

Sustainable Food Systems Partnership for People, Planet and Climate

STRATEGIC RESEARCH AND INNOVATION AGENDA (SRIA)

Abbreviations

CSA: Coordination and Support Action	JPI: Joint Programming Initiative
DG: Directorate General	JRC: Joint Research Centre
EC: European Commission	KPI: Key Performance Indicator
EC-SAM: European Commission Science Advisory Mechanism	LL: Living Labs
EFSA: European Food Safety Authority	LCA –Life Cycle Assessment
EFSCM: EU Food Security Crisis Preparedness and Response Mechanism	MA: Multi-Actor
EIC: European Innovation Council	MEL: Monitoring, Evaluation and learning
EIT: European Institute of Technology	MS: Member State
EJP: European Joint Programme	NCD: Non-Communicable Diseases
ENoLL: European Network of Living Labs	NFTP: National Food Technology Platforms
ESD: Environmental, Social, & Governance	NGO: Non-Governmental Organization
ERA: European Research Area	OECD: Organisation for Economic Co-operation and Development
ETP: European Technology Platforms	R&I: Research and Innovation
EU: European Union	R&I&P: R= Research, I=Innovation, P = science-Policy interface
FAIR data: are data, which meet principles of findability, accessibility, interoperability, and reusability	RRI: Responsible Research and Innovation
FAO: Food and Agriculture Organisation of the United Nations	SCAR: Standing Committee on Agricultural Research
FBDGs: Food-Based Dietary Guidelines	SCAR FS SWG: SCAR Food Systems Strategic Working Group
FBS: Food Balance Sheets	SDGs- Sustainable Development Goals
FS: Food Systems	SFS: Sustainable Food Systems
FS-Labs: Living Labs for Food Systems	P-SFS: Partnership Sustainable Food Systems
FWL: Food Waste and Losses	RIPE: Research, Innovation, science-Policy and Education
GHG emissions: Greenhouse gas emissions	SAM: Scientific Advice Mechanism
GO: general objective	SHD: Safe and Healthy Diets
HBS: Household Budget Surveys	SME: Small and Medium-sized Enterprises
HLEG: High Level Expert Group	SO: specific objective
HLPE: High Level Panel of Experts	SPI: Science Policy Interface
ICN: International Conference on Nutrition	SRIA: Strategic Research and Innovation Agenda
IDS: Individual Dietary Surveys	TRL: Technology Readiness Levels
IPFSS: International Platform for Food Systems Science	WHO: World Health Organisation

Definitions (*work in progress*):

- **Environmental footprint** is defined in the Single Market for Green Products European initiative, which includes 16 environmental impact categories among others Climate Change, Ozone layer depletion, resource and water depletion or toxicity (EC, 2022a.)
- **Food environment** is the micro- and macro context in which a consumer chooses food. It is the environment beyond the individual (e.g. beyond own attitudes or competences), encompassing also the social context and the direct environment (e.g. the supermarket or canteen), which in turn are impacted by the macro-environment (e.g. the economic, social, cultural, technical).
- **Food Democracy**: the need for “greater access and collective benefit from the food system” (Lang, 1999)
- **Governance** describes the characteristic processes by which society defines and handles its problems.
- **Leverage points** are places within a complex system where a small shift in one thing can produce big changes in everything (Meadows, 1999)
- **Living Labs**: Living Labs are practice-driven organisations that facilitate and foster open, collaborative innovation and real-life environments or arenas where both open innovation and user innovation processes can be studied and subject to experiments and where new solutions are developed (EnoLL, 2022).
- **Sustainable food system** is a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised (FAO, 2018)
- **Sustainable healthy diets**: Sustainable Healthy Diets are dietary patterns that promote all dimensions of individuals’ health and wellbeing; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable (FAO WHO, 2019).

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1. Executive Summary

A sustainable food system is “a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised” (FAO, 2018). The economic sustainability covers profitability and affordability throughout the system. Social sustainability means wide-scale benefits including health, cultural drivers, just and fair outcomes (SAPEA, 2020). Environmental sustainability means food systems, which have neutral or positive environmental climate and biodiversity footprint (EC, 2022b.).

To reach sustainable food systems (SFS), the European Commission has launched through Horizon Europe the R&I initiative to develop the Partnership Sustainable Food Systems (P-SFS) for people, planet and climate. It is one of the 49 partnerships launched under Horizon Europe to drive green and digital transitions. Ten of them are targeting food systems (FS), namely seven co-funded Partnerships (Sustainable Blue Economy, Agroecology, Animal Health and Welfare, Agriculture of Data, Biodiversa+, Water4All, and P-SFS) and one institutionalized Partnership (Circular Bio-Based Europe). While the other co-funded Partnerships are in particular addressing pre-harvest themes, the **P-SFS has its focus on post-farming and -fishing**. Even though, to reach sustainable FS outcomes, intensive cooperation is needed and foreseen. This includes how to jointly implement system approaches, work inter- and trans-disciplinary and engage multi-actors.

The ambition of the P-SFS is to collectively develop and implement an EU-wide committed research and innovation (R&I) partnership which accelerates the transition towards diets that are healthy, safe and sustainably produced and consumed in resilient EU and global food systems. Since the R&I FS domain after the fishing or farming gate is extensive, four key Thematic Areas – so-called **R&I Areas** – are identified in this SRIA. These will give insights and generate knowledge in how to change the way we eat, process and supply food, but also connect with food systems, and govern them. To obtain these insights, four transversal activities – so-called **Activity Areas** - are formulated. These are pooling R&I resources and programming, launching an observatory, establishing a knowledge Hub of Living Labs, and sharing knowledge.

The P-SFS should allow participating EU countries to jointly respond to sustainability demands set in a number of policies, seeking synergies while respecting local and context-specific situations. Building the SFS of tomorrow is **central to the transition to a ‘Sustainable Europe by 2030’**, where the EU policy initiative for a Legislative Framework on Sustainable Food Systems could be pivotal (EC, 2022c.). The P-SFS will play a key role in enabling the European Green Deal (EC, 2021a), the Farm to Fork (EC, 2021b), the Biodiversity (EC, 2022b.) and Bioeconomy (EC, 2022d.) Strategies, and Food2030 R&I ambitions towards ‘climate & sustainability’, ‘nutrition & health’, ‘circularity & resource efficiency’, and ‘innovation & communities’. Since all these contribute to meeting the United Nations Sustainable Development Goals (SDGs) (UN, 2022a.), the future Partnership seeks **cooperation globally** to reach co-benefits while avoiding trade-offs.

Why should we develop a *new* European R&I Partnership SFS? The viability of our planet – and its societies and food security – is threatened. Food Systems hold the power to realise our shared vision for a better world (UN, 2021a.). However, this will only be possible by **collective FS approaches of many different actors**. In the P-SFS, it concerns in particular actors beyond the farming and fishing gates, while in other Partnership mainly in production. However, all are asked to join forces and to motivate others to act, creating a snowball or catalytic effect. Hence, this is what also the P-SFS envisages and describes in its SRIA. It will be as inclusive as possible with public and private actors, policy makers, foundations, NGO’s, citizens, locally, sub-nationally, nationally, EU-widely and, globally. It will pool resources via strategic jointly co-funded R&I activities. It will transparently contribute to monitor and show where we are on our way towards SFS. It will showcase practices which are inspiring others to act locally and seek synergies in Europe. Overall, it will contribute to develop a common language on the systemic features of SFS, providing input to the Legislative Framework on SFS. This also allows to unambiguously describe complex interactions within FS, and communicate across multi-actor networks to jointly agree and embark on transformative actions.

2. Introduction ‘challenges to tackle’

The future health of Europe’s people and the planet lies on our plate. This has been extensively described in numerous reports and publications (see Fig. 1), and also in the Narrative (SCAR FS SWG, 2021) and the Template (EC, 2022e.) of the Partnership SFS. In short, some significant shortcomings of current FS are:

1. In the EU, food systems account for ca. 30% of greenhouse gas (GHG) emissions (Crippa et al., 2021) hence substantially impacting climate change. ~70% originates from animal-based foods (Leip et al., 2015; EEA,2019); the share of the post farming and fishing part of FS is ~30%.
2. In Europe, approximately 80 million tons of food waste is generated – which is ~30% of food produced – of which nearly 50% from households (EU Fusions, 2016). The latter is important because wasting food at the end of chains means wasting inputs in all previous stages.
3. The agro-aqua-food sector is the largest producing and manufacturing sector in Europe¹, and the most concentrated one at a global level. Yet, the food sector needs viable, future-proofed economic models to safeguard and create jobs (OECD, 2019). This should incorporate environmental-friendly management operations to preserve soil, water and biodiversity and to deal with the increasing scarcity of resources – e.g. a switch to their circular usage – while facing a growing world population.
4. Unhealthy consumption patterns are leading to the triple burden of malnutrition, namely over-nutrition, under-nutrition (projection of 840 million people in 2030) and micronutrient deficiencies. These are responsible for a number of non-communicable diseases such as diabetes, cardiovascular diseases and approximately 30% of all cancers (WHO, 2022).
5. Food systems feature systemic shortcomings in fairness, inclusiveness and maintaining cultural food heritage. These appear in the entire food chains, revealing power unbalances, disconnections between rural and urban areas, and unequal access to and insecurity of food (SAPEA, 2020).

The importance of current challenges is accentuated by shocks and stresses that test resilience of FS, including the Covid-19 crisis (Bakalis et al., 2020), the war in Ukraine, economic and energy crises, and increasing rates of drought and heat (EC, 2022e.). The new P-SFS will tackle the shortcomings.



Fig. 1 The storyline behind the Partnership, describing needs, evidence (reports) and actions

¹ More than 10 million farms and 22,000 agro-aqua-food cooperatives in the EU create jobs for a workforce of 20 million employees, especially in rural areas, and more than 294,000 food processing companies provide jobs for 4.8 million people. Overall, the agro-food ecosystem is by far the biggest employment sector in Europe [FDE, 2022].

3. The Sustainable Food Systems partnership: for Who and What and How?

As stated before and detailed in the P-SFS Narrative (SCAR-FS, 2021) and Template (EC, 2022e.), reaching SFS requires collective actions. Many successful transnational R&I funding initiatives have previously been running. Examples are the ERA-Nets (like Susfood and CoreOrganic), European Technology Platforms (ETP's like food for life, organics or aquaculture), European Joint Programmes (EJPs like on soil), European Institute of Technologies (EIT like EIT Food), Joint Programming Initiatives (JPIs like Healthy Diets for Health Life, Oceans or Agriculture, Food Security and Climate Change (FACCE-JPI)), and BIOEAST (Central and Eastern European Initiative for knowledge-based agriculture, aquaculture and forestry in the bioeconomy). These have been thematically focused initiatives, tailor-made for the needs and requirements of researchers and funder communities. Their clear focus on specific sectors or actors has led to a multitude of interesting projects with budgets ranging from ten thousand to a couple of million euros.

In the future, the P-SFS will be asked to be as inclusive as possible, mobilizing a budget of a couple of 100 million euros. **WHO** is concerned? A wide range of actors and their networks (FOODPathS, 2022) will be mobilized to address the diversity of FS in their transition towards sustainable outcomes. Different actors in the public, private, research, education, philanthropic, NGOs, etc. have thus been identified (see chapter 8.4) which operate locally, regionally, nationally, EU-wide or globally. Since this Partnership is post-farming and -fishing-oriented in the food domain (hence, in both green and blue environments), it will join forces with other Partnerships and large initiatives in production, environment, water, energy, health, and the bio-based product sectors (see also 8.4). Due to **systems approaches**, cooperation with other Partnerships are feasible around common principles, themes or even infrastructures². Consequently, the P-SFS SRIA is complementary to their SRIAs.

Thanks to the diversity of involved actors, the P-SFS will deliver benefits in the form of better understanding interlinked processes, potential co-benefits and trade-off's elsewhere in FS. It will generate data and knowledge to support assessing the systemic impacts of megatrends and policies, and find leverage points in business, place-based, community- and/or government-driven actions. The P-SFS will expand EU's potential for context-dependant, socially-embedded and environmentally-relevant innovations and changes towards sustainable practices and policies. The P-SFS data concern dietary habits and consumer attitudes, products and processing methods, logistics, waste management and circularity, environmental conditions, business models, institutions and policies.

The overwhelming complexity of FS requires new knowledge and a structuration of relevant thematic R&I areas in its SRIA, all considered from a food systems lens. **WHAT** four **R&I Areas** (see chapter 5) have been identified:

- **R&I 1 'Change the way we eat'**
- **R&I 2 'Change the way we process and supply food'**
- **R&I 3 'Change the way we connect with food systems'**
- **R&I 4 'Change the way we govern food systems'**

² Infrastructures in the area of food, health and bioeconomy are envisaged in the frame of the European Strategy Forum for Research Infrastructures (www.esfri.eu).

HOW will new insights be obtained in the four R&I Areas? Via a set of four inter-connected Activity Areas, the P-SFS will achieve its ambition to coordinate, align and leverage European and national R&I efforts to future-proof food systems. These are:

- **Activity 'A' Pooling R&I resources and programming**
- **Activity 'B' Launching a food systems observatory**
- **Activity 'C' Establishing a food systems knowledge hub**
- **Activity 'D' Knowledge sharing and scaling, adapting knowledge systems, innovation platforms and science-policy interfaces**

The R&I areas and Activity areas are schematically presented in Fig. 2.

Enable R&I to drive food systems transformation processes

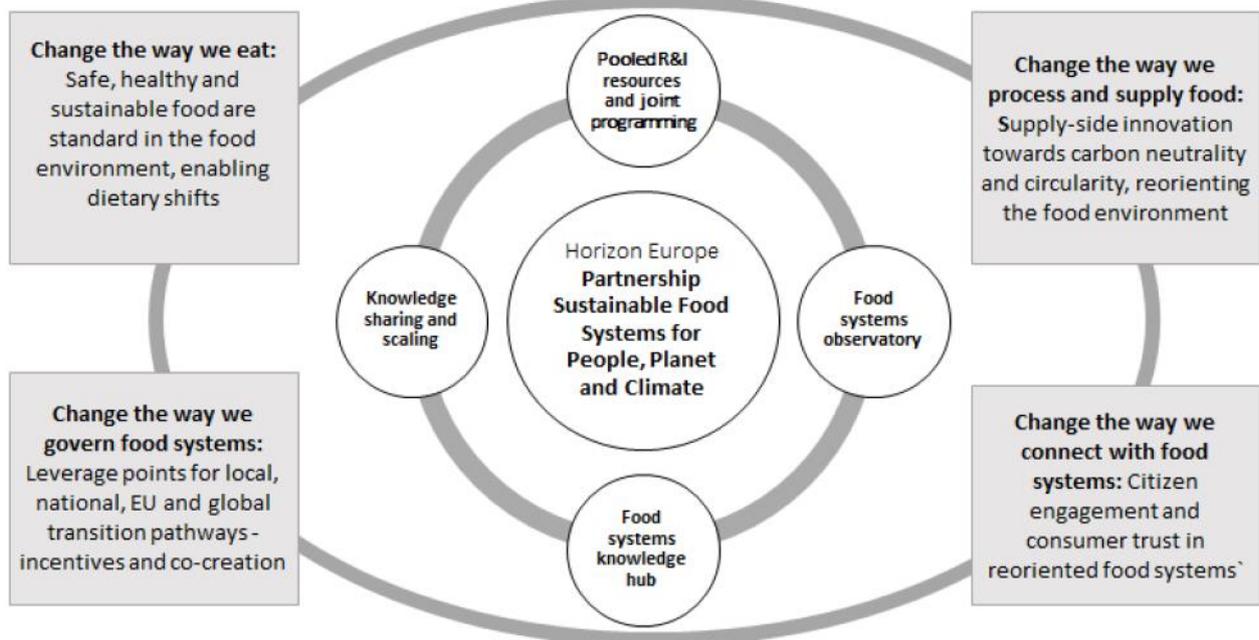


Fig. 2. The four R&I Areas and four Activity Areas of the Partnership SFS, all inter-connected.

4. Vision and mission

The overarching **VISION** of the Sustainable Food Systems Partnership is that its actors collectively will achieve environmentally-friendly, socially secure and fair, economically viable, healthy and safe food systems in Europe in order to help realise its goals of the Farm to Fork strategy, in line with the global ambitions of United Nations (UN) Sustainable Food Summit 2021.

The **MISSION** of the Partnership is to mobilize Research and Innovation (R&I) to accelerate the transition towards Sustainable Food Systems with a wide range of actors, who are joining forces in this Partnership.

5. Which intervention logic, relevant strategies, FS approaches & insights needed for P-SFS?

5.1 Impact, Outcomes and Objectives

Building the Partnership SFS is central in the transition to a 'Sustainable Europe by 2030'. Past experiences and current crises confirmed the need to – jointly as diverse actors – implement new and systemic approaches to Research and Innovation (R&I) in food. Therefore, partners in the P-SFS share (i) the Impact that they intend to achieve, (ii) the concrete Outcomes that they can reach, (iii) the General Objectives that are resulting in these outcomes and (iv) the Specific Objectives that guide them to the general objectives. This is described in the Intervention Logic, and summarized in Table 1. Herein, also the four thematic R&I and four Activity Areas converge into an inclusive R&I Partnership.

In short:

Impact: The table shows what the P-SFS likes to achieve in terms of impact, namely 'Achieving SFS in Europe in 2050 as well as in its Member States and their regions and communities'. The impact is fully in line with the vision of the P-SFS as stated in Chapter 3.

Outcomes: To reach such impact, the required outcomes will be 'a functioning Partnership' and 'a sound SFS research foundation'. This relates to the Mission of the P-SFS.

General objectives: In order to arrive at such outcomes, a set of general objectives is formulated around 'the functioning of FS', 'system approaches', 'inclusive government' and 'co-creation cases'.

Specific objectives: To reach the general objectives, a set of specific objectives is defined that focuses on the understanding of FS, the development of FS approaches in Research, Innovation, Science-Policy and Education (RIPE), and the establishment of a vibrant P-SFS.

The specific objectives can neither be addressed in all imaginable R&I Areas in food nor using endless number of activities and tools due to budget restrictions and operational efficiency. Therefore, the **four R&I (thematic) Areas** have been prioritized (listed in Table 1): (i) change the way we eat, (ii) change the way we process and supply food, (iii) change the way we connect with food systems and (iv) change the way we govern food systems. In addition, *four interconnected Activities Areas* are proposed: (A) Pooling R&I resources and programming, (B) Operational FS Observatory, (C) Active FS knowledge Hub of FS Labs, and (D) Functioning knowledge sharing and scaling mechanisms.

Table 1. Summary of the SFS partnership impact, outcomes, objectives, activities and the policies behind it.

Impact (what we like to achieve)			
A European Sustainable Food System in 2050 and beyond based on inter-connected, territorialised, sustainable food systems (being fair, safe, healthy, biodiverse, ..)			
Outcomes:			
<ul style="list-style-type: none"> - <i>EU-wide functioning Partnership</i>, based on collective and inclusive actions, providing knowledge for realising European SFS Policies, as well as public and private sector opportunities - <i>Strong foundation for a European SFS Research Area</i>, connected to global initiatives, with harmonised EU-wide policies and regulations, while respecting locally diverse contexts 			
General objective ('we like to'):			
<ol style="list-style-type: none"> 1. Understand <u>what SFS are</u>, how they function and how to enable their development; 2. Demonstrate that the partnerships '<u>systemic approach</u>' functions as a <u>catalyst</u> – for many FS actors – to jointly transform FS into SFS (also beyond the lifetime of the Partnership); 3. Ensure that the <u>well-governed Partnership</u> contributes to SFS via frameworks and evidence-supporting policy options for EC objectives in F2F, missions, Green Deal and the UN-SDGs; 4. <u>Co-create</u> with various actors in a diversity of Living Labs³ to develop SFS concepts. 			
Specific objectives (leading to concrete outputs that are generically applicable):			
<ol style="list-style-type: none"> i. Deepen insights in SFS research and innovation in particular in 4 thematic R&I areas, all considered from a FS lens and supporting transition through Living Labs; ii. Develop an innovative, systems approach that changes our way of collaborative working in RIPE activities; iii. Establish a vibrant epistemic community based on accepted working procedures, joint activities, and pooled resources that works together with related Partnerships. 			
Thematic R&I Areas			
R&I Area 1: <u>Change the way we eat:</u> Transition to sustainable healthy diets everywhere: shifting dietary patterns and consumption of safe, healthy, nutritious, affordable, accessible, equitable with reduced environmental footprint and culturally accepted foods.	R&I Area 2: <u>Change the way we process and supply food:</u> Supply-and demand-side research and innovation topics reorienting the activities in post-farming and fishing to reach sustainable healthy diets.	R&I Area 3: <u>Change the way we connect with food systems:</u> Citizen engagement and consumer trust in reoriented food systems delivering sustainable diets.	R&I Area 4: <u>Change the way we govern food systems:</u> Leverage points for local, national, EU and global transition pathways, public procurement, F2F code of conduct & local initiatives (incl. cities).
Transversal Activities			
Activity A: <u>Pooling R&I resources and programming</u> Joint transnational R&I support via project funding and alignment of funding priorities and mechanisms enabling multi-actor and systems approaches	Activity B: <u>Launching a FS observatory</u> Platform for sharing methods, metrics, data and assessments on the sustainability performance of food systems	Activity C: <u>Establishing a FS Knowledge Hub</u> for complex FS, transformative research and FS-Labs on systemic innovations at different scales (using a 'vitrine' for demo's)	Activity D: <u>Knowledge sharing, and scaling:</u> Adapting knowledge systems, innovation & demo platforms and science-policy- society interfaces for ensuring impact
Process cycle (for all Activity Areas)			
Foresights & planning (strategy & portfolio management), acting and developing (collaborative activities in FS labs), monitoring (via P-SFS specific KPI's), analysing and assessing, learning and deliberating, sharing and scaling, feeding back and adapting (the cycle of activities in different contexts), Impacting and strengthening the ERA			

³ There is a large variety of Living Labs, like policy labs, city labs, fab labs, field stations, experimental restaurants or supermarkets, logistics simulators, etc. (ENoLL, 2022)

5.2 Relevant strategies and pathways for the Partnership on Sustainable Food Systems

There is a global call to sustainable food systems (FAO, 2018; UN, 2021a.; FAO, IFAD, UNICEF, WFP and WHO, 2021). FS transformation is a key catalyst to meet the UN SDGs: end poverty, protect the planet (Rockström et al., 2009), and ensure that by 2030 all people enjoy peace and prosperity. Food is the common link between the 17 SDG's given the interconnected economic, environmental and social dimensions of FS. Even more, on one hand FS partially are responsible for the current planetary and social challenges (e.g. large emitter of GHG and user of water); on the other hand, they are able counteracting these challenges (e.g. capturing CO₂ via photosynthesis and recycling of water).

Hence, reforming FS provides a powerful lever to meet the SDGs. To take action to meet the SDGs builds sustainability on a local, national and global level. Considering the societal challenges, this process needs to be accelerated and this is why the *UN FS summit 2021* proposed action tracks (UN, 2022b.). These action tracks are: (i) Ensure access to safe and nutritious food for all, (ii) Shift to sustainable consumption patterns, (iii) Boost production that is positive for nature, (iv) Advance equitable livelihoods, and (v) Build resilience to vulnerabilities, shocks and stress.

With the *Green Deal* (EC, 2021a), the European Union has committed to a radical transformation of its economy into a sustainable, circular and inclusive economy. It aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050. Thus, it should aim to protect, conserve and enhance the EU's natural capital and eco-system services and protect the health and well-being of citizens from environment-related risks and impacts. The Green Deal is an integral part of the European strategy to implement the Paris Climate Agreement and the UN's 2030 Agenda for Sustainable Development.

The *Farm to Fork Strategy* (EC, 2021b.) aims to accelerate the transition to SFS that 1) have a neutral or positive environmental impact, 2) help to mitigate climate change and adapt to its impacts, 3) reverse the loss of biodiversity, 4) ensure food security and safety, nutrition and public health, making sure that everyone has access to sufficient, safe, nutritious, sustainable food, and 5) preserve affordability of food while generating fairer economic returns, fostering competitiveness of the EU supply sector and promoting fair trade. The P-SFS vision, mission and priority areas address all 5 ambitions. Also, some specific Farm to Fork strategy targets are similar for this Partnership, namely (a) creating a healthy food environment which makes the healthy and sustainable choice the easy choice, (b) food labelling to empower consumers to choose sustainable healthy diets, (c) stepping up to fight against food waste, (d) R&I and (e) promoting the global transition.

The *Food 2030* agenda lists ten pathways for action, which include governance and system change, urban FS transformation, food from oceans and freshwater resources, alternative proteins and dietary shifts, food waste and resource efficiency, the microbiome world, healthy sustainable and personalized nutrition, food safety systems of the future, FS Africa, and FS & data (EC, 2020). It also addresses priorities and the diversity of expected co-benefits for each pathway in terms of nutrition, climate, circularity and innovation. The FOOD2030 agenda will serve as a guide for this Partnership and help aligning its annual work plans to seek complementarities, exchange findings and avoid overlap.

The 5th *SCAR Foresight exercise* lists diversity, sustainable diets and full circularity as the pathways to action to reach a safe and just operating space for food systems (SCAR, 2020), similarly as the P-SFS SRIA. In addition to their very clear recommendations on how to proceed, there are multiple other policy documents and strategies that provide motivations or directions for the transformation of food systems to sustainable outcomes. These are included in the Table 2.

Table 2. Contributions to EU Policies & International initiatives (all Areas may contribute to all policies; here, only some, first, most-likely, contributions are listed (this draft needs to be updated):

EU Policies / Partnerships / Strategy doc <i>(alphabetic order first in Europe, than global)</i>	R&I Area 1 'Eat'	R&I Area 2 'Process & Supply'	R&I Area 3 'Connect citizens'	R&I Area 4 'Govern'	Activity 'A' Co-funding & programming	Activity 'B' Observatory	Activity 'C' Hub of FS Labs	Activity 'D' Knowledge sharing
Bilateral & Global Trade Policies								
Biodiversity Strategy 2030								
Bioeconomy Strategy and Action Plan								
Blue Economy								
Circular Economy action plan								
2030 Climate Target Plan								
Common Agricultural Policy / Common Fisheries Policy								
Europe's Beating Cancer Plan								
Europe's Digital Decade								
Farm-to-Fork Strategy								
Food2030								
Green deal								
High Level Expert Group, Platform for Food Systems Science (IPFSS)								
Open Science Policy								
Single Market for Green Products								
a Soil Deal for Europe								
Sustainable Aquaculture								
Waste Framework Directive								
Zero pollution action plan								
<i>Partnership Agroecology</i>								
<i>Partnership Animal Health and Welfare</i>								
<i>Partnership Agriculture of Data</i>								
<i>Partnership Biodiversa+</i>								
<i>Partnership Circular Bio-Based Europe</i>								
<i>(Partnership) EIT Food</i>								
<i>Partnership ERA4Health</i>								
<i>Partnership Sustainable Blue Economy</i>								
<i>Partnership Water4All</i>								
2030 Agenda for sustainable development & SDG, 2015								
FAO/WHO ICN2 Rome Declaration & Framework for Action 2014								
UN Decade of Ocean Science for Sust. Development (2021-2030).								
UN FS summit 2021 proposed action tracks								
United Nations (UN) Decade of Action on Nutrition 2016-2025								

The relevant policies and initiatives reveal that a renewed systems approach is crucial. According to numerous environmental, social and economic indicators, continuing our current lifestyles may surpass planetary and societal boundaries. This also holds for activities in the agro-aqua-food domains. Hence, we need to find pathways to urgently and possibly radically change future FS. The question of ‘which pathways to follow, and what actions to focus on’ translates into ‘renewing system approaches’ (chapter 5.3). This implies in-depth understanding of the complexity of diverse food systems (chapter 5.4). Only then, most appropriate leverage points can be selected. The approaches to food systems R&I will be further explored in the seven year’s duration of the P-SFS, across all four R&I (chapter 6) and four Activity areas (chapter 7).

5.3 The need for systems approaches and mission-orientation for the transition towards SFS

The different challenges of food consumption and production are linked, simply because improving – on the one hand – peoples’ diets for better health requires changes in what the food sector offers to consumers. This again depends on changes in primary production, processing and supplying food, all of which - on the other hand – may result in changed climate and environmental outcomes. A food systems approach is necessary in order to grasp these linkages, find synergies which may support several positive outcomes and facilitate conscious changes.

A FS can be defined as a system that embraces all elements (environment, people, inputs, processes, infrastructure, institutions, and power relations, markets and trade) and activities that relate to production, processing, distribution and marketing, preparation and consumption of food. A systems approach acknowledges the *interactions* between natural resources/ecosystems services, primary food production (farming, aquaculture and fishery), food processing, packaging, logistics, marketing, retail, food services, food consumption and waste management/recycling and the many feedback loops between them, which together defines the *degree of complexity* (Halberg and Westhoek, 2019). As mentioned, the P-SFS focuses on post fishing and farming.

These interactions result in a number of *outcomes* such as health, climate and environmental impacts as well as economic performance for different stakeholders. There are important *interdependencies between these outcomes*, e.g. the impact of consumers’ diets on their health as well as on climate emissions. Therefore, solutions to one challenge, in terms of FS transformations, needs to consider other consequences somewhere else in FS. Thus, FS perspectives should look for, on the one hand, synergies - where transformations in parts of the system may lead to improvements in several outcomes and for several stakeholders - and, on the other hand, trade-offs between desirable outcomes.

Likewise, a food systems approach may help identifying *drivers for change*. This also includes pressure from consumers or other stakeholder groups, innovations and niches with strong potential, as well as *leverage points*⁴, where changes in one part of the system may produce large transformations across the whole system and its outcomes. Contrary to this, one may also identify *lock-ins*, like established structures and strong economic or cultural interests of some stakeholders that block desirable transformations for others.

A ‘food systems lens’ will help establishing a shared understanding of the challenges and the complex interactions between actors. This serves as a basis for coherent activities including how to prioritize integrative and thematic R&I actions. Thus, a ‘FS approach’-oriented partnership should focus on the interactions, interdependencies as well as drivers, leverage points etc. in the strategic programming of R&I. Such a FS perspective needs to be further developed and guides the overall prioritization of the funded activities from a portfolio perspective, thus continuously recording and assessing outcomes from the

⁴ Leverage points are places within a complex system where a small shift in one thing can produce big changes in everything. D. Meadows, 1999

projects. The outcomes should be analysed in light of impact pathways in order to ensure that remaining and new knowledge gaps will get sufficient attention in next round of activities.

5.4 Getting insights in (un-)Sustainable Food Systems as basis for 8 Areas

The first concepts of food systems with drivers, activities, and outcomes were published 15 years ago (Ericksen, 2008). Thereafter, attempts were made to unravel food systems via modelling approaches (e.g. van Mil et al., 2014). However, FS are rather complex due to the diversity in resources, actors, activities, regulations, contexts as well as the countless interactions between actors (Halberg and Westhoek, 2019). This makes it difficult to determine whether pathways are really leading to desirable, sustainable, outcomes. If SFS should not compromise future generations (WCED, 1987 'Brundtland definition'), then FS should endlessly balance between both a lower- and upper limit for each 'sustainability' indicator (de Vries et al., 2021). This notion needs to be incorporated in future FS concepts.

The first challenge is to establish harmonised, operationalised and manageable concepts, models and methods for FS. These should help to guide the future P-SFS actors in overall programming as well as in case studies (see below). As an illustration, one may build on widely shared experiences with games (like cards, soccer, chess, and Monopoly; see Fig. 3; adapted from de Vries et al., 2022), but now projected as serious attempts to understand FS.

In a game, there are seven building blocks: *pieces*, *moves*, *players*, *rules*, *playing field* (or *space*), *time*, and win-lose *outcomes*. If one characterises FS in such a way, we will have (i) 'pieces' like resources, food products, diets and food services, (ii) 'moves' like food handling schemes (like production, processing, distribution, consumption, digestion and recycling) and supply-demand chains (for main and co-products, and waste), (iii) 'players' like food actors (directly involved in consumption such as consumers, farmers and manufacturers, and indirectly involved as financiers or medical doctors), (iv) 'rules' like regulations and incentives (novel food law, code of conducts, subventions), (v) 'time' like time-schemes for FS operations, (vi) 'playing fields (space)' like food contexts (geographic, cultural,..) and (vii) 'win-lose outcomes' as sustainable or unsustainable FS outcomes.

The analogy between the 4 R&I and 4 Transversal Activity Areas and the seven building blocks is apparent in Fig. 3, and is expressed as follows:

- ❖ R&I Area 1 deals with (eating) diets which are 'pieces' (i);
- ❖ R&I Area 2 with processing and supply as 'moves' (ii);
- ❖ R&I Area 3 with connected citizens (acting in different roles) as 'players' (iii);
- ❖ R&I Area 4 with governance and legislation as 'rules' (iv);
- ❖ Activity 'B' Observatory following the dynamics of food systems as 'time (or timing)' (v);
- ❖ Activity 'C' Living Labs as different 'playing fields' (vi).
- ❖ Activity 'A' (co-funding & programming) and Activity 'D' (knowledge sharing) are different. They are providing the means (funding) to play and interact via information sharing and hence strongly steering actors towards sustainable or unsustainable FS outcomes (vii).

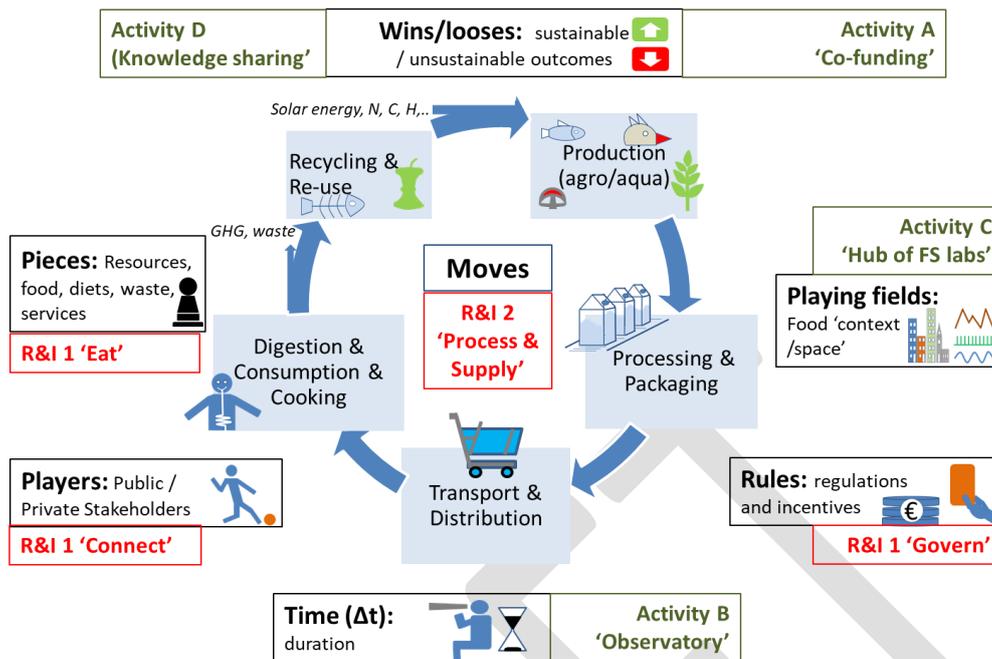


Fig. 3 the seven building blocks of FS (by analogy with a game); modified from: de Vries et al., 2022.

It should be noted that the analogy with a game also holds for reflecting on interactions between all four R&I and four Activity Areas. The seven building blocks in a game form a coherent set; one cannot play a game without players or pieces, etc. This set allows playing a game: a player moves pieces on a playing field, sticking to rules, respecting time constraints, with the ambition to get a positive outcome. In a similar way, if we change the way we eat, we need to change the way we process and supply, or govern, or act and connect to food systems as citizens in our own specific food environments. Without an observatory we will not be able to follow in time what happens. If we don't have experimental FS-Labs we cannot test our activities to reach best outcomes. Without pooling resources, nothing will change. Finally, if we don't speak a common language we cannot inclusively strive for better results.

Food systems are continuously challenged by changing conditions. Each external change or stress – like extensive flooding of a 'playing field' - will first target a specific building block of a FS, and consecutively affects all other building blocks. It may destabilize FS that are not sufficiently resilient. The same holds for a targeted external measure, like the Farm-to-Fork Strategy objective for 50% per capita food waste reduction; this is a changing 'rule' at retail and consumer level by 2030 (SDG Target 12.3). Each time that something is changed (either on purpose or not), the key question is: *'will this change serve as leverage point that impacts all building blocks of FS such that the overall outcome will be sustainable or are there unforeseen lock-ins, outcomes and trade-offs?'*

Consequently, the resilience of food systems – understood, as their capacity to adapt to external shocks while maintaining their basic functions and objectives – is an crucial element of sustainable systems⁵. Thus, deeper insights in the degree of resilience of highly different FS are needed (e.g. via complex adaptive systems theories, agent-based modelling, scaling phenomena, etc.). For each external change, the seven building blocks should integrally be taken into account, as mentioned previously, and their emerging properties be monitored and analyzed (in Activity 'B'). In Activity Area 'C', the hubs (FS-Labs) will provide the

⁵ In nature and society, numerous examples exist of complex, dynamic, systems that are able to evolve (like for example human being or cities) thanks to their self-organizing capacity.

enabling conditions to elaborate a set of diverse FS cases with different stakeholders in diverse contexts (thanks to co-funding of Activity 'A'). It will not only target local cases, but also interactions between them and potential trade-offs; here, knowledge sharing is primordial (Activity 'D'). This also requires developing exchange mechanisms which guarantee that interacting FS all together reach sustainable outcomes (in the EU-wide Knowledge Hub of Activity 'C'). Examples are exchanging critical resources, sharing expertise on food handling, circular business models between actors in different FS, trade exchange measures like the CO₂ credits, or new social compensation measures, etc.

DRAFT

6. Four Research and Innovation (R&I) Areas

The thematic R&I Areas and Transversal Activities were developed in a process guided by the SCAR Food Systems SWG and DG RTD. National representatives and a representation of trans-European umbrella organisations and stakeholder groups were involved. Since autumn 2019, several workshops have been organised to discuss the content and the process. Four narratives have been written by nearly 50 experts; these have been consolidated in a single narrative (SCAR FS SWG, 2021). The narrative served as basis for the Template (an EC-format), which provides an overview of all key elements of the future Partnership (EC, 2022e.). All trajectories have been interactive, including open consultations with the wider public. During this trajectory, the following four R&I and four Activity areas to drive the change towards SFS have been consolidated and detailed by a Taskforce of eight persons from different EU countries; each of them got support from a group of experts.

6.1 R&I Area 1 'Change the way we eat'

Subtitle: Transition to sustainable & healthy diets everywhere: shifting food environments and consumer behavior to promote sustainable consumption of safe, healthy, nutritious, affordable, accessible, equitable and culturally acceptable tasteful foods while tackling malnutrition in all its forms and promoting health.

Status

The global FS is facing a range of challenges, but also contributes to some of them: Climate change, resource scarcity, biodiversity loss, soil degradation, pollution, a growing and ageing population, urbanisation, food waste, food insecurity, poverty, and unhealthy diets (e.g. low in whole grains, fruits and sodium (Afshin et al., 2019)). These impact human and planetary health and markedly contribute to non-communicable diseases (NCDs), global environmental and climate change, social health and environmental inequalities (Willett et al. 2019; von Braun 2021).

Monitoring policy implementation in WHO European Region shows that even though there are improvements in the food and drink environment, still significant MS-driven FS transformations are needed (Breda et al. 2020). Continuing current trends, by 2050 the world will need 30-50% more protein to meet demand. The triple burden of malnutrition – undernutrition, overweight and obesity, and micronutrient deficiencies, is present to variable degrees in all EU countries (Swinburn et al., 2019; FAO, 2021).

The partnership on Sustainable Food Systems will adhere to the definition of sustainable diets as defined jointly by FAO and WHO (2019) under the term “Sustainable Healthy Diets”. *Sustainable Healthy Diets (SHD) are dietary patterns that promote all dimensions of individuals’ health and wellbeing; have low environmental pressure and impact; are accessible, affordable, safe and equitable; and are culturally acceptable. The aims of Sustainable Healthy Diets are to achieve optimal growth and development of all individuals and support functioning and physical, mental, and social wellbeing at all life stages for present and future generations; contribute to preventing all forms of malnutrition (i.e. undernutrition, micronutrient deficiency, overweight and obesity); reduce the risk of diet-related NCDs; and support the preservation of biodiversity and planetary health. Sustainable healthy diets must combine all the dimensions of sustainability to avoid unintended consequences.*

Thus, besides objectives of improved nutrition, major sustainable dietary shifts are imperative to reach the ambitions of the EU Green Deal, Farm to Fork strategy, and EU’s climate goals. Health, climate and

environmental objectives of SHD are still poorly aligned (Springmann et al., 2018; Herforth et al., 2019; Martini D et al., 2021).

Given the complexity of dietary behaviors and the wide range of factors influencing dietary choices – including in particular also taste, price, convenience, and cultural habits – joint actions of a variety of actors and targeted policies are now needed to reach sustainable healthy diets. This asks for data on current diets of different social groups around Europe. To harmonise dietary intake survey methodologies and build a common “EU food consumption database”, EFSA (2022) is currently supporting 36 dietary surveys on children and/or adults from 18 EU-MS and 4 pre-accession countries (Ioannidou et al., 2020; Gurinovic et al., 2022). National food-based dietary guidelines provide context-specific advice and principles for healthy diets and lifestyles. These respond to their public health and nutrition priorities. Food production and consumption patterns, socio-cultural influences, food composition data, and accessibility, are taken into account, but ecological considerations and tools for multi-criteria assessment are only recently looked at. Moreover, most of these datasets are not comparable because different methodologies and parameters have been considered. Furthermore, consumers are confronted with a multitude of private quality schemes, guidelines and public and private production schemes (organic, vegan, vegetarian etc.). We still do not know enough about the impact of these guidelines and schemes on behavior, and the tools to direct behavior in a sustainable way. In addition, as proposed by JPI HDHL (2019), focus should change from individual approaches to more collective approaches, because research has shown that individual interventions, such as education around sustainable food, are insufficient to change behaviour.

The WHO estimates that food-borne bacteria, parasites, toxins and allergens cause about 23 million cases of illnesses and 5 000 deaths in Europe every year (WHO, 2015). Due to climate change, food safety risks could increase (FAO, 2020), since a number of food and water-borne pathogens in Europe are climate-sensitive. Their distribution, incidence frequency and severity of diseases are likely altered (McIntyre *et al.*, 2017). Shifting to sustainable diets requires thus food safety attention, even more, due to new FS transformation practices targeting circularity, diversity, etc. (FAO 2022).

How will R&I Area 1 contribute to the impact pathways and the Intervention Logic

Only shared, science-evidenced and socially-accepted views on principles of sustainable diets will contribute to future SFS in Europe and its territories – while acknowledging that new view can challenge stakeholders. This needs incorporation of perceptions and attitudes of citizens on sustainable consumption and desirable diets into food policies, and food-based dietary guidelines (FBDG).

P-SFS will provide improved knowledge and understanding of synergies and trade-offs between health/nutrition qualities of foods and diets in different contexts and facing other sustainability objectives (with R&I 1). This will provide a basis for improved composition of individual foods through innovations in products, product composition by food producers – also using new and upcycled ingredients – with improved efficiency in processing strategies and technologies (with R&I 2). These should attempt to combine reductions in environmental and climate impact with improved nutritional composition and reduction of unhealthy components. The food environment⁶ - as the pivotal interface between the food supply chain and the citizens (see R&I 3) - will in the future contribute to sustainable, healthy, and safe food and diets by making them attractive, available, accessible, acceptable, desirable and affordable for consumers including low-income groups. Moreover, R&I can contribute to improved identification and characterisation of new

⁶ The food environment is the micro- and macro context in which a consumer chooses food. It is the environment beyond the individual (e.g. beyond own attitudes or competences), encompassing also the social context and the direct environment (e.g. the supermarket or canteen), which in turn are impacted by the macro-environment (e.g. the economic, social, cultural, technical).

(re-)emerging foodsafety hazards (chemical, microbiological, toxicological), which may be handled by a dynamic and up-to-date, science-based monitoring and regulation system.

Knowledge gaps to be addressed

Achieving sustainable diets is complex and requires a multi-pronged approach. Actions include – besides new ways of processing mentioned in R&I Area 2 - awareness-raising, behaviour change interventions in food environments, food education, strengthened urban-rural linkages, reformulation, improved product design, packaging and portion sizing, understandable labelling, new ways of improving accessibility, investments in FS innovations, public private partnerships, public procurement, and alternative uses of food waste (Herrero et al, 2021). The necessary citizen engagement and innovations in governance are mentioned in R&I Area 3 and 4, respectively. If multiple and interlinked outcomes of SFS should be negotiated and mutually accepted (e.g. criteria for healthy, sustainable, accessible diets), knowledge and experience about accepted and achievable norms should be developed. Also, tools for multi-criteria assessment of food and diets are then required using a sustainable FS framework for evaluations of current and new sustainable diets FBDG in a FS perspective (with Activity 'B'). These should support dialogues between stakeholders in FS-Labs (with Activity 'C').

More in detail, the following gaps are to be addressed:

- Assessment of existing FS status elements for sustainable diets on European, national and sub-national levels: analyse the available current food consumption data using harmonised individual dietary intake methods for comparison of diets for different population groups, by age, gender, income and regions as baseline to identify dietary shift and nutrition indicators changes using the FS lens.
- Assessment of climate and environmental impacts from FS by improving Life Cycle Assessment (LCA; EC, 2021c.) methodologies from single products to diets and further combining LCA with other sustainability criteria including nutritional value.
- Understanding and assessing potential burden shifts in FS from prioritizing certain objectives such as climate smart food at the potential cost of other criteria such as animal welfare, biodiversity or water use.
- Development and implementation of FBDG: an important tool for sustainable diets, a key instrument to guide policy, private sector and citizens, a communication and dissemination tool for health and education professionals for implementing FBDG in public sectors (health, agriculture, education) and settings (schools, community and workplaces) and for influencing food environments. A Methodology Guide is needed how to develop or revise existing FBDG in Europe taking into consideration international principles for sustainable diets, cultural, socio-economic and environmental conditions in MS.
- Understanding how best to enable and motivate consumers to make responsible consumption choices is pertinent information for actors in the entire FS. Relevant strategies to explore include consumer's own dietary strategies aimed at moderation (energy balance and reduced over-eating), diversity (e.g. meat replacement and eating more plant food), whole foods or targeted environmental impact (e.g. reducing waste or eating fish from lower trophic species) and consumer's acceptance of producer strategies (e.g. new protein sources from plants cultivated in water or marginal lands and bacterial and fungal biomass, and mild processing methods).
- To which degree consumer attitudes towards the environmental and social dimensions of sustainability is related to specific enablers in food environments that may also positively interact with food choice for better nutrition and health - and vice versa.
- And how may Data-driven documentation of sustainability aspects be based on collection and processing of data from entire FS and to which degree will they contribute to sustain the trust of the customers?
- Know-how for creating enabling food environments: through government mechanisms, incentives and disincentives, legal frameworks, and regulatory instruments, the production, processing, distribution,

labelling and marketing, and consumption of a variety of foods should be promoted that contribute to Sustainable Healthy Diets (with R&I Area 3 and 4). Barriers for change (lock-ins, resistance among stakeholders, negative feed-back loops) and leverage points are to be understood, including new models taking into account consequences for vulnerable populations globally. Food safety: insights are lacking in new forms of trade and value chains as well as innovative products and processing (with R&I Area 2). This offers opportunities for developing improved methods for risk-benefit analyses of sustainable diets and potential (unknown) emerging hazards (e.g. increased intake of e.g. alternatives to animal derived products like cultured meat, algae, insects ready to eat products or raw/minimally processed products; microbe-based, ocean-based other than algae, fungus-based.). There are also knowledge gaps and lack of methods for understanding the interrelations of food additives, micro plastics, residues of veterinary drugs and pesticides, the gut microbiome and human health.

R&I&P questions to be answered in R&I Area 1

- What diet changes will have the greatest positive potential impact on health, environment and other sustainability criteria taking into consideration the diversity of European FS, agriculture, natural, social and cultural conditions and potential indirect impacts on global and local FS?
- How may the current FBDGs across Europe become better aligned with guiding principles for sustainable diets and how may LCA methodology be improved to assess sustainable diets from multiple criteria?
- Which barriers and opportunities will policy makers and consumers face in order to compose diets which are e.g. healthy, climate smart, environmentally and economic sustainable and culturally appropriate? What are possible trade-offs between nutritional, environmental and climate objectives under different conditions?
- Leverage points for dietary changes: what are main determinants, barriers and leverage points for consumers to change the way they eat? What are factors influencing consumer dietary choices?
- To which extent and how do different groups of citizens perceive dietary choices and the linked consequences in a FS perspective? And how may use of big data to assess demands, willingness to pay, nudging, and cultural and social barriers.
- How to combine health and other sustainability aspects in strategies to balance multiple criteria in culturally and culinary-diverse dietary habits while adapting to lifestyle changes and physical needs?
- What is the role of shaping the food environment in EU or MS to facilitate acceptable and affordable, healthy and environmentally sustainable choices while reducing inequalities?
- How can consumers be enabled and motivated to shift towards more responsible consumption, taking into account information on sustainability attributes at product and dietary levels including appraisal of e.g. plant-based and novel foods using recirculated residues and reducing food waste?
- To which extent are niche consumption strategies (vegan, vegetarian, flexitarian, organic, prosumer) efficient ways to help achieving sustainable diets at local and global levels?
- What are the possible synergies between policy/governance (R&I Area 4); citizen engagement (R&I Area 3), changes in Food environment and novel technologies (R&I Area 2) to support FS transformation and uptake of sustainable diets?
- What are the most pertinent challenges to food safety arising from transitions towards SFS and which innovations are needed to tackle new food safety hazards influenced by e.g. climate change?

Requested enabling conditions

- Shifting dietary habits presents a significant challenge for cultural, political and economic reasons, and will require actions at all levels involving Science-Policy Interfaces (SPI), governments, stakeholders

(Science-practice interactions) and individuals as well as information and education programmes for continuous capacity development.

- Governance of multi-sectoral and multi-stakeholder, transdisciplinary coordination mechanisms that addresses the country's food and nutrition security challenges and commitments.
- R&I policies and socio-economic preconditions as drivers for sustainable diets.
- Multi-actor engagement processes based on systemic approaches to connect, scale-up and boost EU R&I in a diversity of sectors; these processes should allow back casting from public health and environmental impacts to FS activities in food environments (retail, shops), food services (e.g. restaurants, canteens), logistics, manufacturing (safety, reformulation), procurement, and primary production. Support by researchers, policymakers, SME and industry, NGOs, educators, knowledge brokers, consumers and civil society is needed and especially the private sector is expected to contribute to joint R&I activities. Improve FS communication and education of various population groups and FS actors with methods adapted to different cultures, age/gender, values and beliefs at different levels (governments/public authorities, healthcare providers, educational systems, etc.). Develop innovative digital tools to inform and nudge consumers through food labelling/campaign/strategies on the link between healthy and safe food consumption practices with other aspects such as sustainability, environment, climate change, diversity, and empowerment to make conscious and responsible choices.

Expected results

R&I Area 1 contributes to the general objectives by providing insights in FS approaches resulting in (mutually accepted concepts, methods and models for) sustainable diets, including their contexts ('food environments') of consumption and identifies potential new policy measures necessary to support sustainable diets. It provides content to the outcomes, namely to the European SFS Area, in particular in the area 'change the way (what) we eat', and supports the functioning of the Partnership as inclusive platform by mobilizing different consumer groups around Europe.

Due to the ambition to provide healthy diets, that are sustainably produced in the very diverse, territorialized food systems, R&I Area 1 will substantially contribute to the P-SFS impact. It's EU-wide focus on alignment of health, safety and sustainability objectives and its respect for culturally-diverse, tasteful and affordable diets locally, underlines the importance of R&I Area 1 as focus area.

Activities to carry out to achieve the expected results

There will be a variety of activities to be carried out; these will be annually updated. Here, first activities are fully focused on answering the questions stated above in the **R&I&P** section.

The main activities will be to manage a portfolio of R&I projects supported via calls developed and supported with Activity A. The calls will be formulated to cover the identified knowledge gaps and R&I questions from a FS approach, thus taking into account linkages between the four R&I areas. Moreover, R&I projects will contribute to the Activity areas B and C insofar as their results will feed into the FS observatory and some projects will build on FS-Lab methodology.

6.2 R&I Area 2 ‘Change the way we process and supply food’

Subtitle: Supply- and demand-side research and innovation topics reorienting the activities in post-farming and -fishing part of food systems to support sustainable diets

Status

The P-SFS focuses on post-fishing and -farming part of food systems, hence on processing and supply food, since other Partnerships target pre-harvest in green and blue environments. Numerous food processing concepts have been developed that are resource-, energy- and water-efficient. They seek to deliver food properties and functionalities according to consumer preferences, cultural and nutritional needs while guaranteeing food safety. The same holds for efficient agro-food-logistic schemes; they are based on supply and demand chain models and modalities that are connecting consumers, retailers, food service via logistic providers with food manufacturers, producers and recycling firms. Processing and supply chain practices have strongly been favoured by the ‘*economies of scale*’ principle, also visible in sizes of food chain actors including retail. It is hypothesized that this has contributed to over-exploitation and over-consumption, vulnerabilities to crisis, power imbalances in chains, and tensions on employment in SMEs. It may even have resulted in disconnecting consumers from the intrinsic values of resources and their production ways. *Hence, innovative processing and supply are here considered that may help in counteracting these tendencies* (Lillford and Hermansson, 2020). They support rescaling, delocalizing and efficient⁷ smaller-scale manufacturing (in the field or at home) and supplying food. The aims are to contribute to sustainable, diverse and healthy diets, new appreciated product functionalities, less packaging material usage, and near-zero waste. In addition, a more efficient valorisation of co-products and (recycled) waste streams is envisaged, by new clusters of actors (including citizens), in all parts of FS, thanks to adapted legislation and subventions.

How will R&I Area 2 contribute to the impact pathways and the Intervention Logic

Change the way we process and supply food will contribute to European Sustainable Food Systems (SFS) in 2050 and beyond, being resilient to crisis like pandemics and lock-downs. However, the P-SFS needs to join forces with the Partnerships in pre-harvest to really reach sustainable outcomes. Here, we are starting from consumer orientations and from fair, carbon-neutral, low environmental footprints (Poore & Nemecek, 2018), microbial and chemical safe, healthy, near zero-waste and diversified products and diets. The changes will also favour circular usage of resources, including energy and water, at different scales in appropriate food environments targeting diverse consumer group expectations. Hence, they are all responding to Farm to Fork Strategy objectives, EU’s FOOD2030 priorities and the Soil Mission (EC,2022h.), while aligning with FOOD2030 pathways.

Diversification is considered as one of the main drivers for processes and supply chains to provide diverse diets and handle biodiverse (agro-ecological) resources, with a specific challenge to align supply- and demand-driven processing. This also includes tasteful and high quality, innovative food products from alternative protein crops, forgotten (ancient/underutilized) crops, algae, low-trophic fish species and invertebrates, insects, etc. Diversification evokes challenging research questions in the microbiome field and especially holobiont (host plus its microbiome) and its constituent hologenome (the totality of genomes in the holobiont).

Re-localisation and adapted logistic schemes will result in re-scaling of processes and alternative (short and long) supply and demand chains. This includes cascading methods for locally transforming main and co-

⁷ Efficiency is here defined as ‘costing least or minimal effort while taking care of imposed boundary conditions at the same time, where effort can be identified as a combination of minimal exergy loss, minimal diversity of species loss.

products into food and feed, and other bio-based products (in pharma, cosmetics, biomaterials, and bioenergy; with the Partnership Circular Bio-Based Europe). Here, technological, social, economic and organizational innovations are integrally addressed (with Activity 'C').

Circularity is a next driver to close nutrient cycles and efficient usage of resources. This asks for new recycling and processing on-demand methods, food waste prevention and reduction guidance tools (for households, food service and retailers, producers), safety tools and measures (e.g., avoiding migration of non-intentionally added substances from recycled food-contact materials to food), conservation methods, hygienic designs and disease control.

Digitalization of processes and food supply chains is another main driver. Digitalization provides a large potential for bottom-up controlling and steering material flows and reducing waste and inefficiencies along value chains. It provides the potential for flexible production systems e.g. producing smaller individualized batches. This covers adequate sourcing and transport of raw materials with knowledge of quality parameters, processing (local or centralized), intelligent packaging and distribution. By a standardized use of non-destructive digital devices and tailored predictive algorithms, individual decisions can be made, taking into account most appropriate sourcing, product handling, daily needs and pricing mechanisms. This requires new ('top-down'?) measures for balancing 'demands and supplies', combined with 'bottom-up' assembly and disassembly strategies for resources. It asks for transparency on eco-friendliness, bottlenecks, and governance steering (incl. legislation and taxes).

Complex FS modelling, predictive benefit-risk chain assessments and fraud modelling (AI, block chain technologies, etc.), early warning signalling, date marking in relation to food security, safety and waste, and data management, are key themes to be addressed.

A key transversal topic is *novel food processing methods* that preserve the freshness of natural raw material, including vegetables and fruit, with limited transformation of protein, carbohydrates etc. They limit the use of additives and seeks optimal health properties of food (with R&I Area 1). This will be combined with innovative preservation schemes (storage, packaging), adaptable to various supply chains keeping shelf-life all along the food chain. '*What needs to remain fresh, at what costs and how to be balanced between seasonal and all-year-round food?*' To answer this question, guidelines are needed that relate eating behaviour and diet variability between sustainability limits. Collection and processing of data from the entire food value chain is a prerequisite for all areas (together with Activity 'B').

Food design is a second transversal topic. Products need to be more climate-neutral and at the same time safeguard strong eating experiences – to ensure consumer purchase and re-purchase. This requires a deeper understanding of the multi-faceted needs of consumers and customers, their buying behavior and how they use and consume the products (Meijer et al., 2020, with R&I Area 3). This understanding should be combined with research enabling to develop perfect texture, taste and nutritional quality experiences (with R&I Area 1 and health experts from e.g. JPI HDHL (2019)) and reduce food waste. This encompasses knowledge within areas such as fermentation, processing methods, texture, sensory science, and consumer preferences.

Knowledge gaps to be addressed

The following knowledge gaps in post-farming and -fishing are currently hindering the transition to SFS, hence will be targeted:

- Understanding barriers and identifying drivers for transitions towards sustainable food value chain including various actors in food networks (Knorr and Augustin, 2021; with R&I Area 4) – in line with FOOD2030 pathways and Soil Mission – which end at TRL 9 (work to be done together with EIT Food).
- Understanding the pros and cons of innovative, delocalized, mild and targeted processing and supply schemes for circular, low environmental footprint and diversified (agro ecological, marine) production schemes; these include also culturally, age and gender diverse healthy diet characteristics (with R&I Area 1) in territorialized and global SFS;

- Understanding FS scaling principles, via numerical approaches and hybrid models for innovative, diverse, resource-efficient processing and supply schemes.
- Appreciation factors about the role of innovative processing and new products in a SFS perspective (together with R&I Area 3).

How will R&I Area 2 contribute to the overall aim of SFS via a Food systems approach

First, the technological and logistic innovations are combined with organisational (new co-creation models) and social (e.g. new participatory concepts) innovations via systemic approaches. Often, a technological innovation should go hand-in-hand with organisational and social innovations to reach sustainable outcomes. Secondly, there is a need to reconsider processing and supply methods for (re-)valorising forgotten or under-utilized crops or livestock species, saline-tolerant and drought-resistant species, alternative protein sources (like legumes and insects), (cocktails of) micro-organisms (exploring the microbiomes), etc. The reason is that these may allow creating FS, targeting sustainable healthy diets, revitalising food cultural heritage, and so on. Such re-valorization procedures should follow system approaches verifying their positive environmental, social and economic impacts. Cooperation with other Partnerships in pre-harvest is then imperative.

R&I&P questions to be answered in R&I Area 2

- How can food actors – both private and public parties – sustainably optimize current value chains? The following elements are to be considered: new products (incl. microbial-based), new processing technology, smart and efficient food production strategies and technologies, prevention of waste thanks to intelligent packaging, valorisation of co-products, alternative trade channels, innovative marketing and business models including the development of marketing rules and regulations, code-of-conducts, new (co-)financing schemes (with Activity 'A'), citizen-participatory actions, etc.
- What smaller-scale, mobile, mild and targeted technologies can impact current FS (including resource, water and energy efficiency)? What does this imply for rebalancing and co-existing local, intermediate and global chains and engaged actors, for the scalability of FS and the understanding of scaling principles in general? How can they connect developed and developing countries fairly, based on indicator sets, without resulting in trade-offs?
- While seeking higher diversity in resources, how can supply- and demand-driven processing and packaging be matched in time and place? What does this mean for resource-efficient usage, waste recovery, recycling and safety, social appreciation, economic soundness and dynamics of FS actors? What is the potential usage of digitalization (big data, artificial intelligence, robotics, sensing, information exchange models, etc.)?
- Which novel, mild and targeted process, packaging and (circular) supply schemes can support the interactions between different FS (e.g. between MS in Europe) and why? What does this mean for trade and legislation between FS? How will this impact the robustness, resilience, autonomy and performance of each FS in times of crisis (pandemic, war) and of the overall EU FS? Which exchange mechanisms should be put in place in the area of processing, packaging and supply?
- What are the most important unnecessary barriers (including lock-ins) that may block the desired transitions in a FS perspective and which leverage points may enable positive interactions and synergies between technical and social innovations?

Requested enabling conditions

The first enabling conditions concerns the possibility to exploit (thanks to Activity A) different (living) FS- labs, experimental restaurant and retail settings, in-field manufacturing test stations, mobile labs, simulators for agro logistics, and connecting with the European Digital Innovation Hubs Network, Agro-ecology, Soil Mission Labs and EIT food innovation and education activities (with Activity C). These engage consumer groups with

different profiles, cultures, age and gender, behaviours, dietary drivers, food buying profiles, and education levels (R&I Area 1 and 3).

Next, rethinking and launching case studies require willingness of very diverse actors to participate such as out-of-the-box thinkers, politicians, legislators, and investors, also at other continents (R&I Area 4). In addition, a series of workshops should mobilize actors to elaborate on (i) scenario development, (ii) Code of Conduct practices, (iii) 'food' gaming (e.g. with museums), and (iv) potential trade-offs and uncertainties. Also, actors should be capable and willing to exchange data via platforms, e.g. with the JRC'S for statistical data and dynamic hybrid models (with self-learning algorithms) dealing with diversity, circularity, resource-efficiency, LCA, and scaling (with Activity B and C). Finally, exchanges with the new regulatory and policy framework would contribute to the required science-evidence (Activity D).

Expected results

R&I Area 2 contributes to the general objectives of the intervention logic via (i) deeper insights into the resilience, adaptation capacity and level of food security of FS which are transforming and recycling more diverse resources, and their co-products, (ii) the potential to combine technological, organisational and social innovations that reveal new collaborative working concepts systemically, and (iii) the wide variety of well-documented case studies on different delocalised FS schemes provide data for the Observatory, and Hub of Hubs.

It contributes to outcomes in two ways. The focus on bio-/dietary-/cultural-*diversity* in processing and circular supply chains permit collective and inclusive sustainability-oriented actions at all scales in time. It supports locally diverse FS and EU-wide activities, that request new EU regulations and guidelines regarding employment options, cooperation and information exchange.

Regarding impact, the foreseen activities provide both input to local FS striving for sustainable outcomes and food security as well as for the EU-wide SFS with diverse, healthy, safe and accessible-fair diets. Hereby, it will support the innovation of new food ingredients and processing technology.

Activities to carry out to achieve the expected results

There will be a variety of activities to be carried out; these will be annually updated. Some first activities are:

- A series of case studies targeting the R&I&P questions will be performed in diverse FS-labs (with Activity 'C') using down-scaled, mild, technologies, new packaging concepts and logistic schemes. They will address different scales, and use recurrent time-series approaches in which actors, consumer / citizens' inputs are provided continuously. Data collection and analysis will be done with Activity 'B'.
- A number of complex food system studies will be executed which target local, intermediate and global value chain configurations. These studies will include new hybrid modelling using the full spectrum that digitalization can offer. If this concerns new coordination actions between very different actors, CSA-type projects will be launched (with Activity 'D').
- In consultation with the EC's Food2030 Pathways and funders in Activity 'A', R&I projects will be supported that address gaps in existing knowledge and technology for example in processing and logistics that may be crucial for reaching sustainable outcomes.

6.3 R&I Area 3 'Change the way we connect with food systems'

Subtitle: Citizen engagement and consumer trust in reoriented food systems

Status

There is a good basic understanding of the challenges and perspectives of engaging consumers in conscious food choices based on information campaigns and labelling, although the issue of food labelling is contentious and struggle with lack of harmonized criteria and methods. It has also been established that there are large differences between consumer groups and segments. Less, however, is known regarding how to engage the potentially interested, but not yet participating groups in sustainable food systems. The question is to what extent may different segments of citizens be directly engaged in modifications of their FS, development of alternative FS (local, consumer-managed, consumer supported agriculture (CSA), etc.) and/or in re-evaluating their food purchases in light of what is best for the whole value chain or FS? The Food2030 FS intervention experiences have provided examples; however, many did not demonstrate a FS approach. An exception is EIT Food. It has established a number of consumer-directed activities including the EU trust barometer and networks of consumer scientists working with companies to integrate consumer perspectives in innovations in food products, processes and services.

There are ongoing practical and research-based efforts to develop labelling schemes for food products (Animal welfare, Climate, Organic, Sustainability, ...) at EU and national levels and studies of consumer appreciation (Futtrup et al., 2021; Majer et al., 2022). There are some examples of nationally coordinated labelling schemes but also many private labels of single issues (by retailers and/or manufacturers). However, the diversity of labels might cause confusion and lack of trust. Consequently, the ECs long lasting effort to establish an overall framework and methodological guidelines for LCA-based environmental footprints of goods (including food) with wide stakeholder and industry engagement (Product Environmental Footprint (PEF); EcoChain, 2022) is important. There are yet few attempts to combine labelling of different issues, for example to provide information on climate impact and nutritional value of the same products. The Farm to Fork strategy includes an ambition of developing a sustainable labelling framework that covers, in synergy with other relevant initiatives, the nutritional, climate, environmental and social aspects of food products. However, the scientific basis for how to combine a number of such different aspects of sustainability is not in place, neither is the knowledge of how consumers may appreciate a holistic label (Futtrup et al., 2021).

There is growing appreciation of the importance of the so-called "Food environment" (see footnote '6') for consumers' purchase choices and the options for changing consumer interests and habits by nudging. For example, there is ongoing work in some countries promoting diet changes via (training of staff in) professional kitchens. Growing in importance is also the perspective focusing on practices of eating and the notion that they are inter-twined with the whole FS, various actors in the systems, and other practices.

Under the term Food Democracy different organisations and scientists have emphasized the need for "greater access and collective benefit from the food system" (Lang, 1999). While mostly focusing on bottom-up processes in niche FS (e.g. local FS and Community-Supported Farming) increasingly the focus is shifting to opportunities for citizens to influence the mainstream FS beyond using their purchasing power ("voting with your food basket"), thus finding mechanisms for engaging in transforming the dominant food environment by cooperative actions (Cifuentes & Gugerell, 2021). A few EU projects have initiated the development of solutions congruent with Food Democracy in short supply chains (e.g., the PLATEFORM project via the ERA-NET SUSFOOD2 (Susfood2, 2022)), community supported agriculture (CSA) (Lang KB,

2010) and testing the opportunities in digitalization for interconnecting producers and consumers (AgroBRIDGES, 2022).

How will R&I Area 3 contribute to the impact pathways and Intervention Logic

The core issue: Since “diets” are a key element of SFS (R&I Area 1), everyday practices of acquiring food and eating play a key role side by side with other changes in FS. This involves both product choices, diet composition and improving the possibilities of citizens and consumers to engage in FS development to influence “how food is produced, distributed and consumed”. This requires that citizens have a general understanding of the FS perspectives and can trust the other actors in FS (companies, governance, etc.) as well as the information that these actors provide. It also requires motivation and opportunities for taking part in FS transformation; a role that the current FS do not actively provide – besides mentioned_niche activities such as urban community gardens and CSAs. Moreover, better understanding of SFS should help identification of leverage points for action that may push forward important changes throughout the FS. Business and policy makers presuppose that a degree of engagement is required by consumers to search for sustainable foods, making product choices based on e.g. climate labels or supporting new value chains and engaging in practices such as eating new plant-based foods or recycling (why else support communication campaigns and labelling?). Moreover, citizen engagement may support and advance alternative, local, or direct FS through activities in civil society and politics in order to facilitate a change in diets and FS. Thus, changing the way citizens engage with FS may include different types of involvement, which again builds on different assumptions regarding impact pathways and points at different knowledge needs:

- I. Citizens as consumers may be given better possibilities, be informed (or in a more passive form “nudged”) to change diets including healthier and sustainable foods both in-home and public kitchens (canteens, restaurants, catering).
- II. Citizens may be engaged in developing products and diets, services, or value chains/SFS at different scales, including reducing food waste and losses (FWL). At local/regional level citizen-driven initiatives support local FS including Community-supported agriculture, farmer’s markets, small COOP retail and processing companies. At national level, citizens may be engaged in COOP retail chains and/or in developing and promoting new recipes for sustainable diets, promoting diversity and new cultural norms in society vis-à-vis expectations from Farm to Fork strategy as well as promoting systems for reducing FWL reducing pollution, changed logistics, and use of digitalisation (including “social media influencers”).
- III. Citizens can engage in policy making at local to national levels by demanding and supporting initiatives in relation to public meals, city-region FS, and requesting political and administrative support to the mentioned initiatives at local and meso levels and to guidelines/regulation of large-scale and global value chains. Part of this may be initiatives towards democratisation of businesses or value chains such as being part of cooperatives in farming, processing and/or retail.

Knowledge gaps to be addressed

Citizens may become engaged in different degrees from consideration of their own food and dietary choices and practices to actively supporting alternative FS and developing the existing FS towards SFS. The P-SFS should support R&I for a wide understanding of various kinds and ‘types’ of engagement, also between different social groups and their access and willingness to engagement options.

A. Knowledge needs regarding how to engage citizens in SFS by consumption choices:

A number of the below mentioned points should be tackled in close cooperation with R&I Area 1.

- a) Improved understanding of how to enable greater empowerment and ownership by consumers and

citizens (measures ranging from trustworthy and understandable labelling to nudging and promoting new foods and sustainable diets). *b*) Enable informed consumer choices by enhancing transparency and traceability across the food chain by further developing science-based sustainability related labels, fight against green-washing practices, improved awareness of consumers on the impact of marketing standards, on their food choices and the sustainability of these choices. *c*) Understanding of what characterises efficient use of FBDGs for change of everyday practices and what is the potential in repeated interactions that allow feedback and learning over time *d*) Study and development of meal-planning tools that could help people to assess the nutritional and environmental impacts of their consumption choices. *e*) Training and educational activities to familiarise consumers with sustainable diets. *f*) Digital applications, communication and trainings that could enhance citizens' and children's food literacy to support informed choices about their sourcing and consumption while shopping and preparing meals (e.g. cooking skills as well as knowledge on seasonality, origin and food quality) *g*) To what extent may interactions increase internal motivation and self-efficacy for healthy and sustainable eating, if they contribute to identity-building matching with food involvement and/or perception of competence? *h*) Which positive spill-over effects to other areas of healthier and sustainable food consumption might be triggered, when consumer-citizens engage in one area of healthy and sustainable food? Often, it is assumed that consumers change their attitudes and intentions first, which would then lead to behavioural changes. However, it may also be the other way around: when social contexts, public discourses, markets, food provision, and policies change, also citizens' behaviours and practices are reshaped, which may trigger a change in attitudes as well as social norms related to these behaviours. This may also lead to an 'after-rationalisation' or re-alignment with beliefs, attitudes, norms and self-identity. *i*) What is e.g. the power of public canteens changing their offer and assortment in line with sustainable diets with respect to inspiring customers to try out and make new choices, enabling the development of new meanings, attitudes, and social norms also to be practiced at home? *j*) Training and capacity building programs for cooks, kitchen staff, food catering companies and food providers to design sustainable and affordable meals and food products (e.g. plant-rich and/or with alternative foods from new sources, upgrading residues etc.).

B. From an engagement point of view it is also relevant to study the development of FS at different scales:

On the one hand, current FS are for a large part based on international and global networks of production, manufacturing and distribution, providing consumers and citizens little possibilities for direct engagement. How may this engagement be furthered and what is the possible role of Cooperative companies? On the other hand, local and alternative food systems remain or are under development in many regions, providing people with more direct possibilities to engage in producing food themselves or to get involved in, e.g., community-supported agriculture initiatives, urban gardening, farmers' market, etc. Analysing the large and small systems as well as their co-development, interaction, practices and ways of involving consumers and citizens is vital for improving the understanding of the engagement of these actors in SFS. In such analysis, food cultural diversities and social differences in terms of economic, social and cultural capital should be taken into account to provide input for developing inclusive SFS. The potential role of social media and IT-supported engagement for improved transparency and involvement should be clarified for different purposes.

C. Ideas of Food Democracy to be translated into concrete SFS activities: What role may 'increased understanding of sufficiency approaches to food consumption' play with respect to improving FS resilience for the uptake of sustainable diets? How do citizens take ownership of SFS at a lower scale? To what extent may place-based orientation engage citizen, e.g. in the process of cities shaping their FS.

How will the R&I Area 3 contribute to the overall aim of SFS via a Food systems approach?

Supporting R&I activities to improve citizen engagement at different levels is key to changing dietary habits and developing alternative SFS by voluntary means. R&I Area 3 will build new basic knowledge on citizen engagement and consumer trust. Moreover, the improved understanding will allow integrating consumer and citizen perspectives in other R&I and Activity Areas supported under this P-SFS.

R&I&P questions to be answered in R&I Area 3

- To what extent may improving transparency and traceability across the food chain enable and inspire informed and responsible consumer choices and regulate green-washing?
- How will increased awareness of consumers for the power of marketing change their food choices and FS engagement? How should educational and other engagement activities be designed to familiarise consumers with new sustainable diets (e.g. plant rich and/or with alternative foods from new (marine and land) sources, products from upcycled ingredient resources)?
- What is the role of retailers in building consumer trust and influencing consumer choices
- How can consumers be better involved in large-scale FS to advance their sustainability: e.g., development of platforms for co-operation of consumers and manufacturers, or cooperatively owned businesses?
- Which analysis should be done of local and alternative food networks that may empower consumers and citizens in different social positions?
- What are the processes underlying engagement of consumers in development of sustainability labelling?
- How will public catering advance engagement and provide possibilities for consumers to familiarise with more sustainable dishes (e.g., meals based on vegetables and alternative proteins)?
- Which forms of digitalisation (including monitoring, wearables, sensors providing personalized data as tools for dialogue) may empower consumers – and to what degree?
- How may the ideas of Food Democracy be translated into concrete activities in support of SFS and to what extent are citizens motivated to consider whole FS perspectives in their co-decision making?
- How may urban food environments be redesigned by means of participatory urban and regional planning decisions (land use plans, zoning laws)? How to consider spatial justice to increase access to healthy and affordable food, especially for low-income communities and neighbourhoods?
- What incentives do Cooperatives in food processing and retail (e.g. COOP supermarkets and their own brands) offer in relation to engaging members in policy setting and influencing food systems? (e.g. promoting sustainable brands, alternative products and reducing food waste).
- How can Food Cities networks, in Europe and with African Food Cities, foster mutual learning living labs. Linkage points to the EU-African Union research priority on Food Cities Africa to be established.

Requested enabling conditions

The first enabling condition concerns the willingness to join forces by existing facilities for studying consumer reactions to and adoption of new products, packaging, labels and nudging and other aspects of “Food Environment”. The second is that FS-Labs (Activity C) helps to develop and understand conditions and objectives for citizen engagement and their potential transformative power. The third is the need for fora and practices for dialogues and engagement from Food Industry and governance stakeholders.

Expected results

- R&I Area 3 contributes to the *general objectives* targeting improved understanding of requirements and potential for citizen engagement in SFS development (i.e. General Objectives 1 and 4).
- With respect to *outcomes*, R&I Area 3 takes care that actions will be collective and inclusive, with respect to citizen engagement; it will also provide insights in different local contexts uniting diverse groups.
- Inspiring more citizens to engage in ambitions for SFS and adopt sustainable diets may be one of the leverage points for overall *impact* (if the signals are correct and reflect SFS) while also support positive changes for less engaged groups. Enabling groups of citizens to engage more directly in specific FS may support a pressure and a movement towards continuous development of SFS based on wider understanding of interdependencies across European and Global FS.

Activities to carry out to achieve the expected results

The series of activities will target the R&I&P questions to be answered (listed above). These will serve as basis for the writing of the first annual work plans.

The main activities will be to manage a portfolio of R&I projects supported via calls developed and supported with Activity A. The calls will be formulated to cover the identified knowledge gaps and R&I questions from a FS approach, thus taking into account linkages between the four R&I areas. Moreover, R&I projects will contribute to the Activity Areas B and C insofar as their results will feed into the FS observatory and some projects will build on FS-Lab methodology.

6.4 R&I Area 4 ‘Change the way we govern food systems’

Subtitle: *Leverage points for local, national, EU and global transition pathways, co-creation, including private ones like Farm to Fork code of conduct & local initiatives (e.g. cities)*

Note: this theme covers public, private, and civil society arrangements.

Status

The Food2030 pathways for action state that *“The many challenges related to Food Systems (FS), as well as their key impact on climate, sustainability, health, and livelihoods, have made clear that we urgently need to improve our FS governance beyond today’s predominantly fragmented and sectoral approach”* (EC, 2020).

‘Governance’ describes *“the characteristic processes by which society defines and handles its problems”* (Voss et al., 2006). It is the result of the interactions of many actors with different problems, goals and strategies. Governance therefore also involves conflicting interests and struggle for power. This R&I Area aims at contributing to improve knowledge on governance patterns and governance evolution that can steer food systems towards sustainability. Issues related to governance are fragmentation and slowness to change, difficulties in keeping the urgency of the problem high on the political agenda, difficulties in handling the complexity of FS (EC, 2020).

Research on governance starts from the recognition of already existing initiatives in the public, private, and civil society sectors.

In the public domain, the Green Deal raises the issue of how to integrate policies of different administration sectors such as agriculture, health, food safety, environment, internal market, and to what degree policies may and should be harmonized across scales (the EU, the National, and regional/municipal levels of administrations).

In the private domain, the private sector has implemented sustainability strategies that imply assessment, data collection and appropriate governance patterns (Toussaint et al. 2021; Brunori et al., 2016).

In the civil society domain, the engagement of citizens in local food systems (CSA, etc.) and in cooperative business models (production, retail) demonstrate an influence in governance, which to some extent represent FS thinking.

Governance is key to effective policy design and implementation. In the Farm to Fork strategy, the Commission has planned several initiatives related to food. These are among others a Legislative framework for sustainable food systems (EC, 2022c.), actions in the fields of food loss and waste prevention (EC, 2021d.), the EU Code of Conduct on Responsible Food Business and Marketing Practices (EC, 2022f.), measures for sustainable food consumption and production. These initiatives together with the Proposal for a Directive on corporate sustainability due diligence (EC, 2022g.), if properly coordinated, may improve the regulatory efforts and overall governance in a FS view. These policies will need a strong support from research to provide evidence for their implementation and to assess their impact.

New actors are playing a role in food governance. In 2015, many European cities have committed themselves to build SFS in the Milan Urban Food Policy Pact. In the cities adhering to the Pact, experiments of local food policies are being carried out. Horizon 2020 and Horizon Europe have supported the process of networking between municipalities to exchange knowledge on implementation of local food policies. The project Fit4Food2030 (Fit4Food, 2022) has provided input to a policy framework, a review of food-related policies in Europe, targeted responsible research and innovation (RRI) and has developed tools for the transformation of FS. The JPI HDHP (2019) supported Policy Evaluation Network has developed tools for assessing the effectiveness of policies and regulations with regard to food and nutrition and has developed a monitoring tool for assessing the implementation of policies across Europe, i.e. the Food Environment Policy Index.

How will R&I 4 contribute to the impact pathways and the Intervention Logic

The partnership, through its interconnected activities (Activity Area 'A') synthesised via the FS observatory (Activity Area 'B'), and the living labs knowledge hub (Activity Area 'C'), will increase the understanding of the actors in public and private governance of FS, their interdependence and evolution, their relative power and their transformative potential vis-à-vis sustainable FS objectives. The theme will contribute to the assessment and comparison of the performance of different governance patterns around food at local, national and EU level, in synergy with the Farm to Fork monitoring framework. This will support the implementation of R&I Area 1, 2 and 3 since improved (understanding of) governance can shape the drivers of FS sustainability, as in the case of the 'food environment'.

Knowledge gaps to be addressed

The P-SFS aims at understanding how improved public and private governance in a FS view can improve sustainability of Food Systems, by fostering system actors' commitment to sustainability and knowledge re. important leverage points and how to overcome barriers to change. Linked to this aim is a need to assess the performance of food systems (FS observatory, Activity Area 'B') and to facilitate the progress of FS transformation. Thus, a key knowledge gap to be addressed is how society and policymaking is organized in relation to food, what are the strengths and weaknesses of different governance arrangements?

With regard to **appraisal**, we have to consider that effective policies need consistent representations of the systems and useful data to monitor their state and evolution.

In the **public domain**, it is now understood that separate policy sectors generate different bodies of knowledge that are not consistent with each other, that often tend to address the emerging problems with inappropriate knowledge instruments. The research in this field regards how policy problems are framed, the

level of consensus about the problems, the level of agreement of existing knowledge, and how the production of knowledge about them is affected by the interaction between different types of actors.

In the **private domain**, appraisal is key to value creation, as successful communication of sustainability performance of processes and products can be translated into commercial value. Moreover, appraisal is the necessary condition for accountability towards the community. For this reason, from the sustainability perspective it is necessary that methodologies, quality of data, choice of indicators, disclosure of data, participation to priority setting, and communication are subject to common rules that avoid deception and build trust.

In the **civil society domain**, access to information and participation to knowledge production are keys to policy processes. Access to information can in fact empower civil society organizations to raise issues, to have a stake in the agenda setting, to control the processes of implementation.

With regard to **commitment**, there is an urgent need to know how to align the commitments to sustainability of the plurality of the actors that populate the European Food Systems. There is a need for improved appreciation of the importance of coordination between sectors (agro-food-health-social-environment), between operations in the value chain (production/processing/retailing), between levels (local-national-EU-global), between functions (science, policy, civil society), and between disciplines is imperative for a clearer understanding of FS, for a shared vision on SFS, and for policy coherence. As food policies have no jurisdiction in many member states, R&I needs to explore how private and public actors, networks, institutions can be involved in governance with a FS view and thus demonstrate coordinated leadership and entrepreneurship for implementation of sustainable food policies and systems. Thus, there is a need to develop governance tools that can support better coordination and policy coherence, and initiatives that can foster integration between policies. There is a need to identify leverage points, where policy initiatives may create large shifts in overall governance in private and civil society domains leading to SFS outcomes. Research can contribute to improving societal commitment to SFS by addressing common problems, encouraging multi-actor dialogues, leading the co-construction of sustainable solutions to the problems of FS.

In the **public sector**, the key issue is how to align different policy levels (national, regional, local) and different policy domains around shared goals. To improve the speed and the coherence of transformation, new actors and new fora where issues are debated, and coordination is fostered are necessary. In particular, municipalities and local administrations have shown increasing activism in this field. Given the variety of the actors and of the issues, however, there are no one size fits all solutions, and experiments need to be activated and assessed.

In the **private sector**, several governance styles are emerging. Power relations within the supply chain have strong implications for the distribution of value. The landscape of the actors of the European FS is changing due to innovation processes and to market trends. Corporate strategies range between further globalisation and relocalisation; some of them look increasingly to create value for the local community, and to activate more intense relations with local administrations. Some of them exploit market mechanisms to reduce production costs, other create partnerships with their suppliers. The role of intermediate bodies, such as Cooperatives and Farm Advisory services, are key to a healthy, efficient and fair FS. What is their role in the new context emerging with the Green Deal? Can they provide leadership and entrepreneurship for the transformation of FS?

Civil Society has demonstrated to be a driver of change, as they raise sustainability issues to the public attention, act as watchdogs on the private sectors and public administrations, contribute to reframe discourses on food and provide information about unexplored issues, are laboratories of FS transition experiments that promote innovative producers' / consumers patterns. Research on governance should study how civil society can provide entrepreneurship and leadership to promote transformative governance.

How will R&I Area 4 contribute to the overall aim of SFS via a Food systems approach

R&I Area 4 will contribute to the improvement of the governance for SFS through research activities based on observation, comparison, conceptual reflection of existing governance patterns in the public, private, civil society domain. Research in this theme will be carried out mainly through research actions and stakeholder involvement, and will rely to a great extent on living labs' activities, providing research questions and organizing the processes of learning around these issues.

The partnership will study how to improve coordination between actors of the system. As governance is strongly related to knowledge creation, use and communication, the P-SFS aims at creating knowledge ecosystems working actively to contribute to break the sectoral barriers and to foster policy coherence.

The P-SFS will encourage - through strategy, guidelines, communication, evaluation - all actors of knowledge ecosystems to work on governance issues related to their domain of commitment. Through its observatory and the living labs, it will gather insights on best practices and barriers to change. Through FS-Labs, the partnership will also stimulate the actors of the system to experiment innovative governance arrangements and the inclusion of new stakeholders. Moreover, the P-SFS will orchestrate the process of learning around these governance issues.

R&I&P questions to be answered in R&I Area 4

- What is the state and performance of existing governance of food systems in public respectively private domains vis-à-vis the challenges of transformation?
- How to foster joint understanding and coordination between normally divided sectors (agro-food-health-social-environment), between levels (local-national-EU-global), between functions (science, policy, business and civil society) in a FS approach enabling policy coherence?
- What lessons can be learned from comparison of governance patterns? What are the most promising governance patterns of food systems?
- What are the scientific principles of a transformative FS governance? How can these principles be applied to public, private, civil society - related governance patterns?
- What are the actors, the networks and the institutions in public respectively private domains and civil society that can build a transformative FS governance and how do they operate?
- Which key governance initiatives in public, private, and civil society domains could act as leverage points in transforming FS?
- How will private governance adapt to the new food-related policies (public governance) planned with the Green Deal?
- How did governance with a FS approach evolve and did it enable desired transformations towards SFS?
- What are the actors, the networks, and the institutions that are endowed with leadership and entrepreneurship to build transformative Food System Governance, and how do they operate?

Requested enabling conditions

A partnership where all sectors and all actors have a voice, and where participation is balanced, can accelerate the adoption of a system approach. A strong relationship with policymakers in the above-mentioned policy fields will enable to focus on the relevant actions. A strong networking activity with all actors of the governance of food systems will ensure circulation of information and coordination capacity.

Expected results

R&I Area 4 will contribute to deepen insights on the principles of transformative governance for sustainable food systems in public and private domains. The partnership will be itself an experiment of transformative

governance, and research on R&I Area 4 will contribute to governance change and will contribute to policy making at different levels of the policy cycle.

Activities to carry out to achieve the expected results

A first set of Activities tries to respond to the R&I&P questions above by formulating R&I calls for funding within Activity 'A' focusing on understanding and experimenting with new governance patterns. Parts of the R&I activities may be carried out in FS- Labs and contribute to the knowledge hub (Activity Area 'C') and will feed into the FS observatory (Activity Area 'B').

In short, R&I Area 4 activities will produce evidence on transformative public and private governance and policy tools in a FS approach; assess governance coherence; identify leverage points, barriers, synergies, trade-offs to transformation of FS governance; develop assessment methods, guidelines for governance and improved science-policy interfaces.

7. Four Inter-connected Activity Areas

The SFS Partnership achieves the R&I efforts in the above-mentioned thematic R&I Areas through the following **four interconnected activities**:

- **Pooling R&I resources and programming**, with a particular focus on co-funding mechanisms for projects based on food systems approaches;
- **Launching a food systems observatory**, with the ambition to monitor efforts on the sustainability performance of EU food systems and their progress towards sustainability goals;
- **Establishing a food systems knowledge hub**, including a network of transformative research and innovation Food System labs (FS-Labs) on systemic innovations at different scale;
- **Knowledge sharing and scaling, adapting knowledge systems, innovation platforms and science-policy interfaces**, aiming to facilitate all of the FS actors to understand the complexity of food systems, to follow FS approaches and transformations, to align R&I interests and to exploit synergies in an open access manner.

7.1 Activity Area A 'Pooling R&I resources and programming'

Subtitle: *Joint transnational R&I support via project funding and alignment of funding priorities and mechanisms enabling multi-actor and systems approaches*

Status

There is already at our disposal a vast amount of experiences at European, transnational, national and regional level about research advancements and innovative practices stemming from funding programmes and activities, such as the ERA-Net schemes (e.g. SUSFOOD, CORE Organic, ICT Agro-Food etc.), the Joint Programming Initiatives (e.g. JPI HDHL, FACCE or OCEANS), and many others. FS and Multi-Actor (MA) approaches have gained attention during the last years. However, the analysis of what makes FS practices potentially 'good', 'innovative' or 'desirable', and what barriers, drivers and solutions can be found along the entire funding cycle needs to be further examined in order to create a knowledge ecosystem which enables combined FS and MA approaches for upcoming R&I funding and support activities. Thereby, institutional learning, inducing the development of improved legal frameworks, and knowledge exchanges among European actors are central elements creating added values. These pave the way to impact-driven harmonisation of funding practices and longer-term investments and programming.

How will Activity 'A' contribute to the impact pathways and the Intervention Logic?

R&I funding and programming will contribute to all mentioned objectives of the Intervention Logic. It will also be a major mechanism to gain knowledge, insights and evidence within all R&I areas and feed into the science-to-policy interface. Activity 'A' will be particularly instrumental for the P-SFS to achieve its General Objective "Work with a functioning 'systemic approach'" and its Specific Objective 'A' vibrant epistemic Partnership with common rules, joint activities, and pooled resources".

The design and implementation of Activity 'A' aims at making the pooling of resources more impactful and effective for the participating members. Pooling resources in an appropriate way defines the co-funding instrument and thus the functioning of the P-SFS. Combinations of classic funding actions and more innovative support schemes should aim at maximising the R&I contribution for the future FS Research Area.

Gaps to be addressed

- Understanding barriers and enablers for funding of FS and MA approaches in line with existing national/regional funding practices and legislative frameworks.
- Defining realistic approaches within the Partnership instrument regarding the funding of activities and projects within a FS perspective including portfolio management (chapter 5.3).
- Thriving for organisational learning that promotes sound funding practices allowing higher flexibility in call design, e.g. longer runtimes, several project phases, transdisciplinary and follow-up actions.

How will Activity 'A' contribute to the overall aim of SFS via a Food systems approach

Activity 'A' will take care that 'systemic approaches' are strongly supported both in co-funding and programming activities.

R&I&P questions to be answered

Activity 'A' is not an R&I activity, hence not defining R&I&P questions itself, but facilitating the execution of the questions posed in other Areas.

Requested enabling conditions

First, there should be a clear understanding of the Partnership instrument with regard to pooling of resources to support R&I activities. Next, good preparation and management of the annual work plans within the P-SFS programme are imperative, including steps for preparation, prioritisation and consultation among P-SFS beneficiaries, associated partners and others involved. Finally, monitoring activities are to be addressed, supporting organisational learning with the P-SFS, to assess the extent to which the various programming activities lead to actual change in the European FS.

Expected results

The Activity Area A contributes to all general objectives of the intervention logic. It will contribute to the outcomes in the following ways:

Contribution to outcomes:

- Functioning of the P-SFS itself, based on collective and inclusive programming and funding actions, focused on the R&I Areas;
- Fostering transnational collaboration at project and programme level to establish an integrated SFS Research Area;
- Setting of R&I priorities of the Partnership's activities, supporting their execution, and providing lessons learned by guiding funded projects;
- Supporting the design and implementation of evidence-based food policies in the EU at all levels;

- Finally, it contributes to its impact by developing a diverse spectrum of inter-connected funding activities, Activity A allows for a wide range of potential contact-interfaces among FS actors and initiate the emergence of new collaboration arrangements beyond already established actor-coalitions.

Activities to carry out to achieve the expected results

The SRIA will serve as major input for settling the annual work plans and within those, the pooling of resources, aligning of priorities and programming of activities. Joint transnational support of R&I initiatives via project funding will be a major cornerstone to support the implementation of all four R&I areas. Since the R&I areas and subsequent research questions are diverse, also the types of research to be funded will comprise fundamental, translational and applied research at various TRL levels, depending on the call design and the topics agreed upon.

Different types of funds will lay the ground for R&I support and next to public funds, also private funds, regional funds as well as other sources, e.g. from foundations will be considered. Clear and transparent agreements and guidelines for funders and funded projects are needed that comply with the legal frameworks but at the same time allow novel collaborative arrangements to maximise the contribution of R&I towards more sustainable food systems. The P-SFS will be open to new funders at any time with respect to the grant timeframes and participation rules under HE (as full beneficiary or associated partner).

The funding instruments foreseen will comprise joint transnational competitive calls for R&I projects but also knowledge hubs, support of networks, mobility grants and other means depending on the feasibility by funders and suitability to reach the objectives set.

Integrated and co-creation approaches will serve as guiding principles for P-SFS. For the programming and funding, specific attention will thus be paid along the whole funding cycle to the following aspects:

- Systems thinking, e.g. during call design, trainings and support for funders, evaluators, researchers;
- Transnational, multi-actor involvement and multi-disciplinary actions (e.g. offering networking options, also in collaboration with FS-Labs; Activity 'C') with special emphasis to industry perspectives;
- Consideration of cross-cutting aspects like capacity building, RRI (e.g. gender equality), FAIR data management, territorial dimensions (e.g. from proposal stage until monitoring and evaluation);
- Consultations with relevant stakeholders (e.g. for annual programming, call negotiation, project support and evaluation);
- Targeted dissemination and exploitation to various stakeholders (together with Activity 'D');
- Networking and co-creation activities (e.g. via possible interaction with FS labs at proposal stage, during projects or as follow-up).

The results and outputs gained in joint transnational projects will be subject to an established monitoring, evaluation and impact assessment (including project specific indicators). The project results will thereby feed into the observatory (Activity 'B'), but also into the FS-Labs and Knowledge Hub (Activity 'C') and need to be subject to knowledge sharing and scaling (Activity 'D'). A better interconnection within the P-SFS R&I activities should contribute to higher impact, especially with regard to stronger linkage to policy, broad visibility of research and uptake of the results.

In addition to funding of projects in the four R&I Areas, support of other transversal activities should be investigated, e.g. research for the work in the observatory, research within or on the FS-Labs, research on knowledge sharing and scaling.

Since project funding is a classical tool in R&I support, outreach to other Partnerships and beyond the EU should be undertaken in order to align themes, avoid duplication and make use of synergies.

7.2 Activity Area B 'Launching a Food systems observatory'

Subtitle: *Platform for sharing metrics, data and assessments on sustainability performance of food systems*

Status

Monitoring efforts on the sustainability performance of EU food systems and progress in achieving the transition from current state to sustainable food systems are expanding across the EU. The complexity of FS characterised by interdependencies across distant geographical areas, organisation of resources and activities poses a big challenge for the monitoring, data collection and evaluation. This is further amplified by the usage of different kinds of virtual and physical infrastructures on multiple governance levels. 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. Particularly, this concerns the information on the variation in food consumption beyond basic demographic factors. A particular omission is data on the midstream actors in FS, which involve food aggregators, processors, distributors, procurement and food services. A preliminary state of the art on monitoring and consolidated reporting by EU institutions reveals:

- *On FS activities:* EU-wide monitoring is largely done on primary production, e.g. Farm Accountancy Data Network and Eurostat agricultural census and fishery statistics, as well as market observatories pertaining to commodities, nutritional epidemiology and dietary patterns (including Food Balance Sheets (FBS), Household Budget Surveys (HBS) and Individual Dietary Surveys (IDS), Comprehensive European Food Consumption Database, based on national food intake surveys under the EU Menu programme carried out by ESFA;
- *On FS outcomes:* this concerns economic and environmental impact including nutrient flows, land, carbon and water footprint mainly from primary sector (EEA, JRC), food safety (EFSA), SDG indicators (Eurostat), EU Platform on Food Losses and Waste, data on poverty and vulnerable population groups (UN);
- *On FS drivers:* environmental & climate (GEO network, agro-ecology sensing), demography, digitalisation & technologies, culture, perceptions of citizens (Eurobarometer), mappings of R&I on FS (SCAR FS SWG) and bioeconomy, data of platforms like SUSFOOD2 and Biomonitor.
- *On system-wide innovation:* in response to recent disruptions on EU food markets, the EU Food Security Crisis preparedness and Response Mechanism (EFSCM) has established a dashboard for monitoring food supply and food security. While Member States are increasingly active in the monitoring of food poverty, the rising costs of food recommended under dietary guidelines, food aid and distribution services, more coordination is required to allow consolidated analyses.

It should be noted that globally the HLPE on FS concluded that systematic data collection and processing are not available, which cover FS approaches and inform policy development. They stress to link existing food and nutrition data recording and platforms with other data sources. This allows better understanding of how policy initiatives, climate change or price shocks may impact FS and their different stakeholders (EC, 2022c).

How will Activity 'B' contribute to the impact pathways and the Intervention Logic

The Observatory will be a platform, community of practice and data management service for:

- developing new common metrics (beyond the scope of the monitoring framework of the Farm to Fork strategy), mutually agreed definitions and outcome and impact categories, on the sustainability performance of European FS;
- connecting existing databases that vary in data collection methods, quantity and coverage of FS;
- developing and piloting new forms of data collection on FS from different sources (like European Nutrition and Health Report 2004 and 2009, Data Food Networking – DAFNE) both in the public and private realms based on and in cooperation with the foreseen Farm to Fork monitoring framework;
- 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;
- providing foresight and deliberation on potential future policy targets for SFS, integrating lessons learned from previous European projects like SUSDIET and SUSFANS;
- establishing practices for reflexive monitoring and learning including stakeholder engagement on potential transition pathways, leverage points and current progress.

These contributions correspond with the recommendations provided by the HLEG on FS (EC-HLEG, 2022).

Gaps to be addressed

Current differences in FS relevant data recordings across Europe raise caveats for comparison of data between countries and impose challenges for (evaluation of) transitions. Moreover, the lack of a universally agreed operationalization of SFS, implies that sustainability indicators are based on different values and norms (Chaudhary et al., 2018; Béné et al., 2021; OECD, 2021). Consequently, priorities differ for entry points, trade-offs, unequal distribution of benefits and disadvantages, etc. Moreover, there is a need for assessments reflecting diverse stakeholder views. Hence, recording of progressive policy actions in European countries is pertinent in order to track policy contributions to FS transformation and underpin further policy formulation at EU level (Hebinck et al., 2021).

The SFS transition need information on the sustainability performance of today's FS and the projected gap to target. To let such knowledge be taken up by businesses and citizens and to lead to system changes is far from easy. First, information should be relevant for decision-making (actionable), accessible and easy-to-understand. The P-SFS will therefore contribute to the scientific development, consolidation and use of data, metrics and foresight on the sustainability performance of FS from local to global levels. Secondly, capacities should exist to use and deliver such information. The Observatory will foster research and networking actions that respond to these needs with the following objective: *to establish a European platform ("Observatory") for reflective monitoring on the transition to SFS for the purpose of food policy design and planning of mission-oriented R&I actions*. The three main challenges will be:

(I) **TRANSITION MONITORING** on the "signs of change": critical points in the transition will be identified e.g. towards more plant-based diets that include also alternative proteins from insects, microorganisms or specific marine sources, adoption and consumer acceptance of new processing technologies, increased agency of citizens and share of short supply chains. This requires new indicators for monitoring consumers' behaviour, their food skills, and the cultural meanings of food. Other examples are indicators for food environments such as positioning and pricing of sustainable food in supermarkets, investments and legal measures. Next, specific indicators for progress on these critical points will be defined. Third, the impact of EU policies on the transition will be analysed. Finally, the Observatory will initiate and collate long-term monitoring in various places combined with longitudinal analysis and learning on improved policy theories.

(II) **STATUS MONITORING** on the sustainability performance of national and EU FS, crucial for measuring progress. Building on existing efforts in the EC, new indicators will be developed where needed, like on food

loss and waste at subsector level, food poverty and inequality, etc. Broadening current benchmarking approaches, taking into account in particular less accessible private data, will be envisaged.

(III) HARMONISATION of national data of EU MS for mapping FS activities (beyond the primary level) and their final outcomes in terms of health, environment, fairness and economic viability; this will be done with existing initiatives in Europe. Moreover, choices of KPIs, modalities for data collection, scaling, sharing (at which levels) and standardisation are key attention points. Improving interoperability of national and European data for the surveillance on FS is needed, calling for strengthened cooperation of institutions, academia and the private sector. Next, the use of monitoring instruments across domains of public policy are requested. Another key point is handling ownership of infrastructure and data. The Observatory will also work with the foreseen European Data Spaces and the Agriculture of Data Partnership.

How will Activity 'B' contribute to the overall aim of SFS via a Food systems approach

- Monitoring is important for adaptive management of the process of transforming FS from their current inadequacies towards future-proof states that helps achieve the 2030 Agenda (Fanzo et al., 2021). It provides the necessary feedback on the intended and unintended impact and effectiveness of interventions and policies.
- A set of [5-10-50] sentinel sites (including national, urban, rural geographies, etc. together with Activity 'C') will be selected for a panel to establish longitudinal monitoring tools for a comparative assessment of the sustainability performance of FS, as a basis for analysing the impact of EU policies implemented under Green Deal policies.
- By providing data from modelling of complex interactions within FS, effective entry points for change and areas of trade-off can be determined that require careful navigation and deliberation.

R&I&P questions to be answered

Activity 'B' is directly involved in R&I&P, posing the following questions:

- Using OECD (1993) guidelines as reference, which new science-based and standardized indicators are needed for monitoring the transition, like for the contribution of retailers to reduce food waste, reach a fair share of farmers in value chains, reduce food poverty and improved access to healthy food for vulnerable consumer groups in the EU, meaning full investments in food and ESG standards in the financial sector, etc.?
- How to define a robust set of metrics on FS sustainability for national and EU monitoring and how to overcome differences in research methodologies, sample compositions, and analytical techniques allowing for European FS assessments and evaluation of policies and innovations?
- Which data sets can contribute to developments of new FS models and evaluation of food policies?
- How may harmonised data recording and synthesis across European FS lead to improved science advice for policy and private governance and how may these be used in co-creating ideas and scenarios for FS transformation via policy, public engagement and business models?

Requested enabling conditions (with other Areas):

- Appropriate FS-Labs in which actors (industry, academia and institutional organisations) commit to initiate longitudinal studies and allow public data sharing, e.g. on environmental footprints.
- Availability of new tools for assessing qualities and characteristics of food environments for promotion of healthy and sustainable food choices.
- Connecting 'post-farming and -fishing' in the Observatory to activities on primary production through joint activities and alignment with Partnerships Agriculture of Data, Agroecology and Blue Economy.

- Public-private collaboration on sustainability metrics and KPIs in food labelling and performance schemes in business, particularly involving cross-sector platforms for food industry and retail along with civil society and academia.
- Workshops organised on (i) scenario development, (ii) Code of Conduct practices, (iii) 'food' gaming (e.g. with museums), and (iv) potential trade-offs, uncertainties and less precise information.
- Data platforms established with knowledge hubs in the EC (e.g. JRC, Eurostat), academia or science-policy hubs for curation of statistical data and exploitation via data science or advanced modelling (e.g. dynamic hybrid models, artificial intelligence, dealing with diversity, inequities, circularity, resource-efficiency, LCA, and scaling).
- Exchanges with the new regulatory and policy framework regarding sustainability indicators.

Expected results

- The observatory will contribute to the General Objectives by improved decision-making and policy development by consolidating scientific evidence on FS transformations; consequently, it will provide input to the Science to Policy interface (together with EFSA, JRCs, etc.).
 - The progress towards SFS and capabilities of related national and subnational monitoring systems in this regard.
 - Similarities and differences in sustainability metrics/KPIs between private voluntary sustainability labels and public mandatory labelling and performance schemes.
- It will obtain policy-oriented results including:
 - Informing the future reviews on policy targets and actions in the F2F strategy and the legislative action framework (DG SANTE, JRC);
 - Informing about the contribution of farmers and other FS actors to FS transitions through adapting Agricultural Census, farm accountancy (Eurostat/Ag of Data) and FS practices.
 - Supporting monitoring at international levels, e.g. under the International Research Consortium on Food & Nutrition Security and Sustainable Agriculture of the African Union, with the particular emphasis on data and analytical capacities particular regarding trade-offs and co-benefits.
- Several EU and its partnership countries have inadequate monitoring and surveillance services on FS (e.g. in the area of nutrition in East Europe). The P-SFS gives an impulse by fostering knowledge sharing and supporting trajectories for joint capacity building and implementation.
- The Observatory supports monitoring, evaluation and learning (MEL) activities of the P-SFS itself.

Activities to carry out to achieve the expected results

- Establishing a Food Systems Observatory which:
 - gains knowledge of practices within ongoing and comparable initiatives;
 - maps institutions in EU and MS that may contribute to the Observatory (with R&I experts);
 - strategically designs and user-oriented data, together with JRC's;
 - provides terms of references incl. co-programmed and co-funded actions (with Activity 'A');
 - develops architecture & consortium agreements on data sharing.
- Implementing the observatory means:
 - Step 1 – Mapping systems & outcomes (together with all R&I areas and Activity 'C')
 - Step 2 – Analysing interactions (idem; feedback to Activity 'A' for funding priorities),
 - Step 3 – Foresight & decision support,
 - Transversal: set up of methodology, data platforms and communication (with Activity 'D').

7.3 Activity Area C 'Establishing a Food systems knowledge hub'

Subtitle: complex FS transformative research and FS-labs on systemic innovations at different scales (using a 'vitrine' for demo's) including Policy Labs to drive bottom-up policy innovation processes

Status

The Living Labs for Food Systems (FS-Labs) are collaborative, stakeholder-driven R&I approaches to co-create new products and services in the widest sense; these should all support the transition to SFS. Due to the diversity and complexity of FS a variety of FS-Labs may target different objectives – however always within a FS approach. FS-Labs, thus, bring together: (i) the end-users, (ii) the food manufacturers, (iii) other members of FS (including farmers, retailers, etc.), (iv) the knowledge, solution, service and technology providers from the food-related and other disciplines (digitalisation, Industry4.0, nutrition, health, environmental sustainability and circularity, climate, social sciences, etc.), and (v) other stakeholders, like policy makers and governmental bodies - particularly the local and regional ones.

Their aim is to improve the compliance of new solutions according to the needs of food business (users) and to accelerate the adoption of innovations. This will be achieved through involving users and citizens (consumers) in co-creating, testing and adopting innovative solutions, practices, and technologies.

The applications can be focused on specific challenges of FS such as food safety, sustainable healthy diets and dietary shift, environmental sustainability and circularity, mitigation of and adaptation to climate change, food poverty reduction, empowerment of communities, digitalization of the food chain as long as the approach builds on – and accounts for - a joint understanding of the interlinkages and interdependencies within the FS case (chapter 5.3).

How will Activity 'C' contribute to the impact pathways and the Intervention Logic

Activity Area 'C' is at the core of the Intervention Logic in terms of demonstrating and learning from very different cases both at local scales and inter-connected EU levels. Hence, the FS-lab knowledge hub will develop and implement a basic level of joint protocols, ensuring that FS-labs use a FS approach and deliver a minimum set of recordings of results and experiences, which allows learning and scaling of outcomes. Individual FS-labs together with the knowledge hub will contribute to innovations in FS governance, citizen engagement and policy development via co-creation and knowledge syntheses and thus, play a pivotal role in development of next generation science-policy-society interfaces for FS transformation (Fit4food, 2022).

Gaps to be addressed:

The FS-Lab approach is a tool for co-creating solutions to knowledge needs defined by involved stakeholders in the P-SFS. Thus, specific knowledge needs in a FS-lab cannot yet be decided. However, there are knowledge gaps linked to the overall organisation and role of the knowledge hub and its working procedures.

- How and to which extent may a joint protocol ensure a certain degree of common recordings of data and results of the FS-lab innovations and interventions across the diversity of R&I areas?
- How may FS labs build on a FS approach and avoid sub-optimisations when focusing on specific innovations and transformations?

Moreover, since the nature of activities in FS-Labs is highly transdisciplinary, a common approach for innovation is to be developed. The intermediaries and innovation network operators working in FS such as the food industry federations, sector-specific associations, and National Food Technology Platforms can significantly help the cooperation between food businesses, knowledge and solution providers (from food and other disciplines), research organisations, government, citizens, cities and regions. Their expected role

is not limited to organisation and coordination, but ensure building FS competences. They can attract several SMEs (directly or via organised structures like business ecosystems) whose limited available resources represent a hurdle to start the exploration of new costly concepts themselves.

How will Activity 'C' contribute to the overall aim of SFS via a Food systems approach?

Since the activities in FS-Labs are systemic and experimental (*learning by doing*) in nature, this Area will in particular reveal if systemic approaches work, what their strengths and weaknesses are, as well as what opportunities and threats they may imply. By sharing insights between very different FS-Labs activities, we also expect to get more insights in the complexity of FS.

R&I&P questions to be answered

Activity 'C' is directly involved in all R&I areas and science-policy as described here. The main beneficiaries and the mission of the FS-Labs will have a significant impact on the principles of their operations. This will be defined by the founders of each FS-Lab. The following model (Fig. 4) shows a set of questions for founders which follow a sequence of priorities from the top to the bottom. The answers for the top-level, the primary objective of the FS-Lab, defines and restricts the scope of the answers for the following levels (1st-grade critical dimensions), and so on.

The founding members shall agree on the operating principles of the FS-Lab. The answers to the questions shall be developed through consultations with stakeholders in the FS-Lab territory. For some questions, more answers may be possible; consequently, dialogues will be stimulated both at the national and EU level. This shall be facilitated by the P-SFS and its common Knowledge Hub structure.

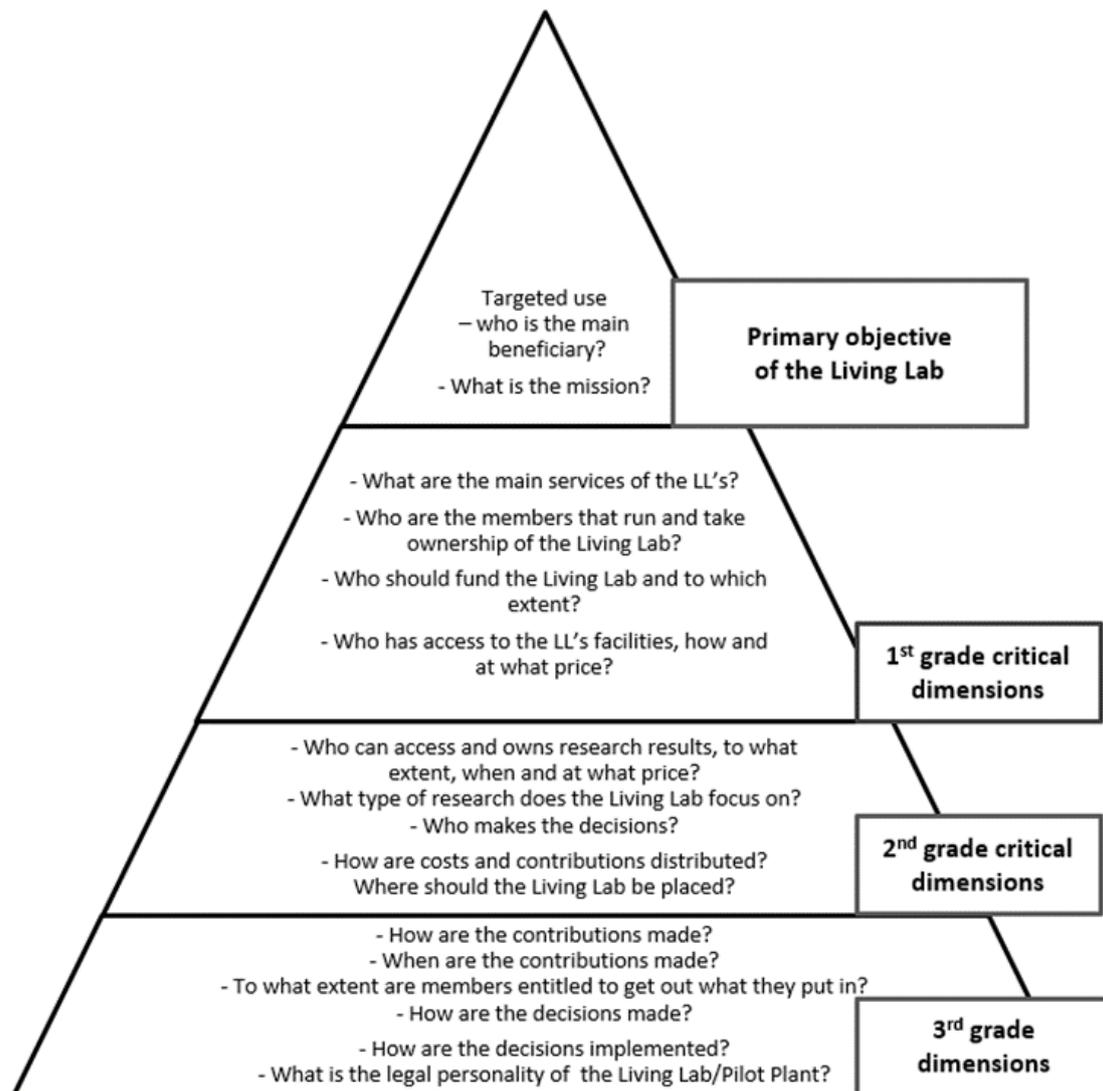


Figure 4. Questions to be answered when orchestrating FS-Labs. Source: "FoodManufuture (2014), draft models for EU Research Infrastructures".

Requested enabling conditions:

Since FS-Labs may target strongly context-dependent topics, generic issues and insights need to be addressed as well since the P-SFS is EU-widely operating. Hence, the establishment of a FS knowledge hub is here proposed acting as a platform ensuring that results and outcomes gained via the FS-labs will be gathered and synthesized as best possible, with a focus on scaling. For this purpose, the knowledge hub will provide the FS-labs with common tools to optimise their operations. Some supporting activities are:

- Elaborating concepts and models for systemic thinking and acting (see chapter 5.3);
- Providing scientific insights in the complexity of FS (chapter 5.4);
- Developing programmes and strategies for funding (with Activity 'A')
- Developing science-based protocols and tools for managing FS-Labs (for indicators with Activity 'B');
- Benchmarking and communicating examples for an integrated FS approach in R&I (with Activity 'D').

On a pragmatic level, for the effective operation of a FS-Lab, it is necessary to have a skilled partner in the operational Partnership team. It should have the competence to convert the information on the new enabling solutions (often from another discipline) to an understandable one for the food business (users). In addition,

it should be able to translate them into applications, which comply with the legal requirements, food safety, quality and authenticity requirements (e.g. of retailers) at reasonable costs and in acceptable time slots.

In addition, clarity about the definition of FS-Labs and its usage in FS is needed. According to the European Network of Living Labs (EnoLL; Vervoort, 2020), there are six common, key elements of LL:

- testing and evaluation of concepts, products, services, in real-life communities and settings;
- multi-method approach and multi-stakeholder participation;
- active user involvement and engagement;
- co-creation – systematic use, developing innovation through co-design with all actors in particular by users and manufacturers;
- orchestration - management and facilitation of the activities by a responsible staff or management team.

Since there is a large diversity of implementation routes, it is difficult to provide a general definition of LLs: “Living Labs are practice-driven organisations that facilitate and foster open, collaborative innovation and real-life environments or arenas where both open innovation and user innovation processes can be studied and subject to experiments and where new solutions are developed” (EnoLL). For FS-Labs, this needs to be specified (for each context), clarified (via training), adopted (for practical work), and communicated widely.

Expected results

Activity Area 'C' will in particular contribute to General Objectives '4' co-creation cases with various actors in different contexts; in addition, it will contribute to General Objectives '1' and '2' by working with FS Approaches in FS-Labs and by gaining insights about the complexity of FS in different settings.

Regarding Outcomes, this Area will in particular visualize the very different local contexts in which R&I actions take place. Actions are foreseen to be inclusive in terms of diverse actor's participations, hence also supporting the first formulated outcome. With respect to Impact, the hands-on way of proposed working in different FS-Labs is the prominent way to learn if outcomes are finally sustainable. The Knowledge Hub is considered as the vehicle to reach inter-connectedness between territorialized SFS, also beyond the lifetime of the P-SFS.

Activities to be carried out to achieve the expected results

The activities to set up the Knowledge Hub and FS-Labs are the following:

- Developing co-creation cases with public-private organisations in national & regional FS-Labs. The kind of mobilized FS-Labs may differ per R&I area; e.g. in R&I Area 1 an experimental restaurant, in R&I Area 2 a fab-lab (for processing) or food chain simulator, in R&I Area 3 a city lab, and in R&I Area 4 a Policy Lab. Practical solutions will be shared as well as generated thematic knowledge. Possible options for new collaboration models in FS-Labs will be encouraged. Here, FS intermediaries and innovation network operators will be agro-cooperative organizations, food industry federations, sector-specific associations, National Food Technology Platforms (NFTP), food clusters, other food industry network operators in collaboration with service providers, research organisations, governments, citizens, cities, and regions.
- Developing co-creation cases with private and public parties at European and global level. This will be done with European farmer, food industry, retail and consumer organisations. Support will be provided by knowledge providers, policy makers in the EU, its Member States and its global partners as well as Networks of Regions, Cities, Foundations, and Civil Society (e.g. as involved in FOODPathS, 2022). Since speaking a same language and knowledge sharing is crucial, this is a joint activity with 'D'.
- The Knowledge Hub 'Hub of FS-Labs' concept that provides insights in the complexity of FS, synergies and context-dependent specificities at EU level with Activity 'B' (Observatory). It will also illustrate and exchange best practices in all 4 R&I Areas. Herein, the Regional SMART Specialisation Strategies and NFTP strategies will play a key role to capitalise on existing networks and connect with Living Labs of other Partnerships and project initiatives at EU level.

It should be noted that the FS Knowledge Hub should have a governance structure where all the FS-Labs from different regions and Member States are incorporated but also where relevant EU actors can engage on setting an aligned roadmap. Examples of potential actors are policy makers (European Commission), advisory bodies (SCAR FS SWG), stakeholder representatives (Copa-Cogeca, FoodDrinkEurope, Eurocommerce), industry-academic platforms (ETP 'Food for Life', TP Organics, EATIP, FABRE, Manufuture, etc.), research community representatives (EFFoST, ISEKI, etc.), consumer representatives (BEUC), and other partnerships operating in FS domain (see chapter 8.4).

7.4 Activity Area D 'Knowledge sharing and scaling'

Subtitle: Adapting knowledge systems, innovation & demo platforms and science-policy interfaces for ensuring impact

Status

Strong policy support on holistic food system transformation to a more sustainable model is present on EU and international level in agreements and documents, but action is lacking. FS transformation can result from coordination of FS actors' knowledge, practices and the policies around sustainability goals. To initiate sustainable system changes, experiences from transition activities must be incorporated and multiplied in the actions of relevant system stakeholders and actors (government, industry, civil society, customers, consumers, researchers, entrepreneurs, etc.). Literature on FS and FS transition is rapidly increasing as the solutions to complex sustainability challenges call for holistic, multi-actor approaches. Research on FS is spread across a wide array of thematic R&I areas and scales, and applies a diverse set of frameworks and methodologies, often not communicating with each other. Existing knowledge from research and FS transformative practices is disseminated, applied and scaled out at only a limited extent in policy making. Because of this, current policies are still creating silos in actions, and hindering the SFS transition.

How will Activity 'D' contribute to the impact pathways and Intervention Logic?

The impact potential of the P-SFS is related to its capacity to share and integrate diverse bodies of knowledge generated in different subsystems, and ultimately to contribute to a consolidation of a SFS science. P-SFS success depends on the transformation capacity of FS actors towards sustainable outcomes, via an understanding of FS, exploring FS approaches, searching for appropriate leverage points and solutions and overcoming barriers and trade-offs.

The knowledge sharing and scaling, adapting knowledge systems, innovation platforms and science-policy interfaces is a transversal activity. It aims to facilitate all FS actors to understand the complexity of FS (at least to a certain degree), and the need of transformation of the social, economic and ecological components. Knowledge sharing and scaling activities facilitates aligning the R&I pathways and open access to knowledge. It exploits the synergies in overcoming the societal challenges of current unsustainable FS and transformation processes. Consumer confidence and citizens trust to the European FS is of key importance. Knowledge sharing and scaling activities help to find solutions and models to strengthen consumer trust and increase awareness of the technologies. Knowledge and common understanding of the solutions is fundamental to the transformation process. All FS actors must be involved and addressed.

Gaps to be addressed

Transition to SFS needs an overarching systems approach to address a number of challenges in an integrative manner and empowering all relevant stakeholders, diverse voices and geographical regions. This transformation requires changing our norms, habits and routines in an inclusive, just and timely way (SAPEA,

2020). To initiate sustainable system changes, experiences from transition activities must be incorporated and multiplied in the actions of relevant system stakeholders and actors (government, industry, civil society, customers, consumers, researchers, entrepreneurs, etc.). Such transition can take the form of new policy measures or policies, but also legislative amendments or new legislation, converting best practices into standards, code-of-conducts or joint action plans (with R&I 4). Emphasis should be given to demonstration, upscaling and experimentation calls that strengthen collective intelligence and effect meaningful transformations through informing all stakeholders on the best science, data and insights from across the food systems.

A Relevant system stakeholder's motivation matrix (similar to Canvas) is not yet existing and should be designed to identify the needs on knowledge and information. Different levels of target audiences – national, subnational, transnational, with an identification who we address – should be a first step. Then such a newly designed matrix allows categorizing needs and preferable communication means.

How will Activity 'D' contribute to the overall aim of SFS via a Food systems approach?

Adapting knowledge systems, innovation & demo platforms and Science-Policy Interfaces for ensuring impact are at the core of this transversal activity. All these facilitate the FS transformation through anchoring and scaling and enabling the transformation by shaping the governance perspectives around the change process. They also permit highlighting the elements of social and technological innovations to overcome current hurdles and practices. The way forward is first to look for solutions as moderate improvements, with benefits to be clearly identified; these reveal new disadvantages, setting the stage for new optimisation processes for innovations and changes. Second, we will certainly not overlook ruptures and radical innovations, however, realizing that these are scarce; still, they may potentially be highly impacting.

Knowledge sharing and scaling activities will support the FS actors in understanding the transition towards SFS. Collaboration, co-operation and co-creation connect and engage the actors in a holistic and systemic way. The approaches open up knowledge, data and solutions for both broad and context-specific applications. Science-based collective intelligence ways of working will make this possible.

R&I&P questions to be answered

Shape a continuous learning process that touches on all the roles of R&I in the food transformation process is what we need and here translate in R&I&P focus points. Different FS R&I platforms currently serve as platforms for communities of practice. Mapping the existing platforms, take them on board, assess and improve their impact; support them to facilitate dialogue between SFS stakeholders and to engage with stakeholders who are less involved. In this process, the FS-Labs and Knowledge Hub of Activity 'C' are gradually incorporated. This evokes R&I&P questions that need to be answered.

Furthermore, evidence that is more granular allows insight in decision making to build targeted policies to regions as 'one size does not fit all'; decision support tools and argumentation models are to be mobilized here. Evaluation of the effectiveness of interventions, synergies and trade-offs in designing policy instruments are to be considered. Cost-benefit analysis of actions and inactions should be performed that help prioritising interventions.

Requested enabling conditions

The first enabling condition is to find ways to overcome the multi-faceted (yet silo-oriented) nature of food issues in governance. Secondly, developing and improving access to knowledge sharing infrastructure is imperative, such as digital knowledge platforms and tools, food knowledge and innovation hubs, incubators, demonstration sites and networks (like in Activity Areas B and C). Means to proceed could be creating food working groups and public procurement groups across several departments, institutionalising policies that

transcend election cycles, establishing ad-hoc departments or offices, starting food committees formed of regional stakeholders from urban and rural territories and committed to long-term sustainability-oriented policies. The R&I system in Europe can encourage crucial cross-linkages and common ground between sectors, for e.g., agriculture, fisheries, aquaculture, health, education, land managers, retailers and R&D.

Expected results

Activity Area 'D' will in particular contribute to General Objective '3' regarding evidence-based new policy options responding to EC objectives in the Farm to Fork, missions, Green Deal and the UN-SDGs. With respect to GO '4', knowledge sharing and scaling will be fundamental in FS Labs. This Area also strongly contributes to the two outcomes, because speaking a same language at the science-policy interface for harmonisation actions at local-global scales is imperative. Finally, this Area will be fundamental for reaching impact since interactions along all scales are based on knowledge sharing, recognizing and respecting mutual interests.

Activities to carry out to achieve the expected results

The foreseen activities targeting knowledge sharing and scaling are: (i) setting up a Community of practice/learning network for exchanging insights obtained in co-funding, observatory, and FS labs, (together with the other Activity Areas), (ii) organizing reflection sessions on the value-added of the activities in the hub and observatory (also with 'C'), (iii) establishing knowledge sharing and scaling actions linked to all four R&I Areas, and (iv) creating a communication, dissemination and exploitation plan for all actors involved in the Partnership; regarding SME and start-ups (and new business models), tools will be used from or aligned with EIT Food, EIC and national incubators.

For all activities, the Activity Area 'D' will invest in several types of knowledge creation, capacity building and training on FS awareness, which will be detailed in the forthcoming annual work plans:

- Encourage the FS lab participation and where appropriate, develop formal and informal education programme and competence building for FS transformation at all levels (e.g. schools, Higher Education Institutions and Vocational training);
- Knowledge transfer for scaling innovations and policy coherence; clear distinction between communication, dissemination and exploitation of results. Focus on message visuals and information transfer.
- Science-policy interfaces in the EU at various levels (local to national), including inter-governmental EU and global levels. Also giving voice to the philanthropic organisations and other less heard actors.
- Knowledge transfer to and from industry organized through the stakeholders and the individual project consortia.

The activities in this Area will allow the P-SFS ensuring collaboration with EC SAM and related activities as well as international initiatives for policy advice in FS. The activities in this area may result in the development of a Food Systems Mission for the medium-term. Particular support will be given to relevant EU Agencies and the Joint Research Centre (JRC) of the European Commission, who are key research stakeholders that provide scientific advice for policymaking.

8. The future Partnership Sustainable Food Systems in action

8.1 From SRIA to Annual Work Plans

The here presented SRIA describes the thematic R&I areas and gives a first idea of the transversal Activity Areas for the full duration of the Partnership. Hence, the SRIA provides the directions of themes and activities, however, not yet the detailed plans and topics to work on. Therefore, annual work plans will be developed, following also the requirements of the European Commission.

For each year, the annual work plan will be drafted via a co-creation approach. Thus, several workshops and consultation steps will be needed, including various experts, the European Commission (including DGs RTD, SANTE, AGRI, REGIONS, MARE, etc.), advisory boards and stakeholders (to be defined in detail with the governing structure of the future P-SFS). In order to avoid overlaps and duplication, interaction will be sought with related programmes and initiatives. The future Partnership Consortium will analyse the inputs and proceed with a prioritization in order to establish a final version of an annual work plan. Depending on the nature of the action, final decisions will be taken by the respective governing body, or for funding activities the Board of funders, of the Partnership consortium. The European Commission will be involved to reach consensus on each annual work plan. Reserving enough time for the process will be crucial and therefore, the first concept version of each annual work plan should be available about 6 months before finalization is envisaged. The very first annual work plan shall be developed in collaboration with the CSA FOODPathS, enabling this very first plan to be prepared and ready at the launch of the future Partnership.

Each annual work plan will contain a diversity of actions that are in line with the objectives set in the intervention logic. The proposed actions will be of different nature (short-, medium-, long-term), comprise all thematic R&I Areas and will be open to new insights and learnings. Each annual work plan will contain a revision of the last work plan and a short foresight on the following one, conform the systemic way of working of the P-SFS. It needs to be closely interlinked with the overall impact assessment of the Partnership.

8.2 The Partnership SFS connected to other Partnerships to achieve overall SFS

To reach Sustainable Food Systems in 2050, objectives, methods and activities between the different (candidate) Partnerships in Cluster 6 and all other relevant Partnerships within HorizonEurope, should be aligned. The reason is that all these Partnership focus on specific domains of food systems; together they cover the majority of FS activities. The most relevant are listed in Fig. 5 below.

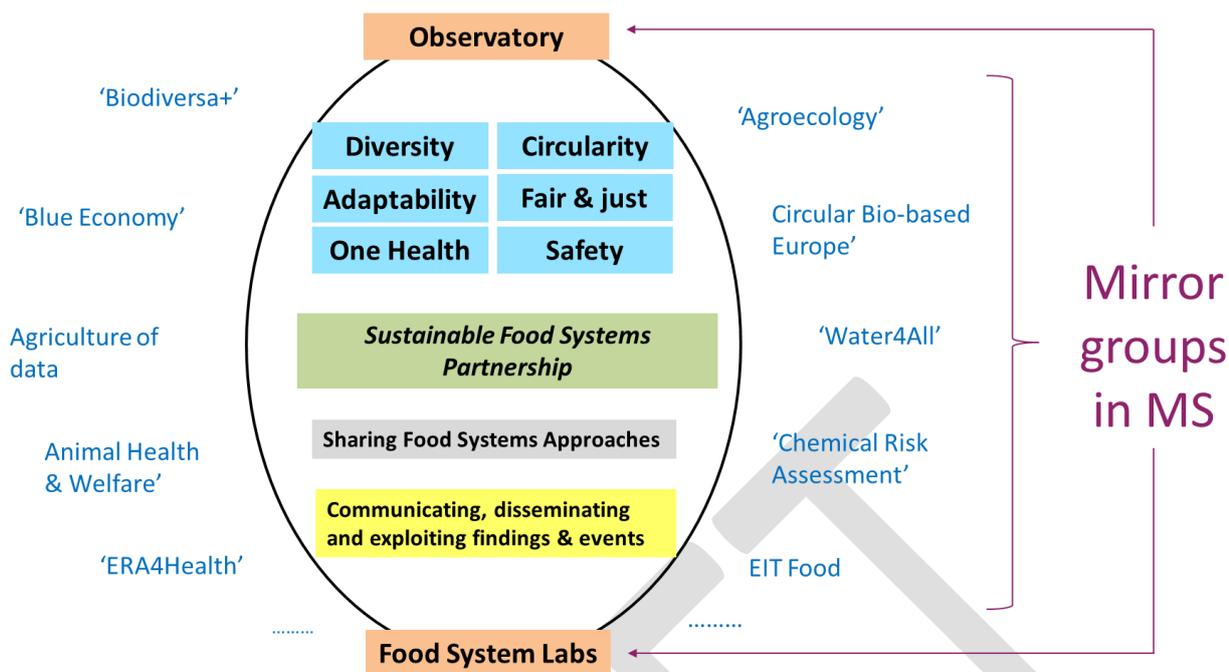


Fig. 5. The partnership SFS has relevant themes and actions to share with other partnerships.

Several ways of cooperation are foreseen: (i) grouping of projects around key themes like diversity, circularity, fair & just, One Health, etc. (see Fig. 3); (ii) mobilizing tools and infrastructures like FS-(living)-Labs for food system-wide actions, (iii) connecting Observatories, including metrics, (iv) jointly communicating, disseminating and exploiting findings and events for policy makers, the wider public, and FS actors, and (iv) exchanging on FS approaches to best reach sustainable outcomes in appreciated ways; this is in particular relevant for activities at the interfaces between pre- and post-fishing and -farming activities.

It should be noted that the overall SCAR FS SWG team – with support of DG RTD – will play a key role in the cooperation between Partnerships as well as to create and continuously support synergies and avoid overlaps. Existing and forthcoming Mirror Groups in MS (see Fig. 5) may support collaborative actions.

8.3 The way towards improved science-policy interaction

Building sustainable food systems requires fair and transparent policy decisions that are advised by science. Science-based knowledge is work in progress that advances by questioning and debating controversial evidence and arguments. This evolutionary role of knowledge brings uncertainty and challenges to integrate insights into policymaking. If the targeted scientific topic deals with higher degrees of complexity – like in our food systems instead of linear food chains – the level of uncertainty increases. This makes its integration in policymaking even harder, but still imperative.

Furthermore, policies are not only based on scientific evidence but also on tacit knowledge and information provided by non-scientific stakeholders. Conflicts between science and policy may arise from different perceptions regarding the weight of scientific evidence in respect to other kind of information available in policy decisions. It may also result in not bringing science to the attention of policymakers. Policy makers and scientists may approach problems from viewpoints that are different. However, better understanding these different viewpoints contributes to improving the science-policy interaction.

The P-SFS addresses a massive societal challenge, namely the sustainability of food systems. The societal challenge is acknowledged and framed in many political background documents (see chapter 5.2). These documents are taken into account in the preparation of the P-SFS to ensure providing policy-relevant research. This allows for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making. In that way, the P-SFS generates science-based evidence to underpin political actions such as in the case of the future Legislative Framework for SFS (EC, 2022c.). Hereby, other environmental, social or economic factors will be taken into account.

8.4 The role of and interactions with different stakeholders

The potential impact of the partnership is strongly related to the capacity to align actors of food systems around goals. The first condition for success is that a wide diversity of actors join forces in a partnership that has a mission for change. Therefore, interactions with different stakeholders are needed.

As recently published by the consortium of FOODPathS (2022), the following stakeholder groups can be distinguished:

- (i) The **'Partners of the P-SFS Consortium'**, essentially consisting of partners from ministries and funding agencies, however all others who will sign the P-SFS-Grant with the EC, like regions, associated partners, private sector actors, etc.
- (ii) The **'Applicants of P-SFS Funding'**, which are the actors that apply for grants delivered via open calls by the P-SFS Consortium.
- (iii) The **'Potential future Partnership SFS Consortium'**, grouping actors that are jointly willing to guarantee the continuation of the Partnership during and **after** the 7-years grant provided by the EC.
- (iv) The **'wider public'** which are actors that are benefiting from the sustainability impact created by the Partnership and provide feedback to the Partners or Applicants in one way or the other.

Next to these stakeholder groups, other key players will (most probably) intervene, like:

- National mirror groups, who are guiding the nationally involved partners and applicants in their SFS actions by seeking synergies, highlight unique contributions, etc.;
- EC JRCs, who may provide expertise to the P-SFS Consortium in terms of monitoring, analysis, science-to-policy recommendations, etc.;
- Relevant networks in Europe and beyond (e.g. the ones in FOODPathS active along all scales from local, regional, national, EU-wide to global), who serve to substantially enlarge the impact of P-SFS actions via enrolling (like a snowball) best and worst practices throughout their networks;
- Experts and expert organisations, who will continuously provide latest insights to the Consortium about the complexity of FS and FS approaches;
- Global institutions, who give feedback on potential trade-offs, in particular regarding developing countries, and co-benefits, both for developing and developed countries globally.
- Philanthropic organisations (as already united in FOODPathS), sharing their supported case studies called 'unusual suspect initiatives' and potentially co-funding targeted P-SFS activities;
- Financers, investing in short and long-term sustainability-oriented activities wherever possible;
- Citizens, Civil Societies and Consumer organisations, revealing their appreciation (or not) of activities, and join participatory actions; the endless number of target groups requires some categorization;

In addition, international cooperation is foreseen with Europe's priority partner countries and regions on the manifold cross-border dimensions of Europe's food systems. Key pertinent dimensions are 1) building

capacities for monitoring the sustainability of FS, 2) global research programming around external dimensions of Europe's Green transition, 3) regional and global science-policy interfaces on FS. Here, the P-SFS will join forces with organisations like the FAO, WHO, UNEP, UNICEF, WFP, etc. to support food security, fight against increasing hunger and respond to the question of 'how to feed 10 billion people in 2050 in a sustainable way?'

The prioritization for collaboration on geographies will recurrently be done under the SRIA of the P-SFS; the policy commitment to shared R&I agenda of key regions is crucial. This includes the EU's associated countries in the South Eastern and Eastern regions of Europe and Africa.

For Africa, as a strategic cooperation partner, the EU seeks to support actions targeted to finding locally adapted solutions to challenges that are global in nature, but which often hit Africa hardest. Green transition is one of the pillars of the European and African EU-AU Innovation Agenda, tackling education, research and innovations. To encourage the international collaboration on these challenges, it is envisaged that the Africa-Europe International Research Consortium (IRC) for Food and Nutrition Security and Sustainable Agriculture (FNSSA) will be aligned with the P-SFS, and that African challenges are considered in its SRIA. The IRC was launched in 2022 as a long-term partnership of government institutions, research funders and research partners in the EU and Africa, building on EU-funded Coordination programs like ProIntens Africa (2015-2017) and LEAP4FNSSA (2018-2022).

Finally, the notion that the transition to SFS only may be achieved together with the seven other Partnerships in Cluster 6 of HE, requires regular exchanges and a well-founded cooperation scheme. Consequently, the above listed key players may be consulted for issues surpassing the P-SFS.

8.5 Evaluation and monitoring of the impact of the partnership

The Intervention Logic serves to define appropriate Key Performance Indicators (KPI's) for monitoring progress – or deviation – towards Impact, Outcomes, and (General and Specific) Objectives. Consequently, a set of generic KPIs will be defined for the overall functioning of the P-SFS. In addition, since the work of the P-SFS is divided into 4 R&I Areas and 4 Activity Areas, KPIs will be established for each Area.

In the process of defining KPIs, we will use the overall framework that the Commission has envisaged for the monitoring and impact of the Partnerships. Most likely, the foreseen Legislative Framework for SFS (EC, 2022c.) will provide guidance for establishing sets of KPIs to reach sustainable outcomes within clear boundaries.

Finally, we will incorporate KPIs provided by FOODPathS, which develops the prototype P-SFS. KPIs are foreseen for (i) co-funding and programming (like number of calls launched, percentage of geographical coverage in funded projects, etc.), (ii) co-creation cases (number of projects, diversity of actors involved, (iii) exemplary FS network (e.g. number of re-using exemplary cases, growth percentage of networks per year), (iv) interface science-policy-education (like number of science-policy debates, rate of alignment between science and education programs), (v) trade-offs and benefits (e.g. the number of workshops with third countries, foreign appreciation rate of P-SFS funded projects), and (vi) systemic way of working as P-SFS (like the degree of adaptation of procedures, a note for the evolution as vibrant epistemic community (see Specific Objective in Table 1). It should be noted that these KPI examples still need to be elaborated since FOODPathS only started in June 2022 and provisional ideas are foreseen in its first year of operation.

9. Literature and Relevant EU Policy documents

The scientific literature and the policy documents related to Sustainable Food Systems is rich. In the SRIA we have only provided a snapshot of literature and documents.

Regarding policy documents, next to the Farm to Fork Strategy and Green Deal, other relevant ones are here listed: Common Agricultural Policy / Common Fisheries Policy; Bilateral & Global Trade Policies; Circular Economy action plan, Blue Economy; Sustainable Aquaculture; Biodiversity Strategy; Single market for Green Products; Europe's Digital Decade; 2030 Climate Target Plan; Waste Framework Directive; Bioeconomy Strategy and Action Plan; Zero pollution action plan; Food2030; Open Science Policy, FAO/WHO ICN2 (2014) Rome Declaration & Framework for Action (FfA); 2030 Agenda for sustainable development & SDG, 2015; United Nations (UN) Decade of Action on Nutrition 2016-2025; EC-HLEG- International Platform for Food Systems Science (IPFSS) in food systems transformation 2022 (EC-HLEG, 2022).

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