS, in a word why do we need it?

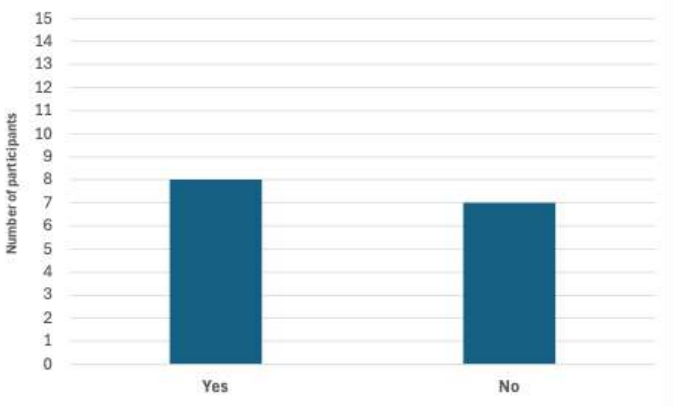
The word most used was monitoring followed by transition, other words like the latest such as transformation and change were also used. Indeed, some words are synonymous of others according to what was discussed in the sessions such as harmonization, consensus, coherence and alignment; or big picture, overview and insight; or data and repository. And other words only stated once and reflecting the view of the participants: trends, orientation, evaluation, transparency, framework and policy making.

If we don't need an FS OBS, in a word why do we not need it?

No word was repeated, and they were written by mostly "trying to imagine" except for the word expensive used by the participant that answered that we do not need an FS OBS.

Do you have any experience with food system transition indicators?

Funded by
the European Union



No relation was established between stakeholder group, domain area or primary field of work and the answers. Eight participants of the focus groups had experience in transition indicators and seven didn't.

If you answered yes to the previous question, list which ones?

Academies (Food, Research)

- *Water use efficiency*
- *Greenhouse gas emissions*
- *Food security and access*
- *Gender balance*
- *Power balance working the food supply chain*
- *Food loss and waste reduction*
- *Innovation adoption*
- *Farmers attitude towards innovation*
- *Consumer acceptance of innovation*
- *Industry acceptance and adoption of innovation*

Academies (Health (food), Research)

- *Nutritional indicators*

Academies (Environment, Innovation)

- *organic agriculture indicators and further sustainability standards: Area, production, operators, retail sales, exports, imports (organic total, growth, share of overall total, per capita)*

Academies (Bioeconomy, Education)

- *Regulatory changes*

Research Funding and Programming (Food, Research)

- *Project-level indicators (on how R&I results have made impact on societal challenges depending on context)*

EU-Wide "clusters" (Food, Research)

- *Economy indicators*
- *Ecology indicators*
- *Social indicators*
- *Health indicators*

NGO's (Food, Innovation)

- *GHG emissions*
- *production yields*

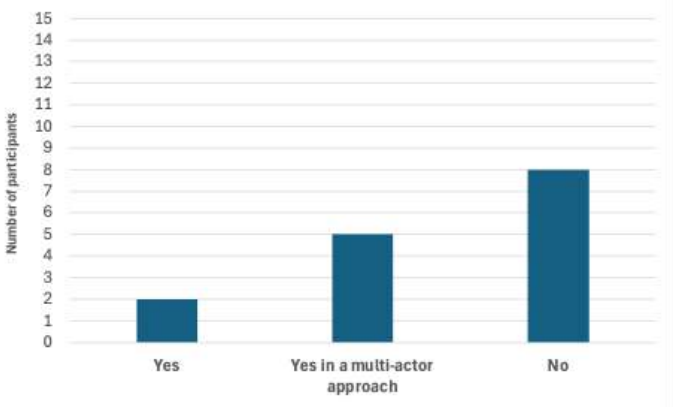
Global public bodies (Food, Policy)

- *Policy*
- *Investment*
- *Governance*
- *SDG indicators*

List 1-3 example projects/reports where food system transition indicators are documented

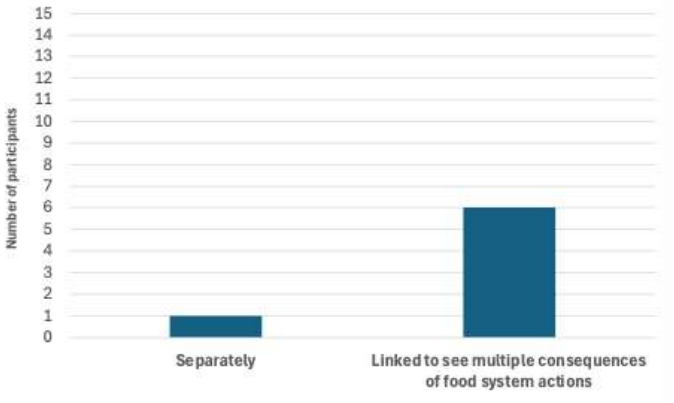
- *Best Re-MaP*
- *World Bank Group*
- *ERA-LEARN guidelines on EU project monitoring, ERA-Net Monitoring reports, Impact reports in general*
- *Eurostat Food systems Dashboard*
- *INFORMAS*
- *Eurostat*
- *project SafeFood4EU*
- *FOODPathS, Food 2030, Pathways 2.0*
- *SusfansFuturefoods*
- *Foodclic, feast, planeat*
- *Grape project (funded by EU, Germany, Finland), Lowinfood (horizon EU), Foodland (horizon EU), Reduce (funded by ITA ministry of environment), SEIZERO*
- *State of food security and nutrition in the world, State of food and agriculture in the world*
- *2021 MUFPP monitoring*
- *Annual statistics publications on organic agriculture and voluntary sustainability standards*

Have you worked on food system transition indicators with other stakeholder groups?



Seven participants answered yes, which means that one of the participants with experience with transition indicators didn't work with other stakeholder groups (Academies, Health(food), Research). The ones that worked with other stakeholder groups and in a multi-actor approach (33%) represented the following stakeholder groups (domain and primary field of work): NGO's (Food, Innovation), NGO's (Urban food systems, Innovation), Global public bodies (Food, Policy) and Academies (Food, Research).

Did you consider the indicators?



Of the 7 participants who answered Yes, only one considered indicators separately; this person represented the stakeholder group Academies (Environment, Innovation).

Which food system transition indicators are relevant for your stakeholder group?

Academies (Food, Research)

- *Soil health*
- *Biodiversity*
- *Supply chain reliability*
- *Food security and access*
- *Adoption of sustainable technologies*
- *Food waste*

Funded by the European Union

- *SDG 12.3 (food loss and waste)*
- *All indicators related to FS sustainable transition depending on the specific goals and thematic area identified for the research*

Academies (Health (food), Research)

- *Heath & nutrition*

Academies (Environment, Innovation)

- *Area*
- *Retail sales*
- *International trade*

Academies (Bioeconomy, Education)

- *Policy changes*
- *Food waste utilization*
- *Education programmes*

Research Funding and Programming (Food, Research)

- *Knowledge basis*
- *Uptake of R&I results in economy and society*
- *Effects on sustainability*

EU-Wide "clusters" (Food, Research)

Indicators without efficient information, research can provide it.

EU-Wide "clusters" (Aquaculture/Marine, Innovation)

- *LCA*
- *PEF Score*

EU-Wide "clusters" (Health (food), Research)

- *Food based Dietary guidelines*
- *Nutrition indicators*
- *Food environment indicators*

NGO's (Food, Innovation)

- *Percentage of people having access to healthy nutrition*

NGO's (Food, Policy)

- *Food consumption*
- *Food availability*
- *Food affordability*

NGO's (Urban food systems, Innovation)

- *SDGs - 1,2, 8, 11*

Global public bodies (Food, Policy)

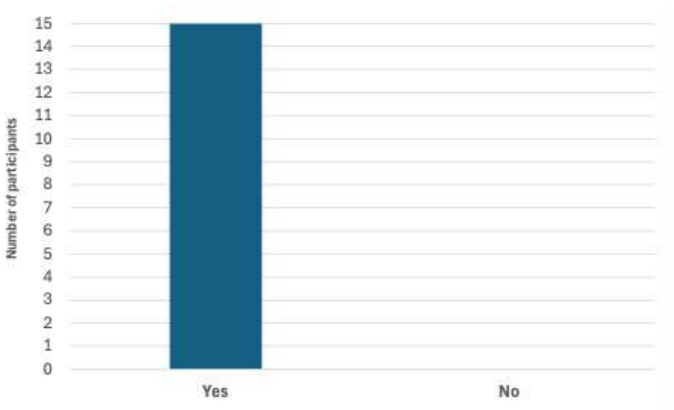
Both impact indicators (like SDGs) and change process indicators (structural, but also relational/power related, as well as dominant mindsets.

Which indicators should be considered with other EU-Partnerships? (write the indicator and the Partnership)

- *Digitalisation (AGData)*
- *Changes on agriculture, combined with overall Food Systems (Agroecology)*
- *Changes in health (ERA4Health)*
- *Changes on blue economy (SBEP)*
- *Changes with AI (Agriculture of Data)*
- *Indicators from agriculture field (Agroecology)*
- *Agri (clean water)*
- *Climate, education and societal mobility (climate action)*
- *NCD indicators, health indicators in general (Era4health)*
- *Recipes food loss and waste (Lowinfood)*
- *HHH emissions of food system (wastewise)*
- *Gender (Foodland)*
- *Urban rural linkages (ash 2, innovation)*
- *Primary sector indicators (Agroecology)*
- *Systemic indicators, drivers and barriers (Futurefoods)*
- *Synergic approaches to data collection and elaboration of indicators (Agridata)*
- *Several indicators like data, land, water GGE and others (European partnership of Agriculture of Data, agroecology)*
- *Area data (Agroecology)*

Multiple Partnerships were listed by one of the participants but not linked to the indicators: Sustainable Blue Economy, Energy Transition, Water4All, Animal Health and Welfare.

Would you consider your current way of working a "Food System Approach"?



If yes, list words which describe your "Food System Approach"?

Food is the most used word because most of the participants did not list words but sentences such as: "providing expertise to food businesses", "Innovation and knowledge transfer in food production", "Food health nutrition", "promoting sustainable food production". The strength of the word health came from the following sentences: "Connecting health of people and planet", "One health" and "Food health and nutrition". And the word different from the following ones: "different viewpoints", "involving different actors, if possible, from different backgrounds".

Synthesis

Our interpretation across the three Focus Groups and Slido sessions

There was no doubt that the participants in these focus groups, primarily people involved in the FOODPathS project, believe that there is a need for a Food System Observatory (FS OBS). Yet when considering what we need it for, the opinions diverged, despite its primary role being generally accepted as monitoring and accelerating transition.

An FS OBS can be used to collect a wide variety of quantitative and qualitative food system data, organize these data by harmonising measurements and methodologies and use them to monitor changes and their impact. The selection of these data needs a common understanding of what we are looking for so that we avoid ending up as a huge server for collecting data. The information should be collected not as raw data, but by indicators used for monitoring food system transition, carefully selected and from reliable sources.

The FS OBS can have the additional role to offer opinions and advice based on the evidence gathered by the indicators. Aiming to guide decision makers, shift public opinion and improve the food system.

To make the FS OBS operational it is essential to choose the right monitoring points, levels and indicators and make the monitoring results available. The FS OBS should be built looking to successful and unsuccessful cases and the dynamics behind implementation of measures should be taken into consideration as well as the resistance from different groups, not forgetting that Europe exists in the context of the world. Also, since governance plays

Funded by
the European Union

an important role in food system transition, it is important to know how policies interact and how their effects are measured.

Monitoring transition in the food system can include the evaluation of myriad indicators which cover the varied perspectives of the food system, turning indicator selection into a very complex task. Indicators already in use were suggested as a place to start which should cover (1) knowledge base, (2) implementation and (3) predicted scenarios. Suggestions from the participants included choice of indicators based on stakeholder role in the food system (many examples provided in the Slido session), linkage indicators, correlations between indicators, and indicators that measure long-term impact. The results from Slido showed that half of the participants worked with food system transition indicators and from these, one did not work with others, and some did not work within a multi-actor approach. In line with what participants discussed, we may suggest proceeding as follow: divide the subsystems, select the right questions with the relevant stakeholders and for each question select the indicators by consulting experts in each discipline. Once the indicators are defined, be sure they are measurable indicators!

An FS OBS could have many users including scientists of several specialities, government at several levels, private businesses, communicators, and the general public. There was general agreement that an FS OBS should be European in scale, though input at the national and regional levels, and a global view were also proposed. Scale was also considered apart from geography, including sector-specific and socioeconomics.

To make it valuable for the users, the information shared by the FS OBS should be not only relevant and up-to-date, available and accessible, but also digestible.

The task of identifying, monitoring and assessing change accelerators and barriers for change is not, for some focus group participants, best done by the FS OBS. This is primarily due to time constraints, the amount of data, modelling needed and also because some of these accelerators and barriers may come from outside of the food system. However, this task can be done by collaborating with others who have more expertise - politics, governance, media, industry and investors - as these are the ones more likely to influence change accelerators and barriers for change in a Food system transition.

Funded by
the European Union

8.5. Appendix 5: Interactive Session Budapest December 2024

Interactive Session Report – Fishbowl

Have your say: What would you expect from a "European Food System Observatory" to support the transition of our food systems?

Sofia F. Reis

Funded by the European Union

Introduction

FOODPathS project organised in Hungary, December 2025, the event entitled "FOODPathS to the Sustainable Food Systems we envision" where 4 workshops took place. In these workshop discussions on **Food System (FS)** case studies and innovative approaches were taken with many invited participants from outside the project including the advisory board, FutureFoodS Partnership members, SCAR members, CLEVERFOOD partners, and many others invited from Commission, NGOs, and other stakeholders related to food systems. The idea was that these discussions starting with the FOODPathS outcomes and going through the thoughts, experiences and insights of participants could contribute to the final recommendations for an ideal Partnership on **Sustainable Food Systems (SFS)**.

One of the workshops was dedicated to approaches and strategies, and the first session "Have your say: What would you expect from a "European Food System Observatory" to support the transition of our food systems?" was organized by the Danish Centre for Food and Agriculture – Aarhus University, ISEKI Food Association and ICROFS – Aarhus University. The concept for a European **Food System Observatory (FS OBS)** was presented followed by a review of existing datahubs, and the stakeholders feedback results so far collected and a presentation from the FutureFoodS partnership. Then an interactive session was performed, and the session was finalised with a SLIDO questionnaire. In the interactive session, called Fishbowl, the participants were invited to contribute to improving the European FS OBS concept by discussing and provide input to the suggested focus, function, and data needs of the FS OBS oriented to support the FS transition to SFS. The results of this interactive session are summarized in this document starting with the instructions and rules of the Fishbowl, following by the discussions provided and finalising with a synthesis of the author's view.

Fishbowl aim, instructions and rules

Aim

Promote a discussion to provide input on the focus, function, and data needs of an FS OBS that looks to the food system transition to SFS.

Instructions and rules

Participants from the session are invited to contribute to improving the concept "European Food System Observatory" in a dialogue with other 4 participants. Five seats are meant to allow dialogues (fishbowl), the participants need to make sure to listen, ask questions and respond as much as providing their own thoughts and insights. Participants are free to volunteer or deny participating when invited. A facilitator ensures reflections and give the required feedback, intervening in the discussion when necessary to keep the flow of the discussion in the required purposes. Intermediaries facilitate the movement of participants into the fishbowl. A note taker does not intervein during the fishbowl and only take notes from the discussion anonymously.

- Participants speak only when seated in the fishbowl (insiders).
- Outsiders should follow and think and not discuss internally outside the fishbowl.
- Insiders will change continuously, either "push or pull".
- Outsiders ready to take place in the fishbowl should stand up to signal.
- Insiders should leave the fishbowl when a new contributor (outsider) arrives and tap their shoulder.
- Intermediaries will ensure timely replacement of insiders and outsiders.
- Respect the note taker, speaking clearly and loudly and avoid interrupting.

Funded by
the European Union

Fishbowl discussion

Facilitator interventions

Introduction

Facilitator started the fishbowl session by presenting the aim, rules of the session and inviting people to seat and start the dialogue on the following questions:

- What do you think will be the main functionalities of the European FS OBS?
- Looking to the observatory's examples, majority data hubs but some recognizing themselves as FS OBS, do you agree with them? Can they be called FS OBS? Don't you feel the need for interlinkages between the FS topics that are missing there?
- Do you agree that for a real FS OBS it should be highlighted some of the interactions? Is it possible in your view the highlight of these interactions between the actors? the interdependencies between the outcomes? The interactions between climate, agriculture and health diets? Or do you think that these interactions are not possible?

Middle intervention

After speaker 5 intervention, facilitator raised that an FS OBS is a lot about interpreting data and thus besides demonstrating data and combining datasets from a lot of places it could also have a governance to provide reports based on the data. And followed another question:

- Can you imagine including a government structure to the FS OBS which provides scientific interpretation of the data with the addition of understanding the interdependencies between the outcomes?

Final intervention

After speaker 7 intervention, facilitator raised the last question:

- Can an FS OBS be objective looking to many specific points and be normative at the same time, how can we achieve this objectivity?

Insiders view

Speaker 1

This speaker agreed that an FS OBS should highlight the interactions and raised that is important that we realize that there is a lot of **data available that should be used in a more sustainable and efficient way** than it's used now. Also added that before building the FS OBS and define what it will be observed and what should be collected, **define first what does sustainability mean for the sustainable food systems**. This will help to decide which data to use and which interactions to observe. Finally, the big question is how to translate the raw data into usable data for the FS OBS and here the universities involvement is undeniable.

Speaker 2

There are some efforts done in food system monitoring, learning and evaluation by others which could become part of this discussion. Data collection points, how the data is used, what kind of data and who is providing the data, what are the different countries doing about (national level overview) is being discussed also by others. There's no doubt for the speaker the interlinkages are important in the process and food system indicators are being looked for this reason. However, what is still missing from the equation is **what we actually mean when we talk about food system indicators**, is not only how we look at these relationships but what are they: are they accountable? can we collect data on relationships? can we put a number on collaboration? For this speaker the focus of the discussion should be on developing indicators that can monitor this system.

Speaker 3

For this speaker an FS OBS is needed but the speaker's concerns were related with a lot of initiatives out there, many that can be used to monitor (e.g. Planetary Health Diet and many others related to health), thus the first thing to be defined is **what do we need the FS OBS for**? To be in the top of what is out there or to find a niche? Or to be the one to connect everything?

Funded by
the European Union

Speaker 4

This speaker did first a brief reflection about an FS OBS: **is for observing and not analysing, collect and observe and later maybe quantify or qualify**. An FS OBS should be a place where anybody who wants to do analysis should be able to come and find the type of information they need, which means that an FS OBS should be **to provide a broad range of information**, but this information should be collected based on what we know already. For around 15 years the food system concept has been thought, and some good definitions have been decided but till now there are no indicators defined, indicators which allow us to understand how everything is connected through the food systems, because **we don't know yet what we need to measure, and this is the big challenge**.

Adding to this point is the word transition, so are we measuring change? Or are we measuring things that already exist? It is fundamental to know what an FS OBS will do, to measure change different things need to be observed than if it is only to measure. For this speaker there's a difference between transition and transformation, are we measuring the real change or the transformation state of our new food system?

Speaker 3 intervened at this point: the FS OBS will measure the systemic level or the outcomes of what is assumed a system will put into motion? It's too difficult at this point to measure systemic indicators and maybe we may go for measuring outcome indicators or impact indicators.

Speaker 5

Proposed a **guiding sentence** for the FS OBS not losing focus "**Transition towards policy goals for SFS**". This speaker focused the FS OBS on observation and transition and believes that a guiding sentence will **facilitate monitoring food systems and help not getting loss**, that can happen very easily in the food systems which are very complex. A parallelism was made with the climate crisis "we know the solutions and we know the science but there are many barriers to the transformation which have organisations and practices behind them". In the case of food systems, the private sector has commercial interests behind which tend to block transition, observe these **barriers**. Target the users and beneficiaries, who will benefit the data from the FS OBS, for sure the European citizen who suffers the **consequences** of badly designed food systems, but they are not necessarily the users. The users may be e.g. NGOs and policymakers to gather data on how much the private sector tried to block things that EU agreed on.

To the facilitator middle intervention, this speaker only agrees with the governance as described if they do not try to do reports on everything in the food systems. For this speaker is **fundamental to be targeted and focused on the transition and things that matter for the transition and the barriers for the transition**.

Speaker 6

From the experience of this speaker, organising meetings with individuals and organisations outside of FOODPathS and the partnership, the discussion around an FS OBS was that needs to support their work (including funding) and should align with participatory processes. These discussions were focused on the transformation of food systems, and the question is would the answers be different if asked about the transition of food systems. For this speaker is really important before the discussion to **clarify the definition of transformation and transition**.

Speaker 7

For this speaker an FS OBS is extremely important, food systems thinking has penetrated public consciousness, is being quoted and referenced but majority of people have no idea what it means. From the speaker experience in food systems thinking none of different sector representatives (producers, industry, academia, research, NGO groups, society) agree with each other. An FS OBS can bring **understanding** and **consciousness** of what food systems thinking is, by observing, collecting and qualifying and being aware that will be used in a different **perspective** by different people.

In the perspective of this speaker we need to look at things from a policy perspective taking into account what the Commission needs are but also including the needs of the others (e.g. high value exports have a significant factor to play in food systems, so you strengthen your food system by high value exports but not everybody see it like that; the concept of understanding and quoting something in a food system approach of an animal welfare NGO is an entirely different reference point to how a producer will quote it; private sector also have its own point of view, but behind this we have jobs, livelihoods, communities, culture and a way of life). This speaker would see the FS OBS a way to bring some level of **objectivity** to all this complexity, in the way that can be a common point that links all the specific points from different places.

Speaker 8

If we need an FS OBS to have a legislative framework than we end up in an enormous complexity, so why not starting with the questions: What are the emerging properties of your food system? Where are you going? Is that difficult yet? It's extremely difficult, but is it possible? Find a simple indicator that start to give us an idea that something happened, like the human body complexity: temperature rise gives us the idea that something is wrong, but then we need to understand the systemics behind it and find other indicators. This is what we need for the transition we expect, first we need to have this **top-level indicator** that fits with a legal framework and then **categorise others** according to the values this indicator gives. Complex systems are based on the interactions of actors and thus a **partnership** should look to the specific outcomes, but this should be looked in a different way and will define the **FS OBS organisation**.

Speaker 9

There's a high awareness now of the need to work more systemically but no one or very few are using this approach in food systems, according to this speaker. The FS OBS may help on **showing how to work systemically**. The measurement of food systems as information on **what's going on at country level in terms of Sustainable Development Goals (SDG) indicators monitoring** is an obvious functionality of an FS OBS, but what else should we be looking at it is not clear. For this speaker there is also a **huge need to bring stakeholders and actors in conversation in a more responsible way**, particularly the private sector but be aware that they are also the key part of certain problems (blocks for transition) and the conversation needs to be carefully build, similar as for the policy coherence between different ministries.

Speaker 10

For this speaker the FS OBS should also be able to give information on what parts of the system we can change and what influence that change will have in all the elements and other sectors of the system, including also the relation with the whole economy. **System dynamic modelling** may be a way to achieve a big picture in such a complex system.

Speaker 11

This speaker reflected on **how the information observed by the FS OBS will be used**? For sure will provide some guidance, and the modelling will allow to advance and move, to understand which interventions may be promising, but also to have more interdisciplinarity analysis and approaches to what we are doing so far and to put together different perspectives. The modelling can give information not only on how the future could be positive but also what is the reality, what are the emerging risks and how could we collaborate to mitigate them at the right stage.

Speaker 12

From the **government perspective** now, looking to the global level of follow up process to the UN food system up to 2030, it would be very interesting if this FS OBS could look at national policies, new types of national and regional policies and **assess how** holistic are they and how do they cover all the food system and finally how coherent are they. May also even **point towards** areas where it can be improved, where are the needs to be more holistic and more integrated across different policy areas.

Speaker 13

This speaker identifies many ongoing initiatives in Europe, in different projects and the commission itself, also global initiatives and many working on food systems, monitoring and observatories. The problem is not they are many, different viewpoints add value, the problem is that they use the same data sources and indicators but give different names (lack of interoperability) and in the end enormous gaps in data coverage which contrast with what have been said before. In addition, there are big gaps in the knowledge about middle of the supply chain (food distribution and retail) where private sector is settled. Thus, an FS OBS should define a strategy of **collaboration** with the actors and stakeholders, to avoid lack of **interoperability** and **knowledge gaps** in the data coverage.

Speaker 14

For this speaker the functionality of an FS OBS should be monitoring the food system, and for monitoring the most important things are the **metrics** and then how the metrics will be measured, the **methodology**. Milestones should be identified, their achievement or not will help to foresee how we will react while doing this monitoring. **Data management** is as much important, in a holistic view a huge amount of data will be needed to see the full picture.

Synthesis

Functionalities

To list the main functionalities of an FS OBS we need to know first what we need the FS OBS for, and it was clear in the end of the discussion that we need it to connect the information out there to measure the transition of food systems, however, how to measure is still unclear.

It was agreed by the majority that an FS OBS is for observing and collect data, which will allow to provide a broad range of information on what is known already but should also quantify and qualify the transition of food systems based on this data. For not losing focus when observing, collecting and analysing (qualifying and/or quantifying) data it was suggested to follow a guiding sentence targeted and focused on transition to SFS, because we need to look to the data that can measure transition, and look to the consequences and barriers of this transition. However, is fundamental to clarify the definition of transformation and transition because not everyone can see the difference. And, to define what sustainability mean for the SFS is also important.

The information provided by the FS OBS may bring understanding and consciousness about SFS approach as well as showing how to work systemically, that not everyone is aware of and need to deal on the everyday life of transition to SFS. It's fundamental that when observing, collecting and analysing the data, the different perspectives of the different actors be considered.

Data hubs

For observing and collecting the data the FS OBS should define a strategy of collaboration with the actors and stakeholders, to avoid lack of interoperability and knowledge gaps in the data coverage. The overall view is that there is a lot of data available that is recognised by some that should be used in a more sustainable and efficient way, however others point the lack of interoperability in the data available and the knowledge gaps on the private sector, responsible for the distribution and retail, and the FS OBS needs to be capable to bring these actors to the conversation in a more responsible way.

Interactions and interdependencies

The interactions between the actors and the interdependencies between the outcomes was agreed by all that are fundamental. They will allow to understand where the gaps in the system are and show what is the influence of a change in all the system, a system dynamic modelling was proposed to facilitate this process, which also may give predictions on the transition, the reality of the transition, possible emerging risks and how collaboration may be done to mitigate them at the right stage. These interactions should include the whole economy and government, to assess the economic impact of transition and the impact of the policies adopted through the system.

Indicators

However, how to measure transition and these interactions is still not clear. There's a common agreement that the measurement of food systems as information on what's going on at country level in terms of SDG indicators should be consider, among others not yet identified, and that indicators need to be used but what are these indicators is still a grey area that needs to be discussed.

And the discussion should start on the idea provided in the discussion by one of the speakers: "find a simple indicator that start to give us an idea that something happened, this top-level indicator that fits with a legal framework and then categorise others according to the values this indicator gives …. a partnership should look to the specific outcomes"

Government structure

An FS OBS which provides scientific interpretation of the data with the addition of understanding the interdependencies between the outcomes was implicit in all the discussion but was never discussed deeply. In the end, it seems that the government structure should follow four steps: (1) to make the pertinent questions for the guiding sentence; (2) to observe data and collect indicators; (3) to analyse the interactions and interdependencies using the indicators; (4) to report the results based on the interpretation of indicators.

Funded by
the European Union

Objectivity

Whether the FS OBS can achieve the expected objectivity for measuring the transition to SFS is a question that cannot now be answered, but building the FS OBS towards this objectivity is a way to achieve it.

SLIDO Session

Introduction

This report follows the Interactive session report – Fishbowl and presents the results of the SLIDO questionnaire performed in the end of the session "Have your say: What would you expect from a "European Food System Observatory" to support the transition of our food systems?" organized in Hungary, December 2024 by the Danish Centre for Food and Agriculture – Aarhus University, ISEKI Food Association and ICROFS – Aarhus University. This session was part of one of the workshops included in the FOODPathS event entitled "FOODPathS to the Sustainable Food Systems we envision".

The SLIDO had 5 questions and was used to close the entire session. Two questions were open text, another two word clouds and one multiple-choice, and they all allowed multiple answers. The questions made were the following:

- Which food system policies should a **food system observatory (FS OBS)** relate to?
- In one word, if you would use an FS OBS, what would you use it for?
- Mention a question in a **food system (FS)** context that a future FS OBS should be able to answer
- Which knowledge format/data format would you prefer on specific FS topics in the FS OBS?
- In one word, list data areas that are obviously missing in the already existing observatories related to FS

The answers given by the participants related to the discussions performed previously in the fishbowl session and all this information will contribute to the final recommendations for an ideal Partnership on **Sustainable Food Systems (SFS)** the overall aim of FOODPathS project.

SLIDO questions

Which food system policies should a food system observatory (FSO) relate to?

Result

Thirty-six participants answered to this SLIDO question many with more than one answer. Figure 1 shows that more than half of the participants stated that an FSO should relate to food safety and security policies (15), health policies (8), nutrition policies (5) and agricultural policies (4). Environment and food procurement policies were referred by at least 3 participants. Sustainability, waste and economy policies referred by at least 2 participants. Finally, referred by 1 participant were social, education, trades and funding policies.

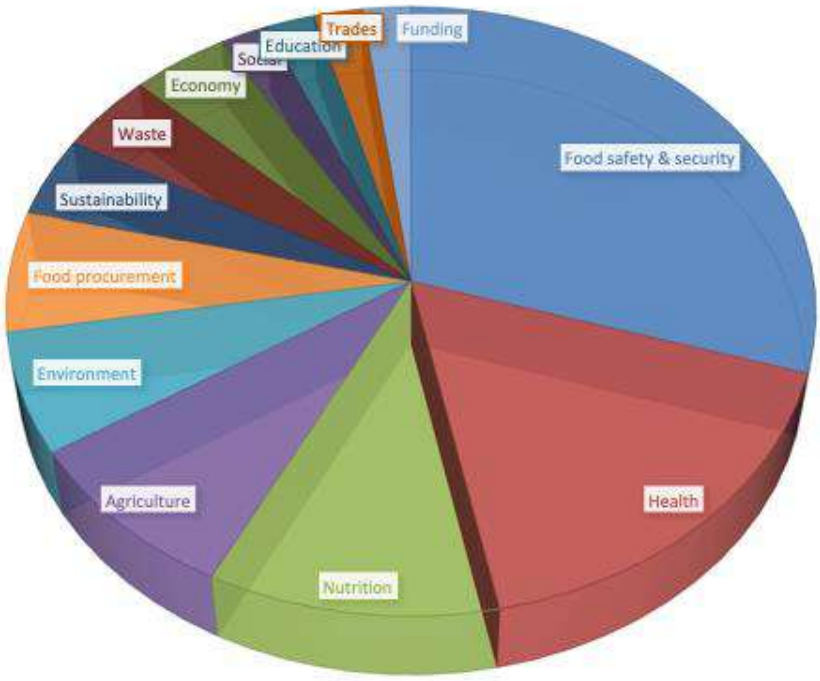


Figure 1: Food system policies that should be related to an FSO (36 participants)

Discussion

Three of the participants answered that the FSO should relate to all FS policies (agriculture, nutrition, biodiversity, climate, etc.). One added that these policies should be interlinked and other that should target all the food supply chain. Specific relations were also given like the FSO should relate to corporate political activity policies, to national food, health and bioeconomy strategy policies, to data quality policies and to rural development policies.

For the food security policies specific cases were given such as food affordability and equity, food democracy, accessibility and traceability policies.

For health policies the specific cases given were commercial determinants of (planetary and human) health and NDCs.

For agricultural policies specific cases referred were improved crop rotations and reduced pesticides use, climate friendly agriculture and common agricultural policy (CAP).

Related but not the answer expected was given by two other participants that the FSO should align with EU policies and break down to national and regional policies.

Funded by
the European Union

In one word, if you would use an FSO, what would you use it for?

Result

Thirty-six participants answered and multiple answers were accepted. Figure 2 shows the word cloud built with the answers given.

Figure 2: What an FSO should be used for (36 participants)

Discussion

For the major participants of this SLIDO session an FSO should be used for monitoring, followed by policy making, learning and for analysis. Many other uses were referred less often mentioned, some general and others related to the previous 4, like mapping, plan and monitoring transition is related to monitoring.

The general uses referred were an FSO should be used for: a holistic approach, sustainability, objectivity, connectivity and transparency.

Policy advises, policy assessment, evidence for policy making, decision making, regulation relates to the policy making and gives the idea that the FSO used for monitoring policies will allow then the evidence for policy making.

Data, data base, informing, supporting R&D, R&I, information source relates to learning, which suggest that for some the FSO should be a database to be used by many to access information.

Identification of gaps, foresight studies, trend analysis, market analysis, interconnected outcomes, reporting, identify weak points relates to analysis, and in this case suggests that it's referring to monitoring analysis done by others and analysis done with the monitoring made by the FSO.

Funded by
the European Union

Mention a question in a food system context that a future FSO should be able to answer

Result

Thirty-six questions were mentioned by the 31 participants who answered this SLIDO question. The questions were organized by themes: general to the FSO (9), specific to the FSO (5), specific to different stakeholders (6) and specific to sustainability (4), policies (6), health (3), environment (1), waste (1) and imports/exports (1).

General to the FSO

- *Can I monitor FS transition?*
- *What are the indicators to measure the transformation to SFS (incl. policies)?*
- *What are most important knowledge gaps that are needed to transform our FS?*
- *What is the theory of change visioned by the FSO? The attribution of change per sector?*
- *What are the future trends we will face?*
- *What are the main challenges?*
- *How to ensure the holistic approach and sustainability of cross-sectorial coordination (work with another observatories and sectors, such as health, environment, etc, to ensure alignment and strategies)*
- *How to ensure transparency and accountability if the reports, state of the European FS?*
- *Is advanced analytical tools and AI needed?*

Specific to the FSO

- *Is FS transition achieved?*
- *Is the FS resilient?*
- *How is the value distributed among FS?*
- *How are cities doing in the process to transforming our FS?*
- *Where do we need more transparency?*

Specific to different stakeholders

- *How should I transform my diet? (should I eat meat or not?)*
- *Which options of funding do we have at regional level?*
- *How much we need to produce?*
- *Are farmers being paid fairly?*
- *What share of Food business contributes to transitioning to SFS?*
- *What are the comparatives PEF scores of different food categories?*

Specific to sustainability

- *Is my local/regional/national/EU FS sustainable?*
- *Where are information missing in the FS to assess the sustainability?*
- *Is the FS delivering across sustainability outcomes?*
- *Is this food subsystem sustainable?*

Specific to policies

- *Who will be the "losers" if this policy will be adopted? What are the costs for them?*
- *Are governments issuing policies to address the disproportionate and unfair influence of commercial actors on FS transformation/transition?*
- *Will this policy transform FS? Which will be the quantifiable impacts of implementing this policy?*
- *What policy tools should we use to make our FS healthy and sustainable?*
- *How to design the future Policy in particular areas?*
- *How can policy makers influence consumers' willingness to change?*

Specific to health

- What is the degree of synergy between sustainable agriculture and healthy diets?
- Is food diversity increasing health and ecosystems?

Funded by
the European Union

- How is our planetary health?

Specific to environment

- *How can we ensure equitable access to nutritious food while minimizing environmental impact?*

Specific to waste

- *How much of our food is wasted?*

Specific to imports/exports

- *How much of our food is imported?*

Discussion

Despite the question was made to a specific FS context, 9 questions were related to the first ones that we should do when building the FSO (general to the FSO) and 5 questions related to what the FSO indicators should answer (specific to the FSO). All the other ones were specific to a FS context and can help in the future to find the indicators the FSO needs.

Which knowledge format/data format would you prefer on specific food system topics in the FSO?

Result

Thirty-four participants answered to this multiple choice, 5 of them selected the 3 options, other 3 selected 2 options, the indicators and consolidated reports, and 1 selected another 2 options, the raw data plus indicators. All the other participants chose one of the options. The answers are represented in percentage in Figure 3.

Figure 3: Knowledge format/data format preferred by 34 participants (results are shown in percentage)

Discussion

The results showed that indicators were the major preferred and is also clear that raw data and indicators are not enough for the FSO. Consolidated reports represent 24% of the preferences followed by the three options choice, that means that all the three are important to the FSO.

In one word, list data areas that are obviously missing in the already existing observatories related to food systems

Result

Thirty-one participants and multiple answers were accepted. Figure 4 shows the word cloud built with the answers given.

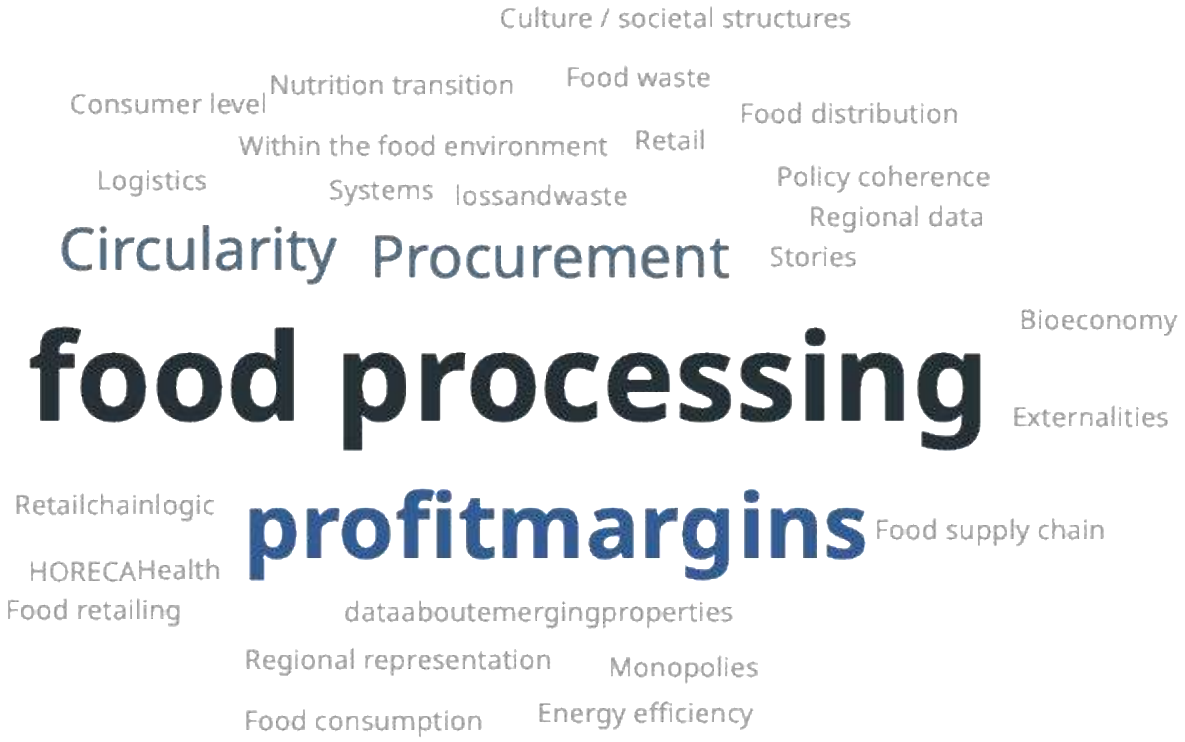


Figure 4: Data areas missing in the existing observatories

Discussion

It seems that a lot is missing in the existing observatories but the most agreed areas missing was food processing, followed by profit margins, circularity and procurement. Many other areas were less often mentioned related to different sectors of the food supply chain (food retail, distribution and consumption), and related to food losses and waste, food environment, energy efficiency, bioeconomy and others.

Funded by
the European Union

Synthesis

Author interpretation of the SLIDO questions considering the previous fishbowl session

Food System policies that an FS OBS should relate to was not directly discussed in the fishbowl session, but health and sustainability were intrinsic in all the discussions and over repeated. Interestingly, was that when participants were focused on this question food security and safety policies were the most important that an FS OBS should relate to, followed by health, nutrition, agriculture, environment, procurement, sustainability, waste, economy, social, trades and funding policies.

According to the fishbowl session ***an FS OBS should be used to*** connect the information out there to measure the transition of food systems. It should be used for observing and collect data, which will allow to provide a broad range of information on what is known already but should also quantify and qualify the transition of food systems based on this data. This idea is reflected in the answers given in the SLIDO session that should be used for monitoring, learning and analysis. The strength given to the policy making in the SLIDO session suggests participants' awareness of the importance that policies have for the expected transition in the FS.

Other answers given in the SLIDO session stated that an FS OBS should be used for a holistic approach, sustainability, objectivity, connectivity and transparency. This aligns with what have been discussed in the fishbowl session that the information provided by the FS OBS may bring understanding and consciousness about SFS approach, may show how to work systemically and that it's fundamental that when observing, collecting and analysing the data, the different perspectives of the different actors be considered.

Many ***questions that an FS OBS should be able to answer*** were listed in this SLIDO session and aligned with what have been discussed in the fishbowl session. The questions were divided into general questions, the ones needed when building the FS OBS, specific questions to the FS OBS that may lead to the top-level indicators discussed in the fishbowl session, and specific questions to different stakeholders and topic areas that may help to find the secondary indicators.

The ***knowledge format/data format preferred*** was not discussed directly in the fishbowl session, but it was referred that the measurement of food systems as information on what's going on at country level in terms of SDG indicators should be consider by the FS OBS and that indicators needed to be used. Also, when confronted in the discussion on the possibility of reports with scientific interpretation of the data with the addition of understanding the interdependencies between the outcomes was only agreed if the reports are not done on everything in the food systems but targeted and focused on the transition and things that matter for the transition and the barriers for the transition. The SLIDO results were very aligned with this with a clear preference by the indicators, following the consolidated reports and a clear result that raw data and indicators are not enough for the FS OBS. ***What is missing in the existing data hubs/observatories*** was never discussed very deep in the fishbowl session. It was referred the lack of interoperability in the data available and the knowledge gaps on the private sector, responsible for the distribution and retail. SLIDO results showed many areas missing including the ones referred in the fishbowl but also food consumption, food losses and waste, food environment, energy efficiency, bioeconomy and others. The most agreed areas missing was food processing, followed by profit margins, circularity and procurement.g***What is missing in the existing data hubs/observatories*** was never discussed very deep in the fishbowl session. It was referred the lack of interoperability in the data available and the knowledge gaps on the private sector, responsible for the distribution and retail. SLIDO results showed many areas missing including the ones referred in the fishbowl but also food consumption, food losses and waste, food environment, energy efficiency, bioeconomy aed others. The most agreed areas missing was food processing, followed by profit margins, circularity and procurement.

Funded by
the European Union

8.6. Appendix 6.

Due to the size of the table, it is not possible to include it in the text, please follow this **LINK** to access it.