SCAR
Standing Committee
on Agricultural Research

SCAR Food Systems

Sustainable Food Systems Partnership for People, Planet and Climate

STRATEGIC RESEARCH AND INNOVATION AGENDA (SRIA)

JANUARY 2023

Abbreviations

CAP: Common Agricultural Policy
CSA: Coordination and Support Action
DG: Directorate General
EC: European Commission
EC-SAM: European Commission Science Advisory Mechanism
EFSA: European Food Safety Authority
EFSCM: EU Food Security Crisis Preparedness and Response Mechanism
EIC: European Innovation Council
EIT: European Institute of Technology
EJP: European Joint Programme
ENoLL: European Network of Living Labs
ESD: Environmental, Social, & Governance
ERA: European Research Area
ETP: European Technology Platforms
EU: European Union
FAIR data: are data, which meet principles of findability, accessibility, interoperability, and reusability
F2F: Farm to Fork Strategy
FAO: Food and Agriculture Organisation of the United Nations
FBDGs: Food-Based Dietary Guidelines
FBS: Food Balance Sheets
FS: Food Systems
FS-Labs: Living Labs for Food Systems
FWL: Food Waste and Losses
GHG emissions: Greenhouse gas emissions
GO: general objective
HBS: Household Budget Surveys
HLEG: High Level Expert Group
HLPE: High Level Panel of Experts
ICN: International Conference on Nutrition
IDS: Individual Dietary Surveys
IPFSS: International Platform for Food Systems Science
JPI: Joint Programming Initiative
JRC: Joint Research Centre
KPI: Key Performance Indicator
LL: Living Labs
LCA: Life Cycle Assessment
MA: Multi-Actor
MEL: Monitoring, Evaluation and learning
MS: Member State
NCD: Non-Communicable Diseases
NFTP: National Food Technology Platforms
NGO: Non-Governmental Organization
OECD: Organisation for Economic Co-operation and Development
PEF: Product Environmental Footprint
R&I: Research and Innovation
R&I&P: R= Research, I=Innovation, P = science-Policy interface
RRI: Responsible Research and Innovation
SCAR: Standing Committee on Agricultural Research
SCAR FS SWG: SCAR Food Systems Strategic Working Group
SDGs- Sustainable Development Goals
SFS: Sustainable Food Systems
P-SFS: Partnership Sustainable Food Systems
RIPE: Research, Innovation, science-Policy and Education
SAM: Scientific Advice Mechanism
SHD: Safe and Healthy Diets
SME: Small and Medium-sized Enterprises
SO: specific objective
SPI: Science Policy Interface
SRIA: Strategic Research and Innovation Agenda
TRL: Technology Readiness Levels
WHO: World Health Organisation

Definitions*:*

- **Co-creation** refers to the design process of a 'product' or 'service' in which input from a group of different actors plays a central role from beginning to end.
- **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).
- **Multi-actor approach:** Involvement of a targeted group of actors, essentially the end-users of project results, from the design to the implementation. This is more than just widely disseminating the results of a project, or listening to the views of a board of stakeholders.
- **Planetary health:** "*the health of human civilization and the state of the natural systems on which it depends".* The Rockefeller Foundation and The Lancet launched the concept as the Rockefeller Foundation–Lancet Commission on Planetary Health (2015).
- **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**. This contradiction to systems approaches (see section 5.3) is addressed through intensive cooperation with the other partnerships and this includes jointly implementing system approaches, working inter- and trans-disciplinary and engaging 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, why and when'

The future well-being 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 in post-farming and fishing part of current FS, underlying the question **WHY** do we need a P-SFS – 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. The major part of GHG emissions originates from animal-based foods (Leip et al., 2015; EEA,2019); the share of the post farming and fishing part of FS is ~30%. Climate change can disrupt food and water availability and affect food safety and quality.
2. The agro-aqua-food sector is the largest producing and manufacturing sector in Europe[1], 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 and water (the Nexus between them) as well as biodiversity (in particular counteracting biodiversity loss and moving towards nature-positive food provision). It should deal with the increasing scarcity of resources (including water) and to most efficiently – circular – use of resources and food production side-streams in all steps of the food chains while feeding a growing world population.
3. In Europe, 57 million tons of food waste was generated in 2020 (Eurostat, 2023). Households generate 55% of food waste. This is important because wasting food in the post-farming and fishing stages – and in particular at the end of food chains – means wasting inputs in all previous stages. Avoiding waste is thus primordial, without trade-offs such as increasing burden of packaging materials or elevated energy costs for storage and transport. Waste and co-product handling may be rather challenging due to very heterogeneous resources, safety concerns, competition of biomass use (for other bio-based products), inappropriate technologies, lack of circular business models (e.g. for clustered SMEs), marketing of products originating from 'waste', economies of scale and logistics, etc. Attention for this topic is even more relevant today since food prices are rising, both in Europe and globally, directly impacting consumer purchase capacity and viability of companies, in particular SMEs. The foreseen potential massive biomass gap in 2050, also partly due to renewable resources needs for other bio-based products, may put further pressure on food availability and prices, hence a combined challenge with the CBE-JU.
4. Current consumption patterns and poor nutritional foods (e.g. high in sugar, salt and saturated fat, low in fibres) are leading to the triple burden of malnutrition, namely over-nutrition, under-nutrition 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). The continuous burden of foodborne diseases, resulting in high number of cases in Europe, underlines the need for the One Health strategy and standardisation of diagnosis methods.
5. Food systems feature systemic shortcomings in fairness, inclusiveness, maintaining cultural food heritage, true cost accounting, and resilience. These appear in the entire food chains, revealing financial and power unbalances, disconnections between rural and urban areas, unequal access to and insecurity of food (e.g. insufficient purchasing power, nutritional insecurity), diverse regulations and incentives, and questioning autonomy and sovereignty of EU's FS while avoiding global trade-

[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].

offs or externalities (SAPEA, 2020). It should be noted that there are substantial differences between European countries, regions and cities – with their policies and numerous different stakeholders – hence this merits attention from a governance perspective and sharing of lessons learned.

6. The public awareness, attitudes, trust and acceptance of the need to shift towards SFS is another important challenge, often related to the food environment and the need for (communicating and educating) insights from social sciences and humanities.
7. Potentially well-reflected actions that respond to the above-mentioned current shortcoming may again result in new shortcomings and trade-offs between the environmental, social and economic dimensions of sustainability. This could be e.g. between climate change, biodiversity loss, deforestation for arable land (for feed and food), food security, social coherence and jobs, etc., either in Europe itself or globally. Hence, an integrated approach of sustainability – using an observatory and experimental hubs like LL – and the development of appropriate skills (targeting R&I and their impact) will be imperative, even more since European FS are diverse, and in general, highly complex.

The new P-SFS itself will tackle the shortcomings in the post-farming and fishing stages, and join forces with the other Partnerships (see section 8.2) to address shortcomings in the full FS. Fortunately, the still appreciated richness of the European Food Culture with its delicious dishes may serve as positive driving force as does the call for advancing planetary health.

Finally, the importance of challenges is accentuated by current shocks and stresses that test resilience of FS, including the Covid-19 crisis (Bakalis et al., 2020), the Russian aggressive war in Ukraine, economic and energy crises, and increasing rates of drought and heat (EC, 2022e.). The impacts, however, are hard to estimate. This poses the question '**WHEN**' should the P-SFS deliver? Preferentially tomorrow, however realistically, sustainable outcomes are foreseen in 2050; each possible acceleration towards solutions at a short timescale is favoured and communicated.

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

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, with their National Food Technology Platforms), 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 (including SMEs and start-ups), research, education, philanthropic, NGOs, etc. have thus been identified (see section 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 section 8.4). Due to **systems approaches (see section 5.3)**, cooperation with other Partnerships are feasible around common principles, themes or even infrastructures[2]. 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 P-SFS is thus also one of the most appropriate arenas for combining hard sciences with social sciences and humanities as well as initiating cross-sector actions.

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 section 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.

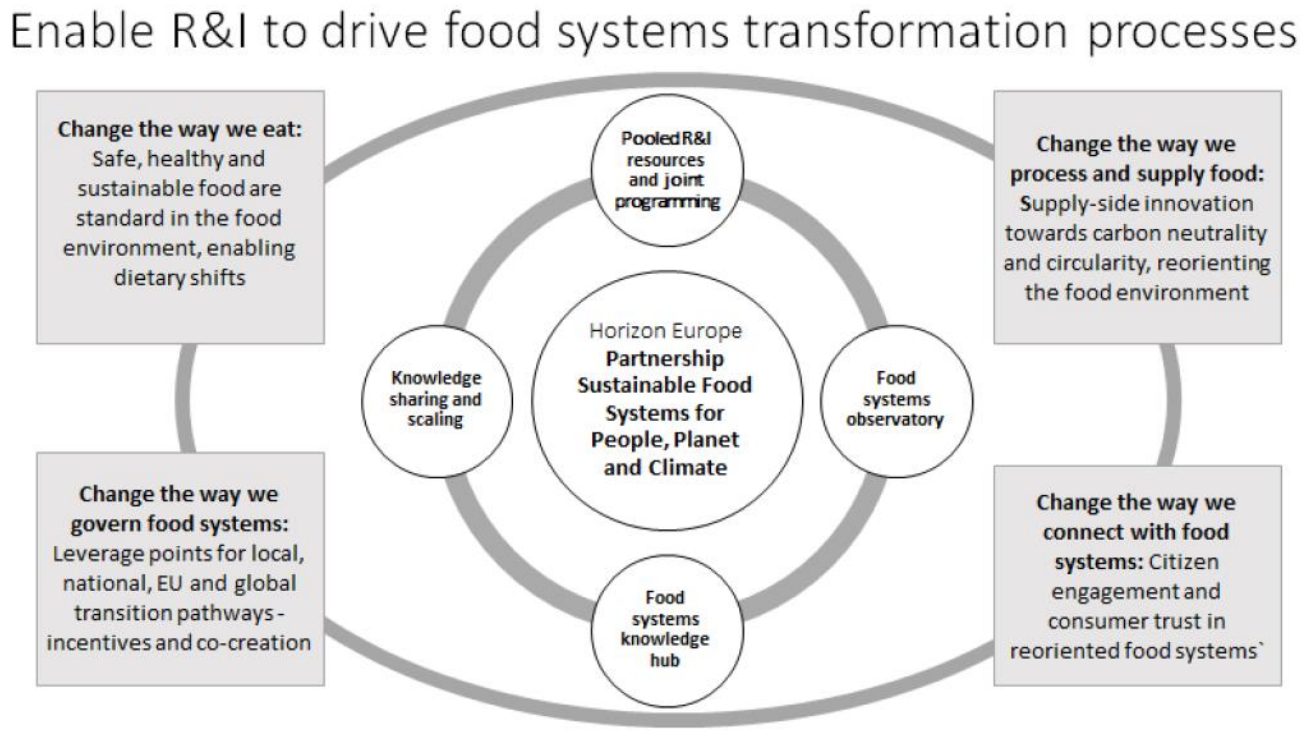

Figure 2. The four R&I Areas and four Activity Areas of the Partnership SFS, all inter-connected.

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 – in which the activities are described serving to support the pathways towards SFS – 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 Section 4.
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.

<table>
<tr><td colspan="4">Impact (what we like to achieve)</td></tr>
<tr><td colspan="4">A European Sustainable Food System in 2050 and beyond based on inter-connected, territorialised, sustainable food systems (being fair, safe, healthy, biodiverse, ..)</td></tr>
<tr><td colspan="4">Outcomes:
- EU-wide functioning Partnership, based on collective and inclusive actions, providing knowledge for realising European SFS Policies, as well as public and private sector opportunities
- Strong foundation for a European SFS Research Area, connected to global initiatives, with harmonised EU-wide policies and regulations, while respecting locally diverse contexts</td></tr>
<tr><td colspan="4">General objective ('we like to'):
1. Understand what SFS are, how they function and how to enable their development;
2. Demonstrate that the partnerships 'systemic approach' functions as a catalyst – for many FS actors – to jointly transform FS into SFS (also beyond the lifetime of the Partnership);
3. Ensure that the well-governed Partnership contributes to SFS via frameworks and evidence-supporting policy options for EC objectives in Farm to Fork Strategy, Missions, Green Deal and the UN-SDGs
4. Co-create with various actors in a diversity of Living Labs[3] to develop SFS concepts.</td></tr>
<tr><td colspan="4">Specific objectives (leading to concrete outputs that are generically applicable):
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.</td></tr>
<tr><td colspan="4">Thematic R&I Areas</td></tr>
<tr><td>R&I Area 1: Change the way we eat: 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.</td><td>R&I Area 2: Change the way we process and supply food: Supply-and demand-side research and innovation topics reorienting the activities in post-farming and fishing to reach sustainable healthy diets.</td><td>R&I Area 3: Change the way we connect with food systems: Citizen engagement and consumer trust in reoriented food systems delivering sustainable diets.</td><td>R&I Area 4: Change the way we govern food systems: Leverage points for local, national, EU and global transition pathways, public procurement, F2F code of conduct & local initiatives (incl. cities).</td></tr>
<tr><td colspan="4">Transversal Activities</td></tr>
<tr><td>Activity A: Pooling R&I resources and programming
Joint transnational R&I support via project funding and alignment of funding priorities and mechanisms enabling multi-actor and systems approaches</td><td>Activity B: Launching a FS observatory
Platform for sharing methods, metrics, data and assessments on the sustainability performance of food systems</td><td>Activity C: Establishing a FS Knowledge Hub for complex FS, transformative research and FS-Labs on systemic innovations at different scales (using a 'vitrine' for demo's)</td><td>Activity D: Knowledge sharing, and scaling: Adapting knowledge systems, innovation & demo platforms and science-policy- society interfaces for ensuring impact</td></tr>
<tr><td colspan="4">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</td></tr>
</table>

[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 CO_2 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. Vice versa, the Partnership will feed the FOOD2030 pathways with new insights from projects following FS approaches and improved understanding of the complexity of FS.

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 *(alphabetic order first in Europe, than global)*	**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								
Partnership Agroecology								
Partnership Animal Health and Welfare								
Partnership Agriculture of Data								
Partnership Biodiversa+								
Partnership Circular Bio-Based Europe								
(Partnership) EIT Food								
Partnership ERA4Health								
Partnership Sustainable Blue Economy								
Partnership Water4All								
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 radically change future FS. The question of 'which pathways to follow, and what actions to focus on' starts with reflecting on and developing 'system approaches' (section 5.3). This implies in-depth understanding of the complexity of diverse food systems (section 5.4). Only then, most appropriate leverage points and pathways can be selected across all four R&I (section 6) and four Activity areas (section 7). In this SRIA, only the first series of activities for each of these Areas are described, however, they require continuous updating based on new insights in FS evolutions obtained during the lifespan of the P-SFS. Hence, also associated sets of KPIs are then to be adapted (see section 8.5).

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 consumption. 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 farming and fishing.

These interactions result in a number of *outcomes* such as health, climate and environmental impacts as well as economic performance for different stakeholders and the resilience towards external shocks such as climate change. There are important *interdependencies between these outcomes*, e.g. the impact of diets on people's 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 citizens 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

[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

activities from a portfolio perspective, thus continuously recording and assessing outcomes from the 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 – like the ones proposed by the FOOD2030 strategy – 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 explore and understand FS. This approach is used in the CSA FOODPathS (preparing the development of the Prototype P-SFS; www.foodpaths.eu), because presumably all actors, including citizens, are familiar with playing a kind of game, hence with their building blocks. This allows them to join participatory projects e.g. in FS living labs, which all follow a common methodology and combine natural and social sciences, including humanities. It enables the future P-SFS to be as inclusive as possible.

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 citizens, farmers and manufacturers, and indirectly involved as financers 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 coherence of a game with its seven building blocks apparently fits very well with the unique set of 4 R&I and 4 Transversal Activity Areas (see Fig. 3); The analogy 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).

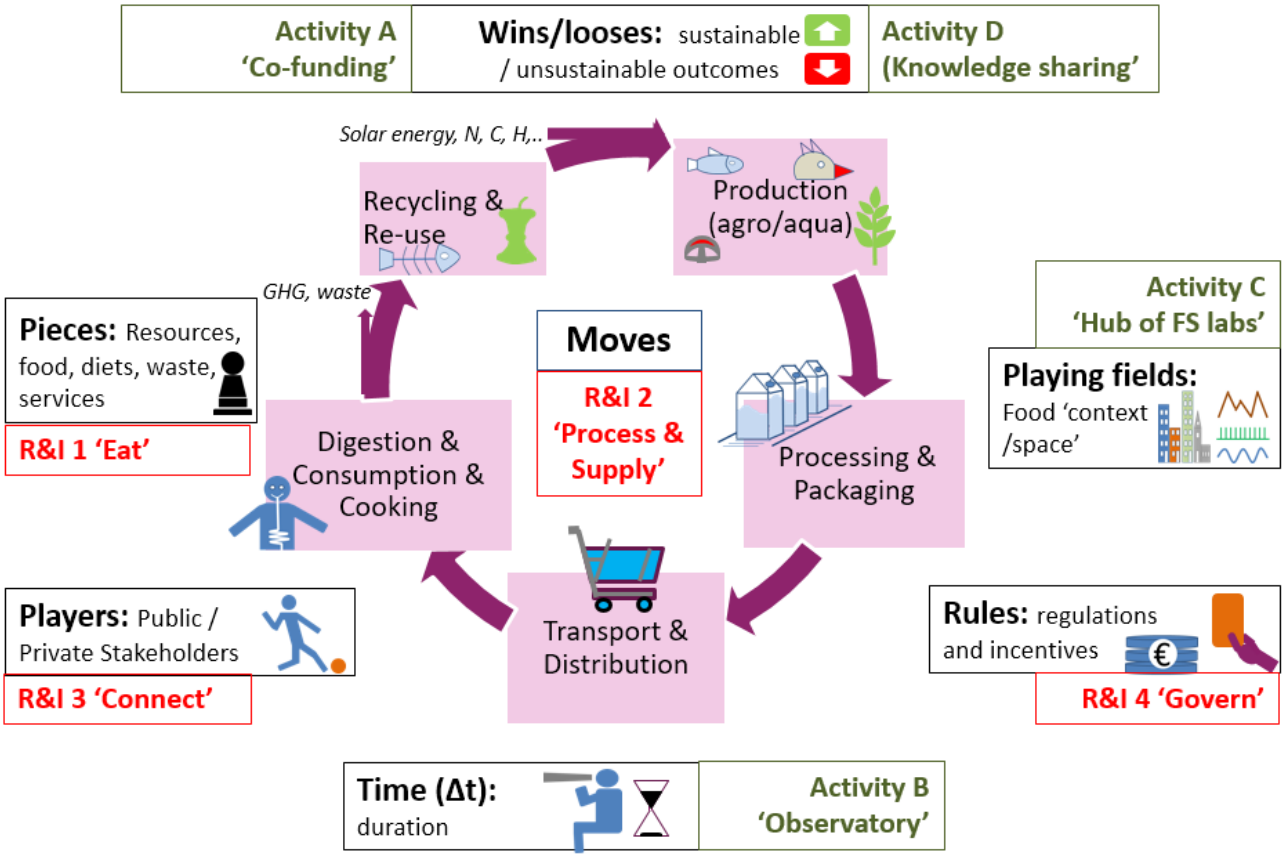

Figure 3. The seven building blocks of FS (by analogy with a game); modified from: de Vries et al., 2022.

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. They together form a 'unique ensemble', which is crucial for following FS approaches. As mentioned before, 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. This is what is meant with '*considering each R&I area from a FS lens*'. 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.

The fact that the 7 building blocks are integrally allowing to play games, can be used to follow the evolution of FS upon an external change. This can be intentionally, like targeting a leverage point in a FS approach, or unintentionally in case of an external shock, crisis, or stress. Food systems are continuously challenged by such changing conditions. Each external change – like extensive flooding or, reversely, drought 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 (F2F) 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). The F2F objective of 25% of total farmland under organic farming by 2030 also impacts as changing 'rule' directly the playing fields and then the production of resources and subsequent post-farming handling steps, operations of actors, etc. 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?' Here, a direct link should be established with the HorizonEurope Climate Adaptation Mission. The 'organic' case may well serve in this P-SFS as an exemplary case since organic consumption patterns may be close to sustainable diets according to the FAO (Strassner et al., 2015).

Consequently, the resilience of food systems – understood, as their capacity to adapt to external shocks while maintaining their basic functions and objectives – is a crucial element of sustainable systems[5]. 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 all four R&I areas in the course of the P-SFS; this should be elaborated. 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 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'), hence reach co-benefits and counteract trade-offs. Examples are exchanging critical resources, sharing expertise on food handling, circular business models between actors in different FS, trade exchange measures like the CO_2 –equivalent credits, or new social compensation measures, etc.

[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.

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.*

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, unhealthy diets and obesity. (Afshin et al., 2019). These factors 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). 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). Moreover, the high and globally increasing demand for livestock products requires high and growing proportions of global land use for feed and is a major contributor to global warming (Crippa et al., 2021). Continuing current trends, by 2050 the world will need 30-50% more protein to meet demand. So, there is an urgent need to change dietary patterns and preliminary research suggests that by transitioning to diets consistent with recent national FBDG may reduce overall carbon footprint from food intake by app. 30-45 % (More et al., 2020; Trolle et al., 2022). 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 at al 2020). 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[6]". *"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*

[6] https://doi.org/10.4060/CA6640EN

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). Moreover, the FSs overall degree of resilience to external shocks such as climate change must be considered (EC, 2020) and included in social and technical innovation efforts (Charatsari et al., 2022) and food systems development towards diversity (Vaarst et al., 2018).

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 dietary behavior, and the tools to direct behavior in a sustainable way. Moreover, it is still not clear to what extent a number of sustainability criteria may be combined into say, sustainability labels on food items, which could guide consumer choices (Torma & Thøgersen, 2021; Futtrup et al., 2021; Majer et al., 2022) 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. Likewise, the question of improving climate resilience of FS requires a diversification of production forms and products which may underpin redundancy and such arrangements may not depend solely on demand driven efforts but also on social and insitutional elements (Vaarst et al., 2018) and higher level governance (R&I Area 3).

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 the 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 other sustainability objectives. 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 Area 2). These should attempt to combine reductions in environmental and climate impact with improved nutritional composition and reduction of unhealthy components. Improvements of products and consumers' preferences should be seen in the perspective of SHDs. Thus, the food environment[7] - as the pivotal interface between the food supply chain and the citizens (see R&I Area 3) - should in the future contribute to diverse set of sustainable, healthy, and safe food and diets by making them, available, attractive desirable and affordable for different consumers including low-income groups. Moreover, R&I can contribute to improved identification and characterisation of new (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 a high proportion of Sustainable Healthy Diets is a complex task, which 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, improved diversity of foods including protein sources, diet reformulations, 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. Other partners across the food systems need also being engaged in negotiations re. the criteria for Sustainable Healthy Diets and identification of barriers and pathways for Food Systems changes – supported by scientific assessments and innovations. Thus, tools for multi-criteria assessment of food and diets are required using a sustainable FS framework for evaluations of current and new Sustainable Healthy Diets and Food System Based Dietary Guideline (FSBDG) 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 including experiences from established alternative food systems such as organic: 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. Moreover, sustainability assessment methods should reflect circular economy characteristics including cascade use of residues and non-avoidable food waste.
- Understanding and assessing potential burden shifts in FS from prioritizing certain objectives such as climate smart food (climate resilient food systems) at the potential cost of other criteria such as animal welfare, biodiversity or water use.
- Development and implementation of FBDG (detailed in a forthcoming FAO presentation): an important tool for sustainable diets, a key instrument to guide policy, private sector and citizens, a communication

[7] 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).

and dissemination tool for health and education professionals for implementing FBDG in public sectors (health, agriculture, education) and settings (schools, community, consumers 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 citizens to make responsible consumption choices is pertinent information for actors in the entire FS. Relevant strategies to explore include citizens 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 citizens 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).
- Increase understanding of food consumption, dietary patterns, and dietary intake in relation to health in vulnerable population groups, e.g. in children, adolescents, and the elderly and the potential for development and uptake of sustainable healthy dietary guidelines for consumer groups/individuals with specific needs.
- To which degree citizen 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.
- How may Data-driven documentation of sustainability aspects be based on collection and processing of data from entire FS and to which degree may a sustainability label on food 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).
- Identification and understanding barriers for change (lock-ins, resistance among stakeholders, negative feed-back loops) and potential leverage points are important, including new models taking into account consequences for vulnerable populations globally.
- Food safety: On the one hand there is overall need to study how dietary changes may impact on human exposure to biological and chemical hazards, including well known and new types of contaminants. 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.
- On the other hand, food safety assessments should be sufficiently efficient to not hamper innovation and market introduction of new foods, which requires new knowledge, technologies and procedures. Insights are lacking as regards food safety 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.).

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, social 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?
- To what extent may established alternative diets and food systems including Organic food serve as inspiration and guide towards support and uptake of sustainable healthy diets?

- Potential health impacts – e.g. nutrient deficiencies, bioactive compounds, digestibility, anti-nutritional compounds and contaminants - from significant dietary changes to new food sources from plants, marine resources, cell culture and biorefinery.
- 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?
- 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.
- Further development of European standards for food labelling re. Environmental footprint and sustainability – based on existing food laws and PEF.
- Which barriers and opportunities will policy makers and citizens 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 including different socio-economic status/income groups?
- Are there risks of developing territorial inequalities in access to Sustainable and Healthy Diets and how may EU and MS policies impact on global food systems?
- Leverage points for dietary changes: what are main determinants, barriers and leverage points for citizens to change the way they eat? What are factors influencing dietary choices?
- Which innovative communication forms (e.g. AI based apps, labels) and messages (personalized vs general dietary recommendations; Individualized nutrition vs FS characteristics) should be used to influence consumption choices in different consumer groups? To which extent and how do different groups of citizens perceive dietary choices and the linked consequences in a sustainable FS perspective? And how to use 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 citizens 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 is the potential role of place-based approaches and local FS in supplying culturally adapted sustainable healthy diets by engaging citizens and cities/local authorities (R&I Area 3)? What is 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, citizens and civil society is needed and especially the private sector is expected to contribute to joint R&I activities. Improve FS communication and education (including practical training, life-long learning and capacity development) 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 citizens 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-farming and -fishing 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 as well as strive for zero food waste. In particular they seek to deliver food properties and functionalities according to culturally-diverse consumer preferences, and nutritional needs and convenient fresh-like food trends, 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 citizens, 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 (in total 290.000 in Europe, footnote 1). It may even have resulted in disconnecting citizens 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; ETP, 2021). They support rescaling, delocalizing and efficient[8] 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- following food-based dietary guidelines (FBDG, R&I Area 1) - 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 sources, forgotten (ancient/underutilized) crops, local varieties, algae, low-trophic fish species and invertebrates, insects, etc. Diversification also evokes challenging (bio- technological) research questions in the microbiome field and

[8] 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.

especially holobiont (host plus its microbiome) and its constituent hologenome (the totality of genomes in the holobiont. Lastly, the potential benefit on agro-biodiversity from provision of diversified diets is an important issue.

Re-localisation and adapted logistic schemes will result in re-scaling of processes and alternative (short and long) supply and demand chains, including at the urban-rural/coastal interfaces This also concerns cascading methods for locally and safety transforming main and co-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', and in particular also with SMEs).

Circularity is a next driver to close nutrient cycles and efficient usage and consumption of resources, food products and by-products (together with Partnerships in farming and fishing). This asks for new recycling, processing and packaging on-demand methods to create added value, prevent food waste and develop tools. The latter are e.g for waste reduction guidance (for households, local communities, food service and retailers, producers), safety measures (e.g., avoiding migration of substances from recycled food-contact packaging materials to food), conservation, hygienic design and disease control.

D*igitalization of processes and food supply chains* is another main driver. The adoption of digital technology ('digitalization') by the food sector 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 connecting and balancing 'demands and supplies', combined with 'bottom-up' assembly and disassembly strategies for resources; the latter provide opportunities for local revenues and jobs, start-ups and SMEs. It asks for transparency on eco-friendliness, bottlenecks, and governance steering (incl. legislation and taxes) and potential implications for food actors.

Complex FS modelling, predictive benefit-risk chain assessments and fraud modelling (AI, block chain technologies, digital twins, virtual environments, etc.), early warning signalling, date marking in relation to food security, safety, transparency and waste, as well as 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, natural preservatives), adaptable to various supply chains keeping shelf-life, while guaranteeing safety, 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 about eating behaviour and diet variability, packaging usage, etc. remaining between sustainability limits. Collection and processing of data from the entire food value chain (including consumer perceptions) is a prerequisite for all areas (together with Activity 'B').

Food design is a another transversal topic. Future products need to be designed in such a way that they are more climate-neutral and at the same time safeguard healthy and tasteful eating experiences – to ensure consumer purchase and re-purchase. This requires a deeper understanding of food process-structure-

proprerty relations with respect to the multi-faceted needs of citizens 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 appropriate 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 food (bio-) technology, texture, sensory science, gastronomy and consumer behavior.

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 (regulatory for e.g. novel foods and ingredients, taxes for e.g. pollution and labour, market organization, transparency for citizens, data gaps e.g. for food fraud, policies) and identifying drivers and incentives (carbon farming, CAP, bioenergy subventions,) for transitions towards sustainable food value chains. This should also include reflections on the roles of various actors outside ('out-of-the-box thinkers') and inside food networks (Knorr and Augustin, 2021; with R&I Area 4) this should be in line with FOOD2030 pathways, Soil and Climate Adaptation Missions – which end at TRL 9 (work to be done together with EIT Food and CBE-JU; with the latter target also the foreseen potential biomass gap in 2050).
- Understanding the pros and cons – as well as co-benefits and trade-offs in wider context – of innovative, delocalized, mild and targeted processing and supply schemes for circular, low environmental footprint (e.g. minimized packaging material use) and diversified (agro ecological, marine) production schemes; these include also culturally, age and gender diverse sustainable and healthy diet (SHD, e.g. low in salt and sugar) characteristics at all levels (with R&I Area 1) in territorialized and global SFS;
- Understanding FS scaling principles in particular under stress conditions, via numerical approaches and hybrid models for innovative, diverse, resource-efficient processing and supply schemes for both terrestrial and aquatic resources (and mutual learning between them).
- Socio-cultural and consumer appreciation factors about the role and level of innovative processing, packaging, logistic and new products schemes in a SFS perspective (with R&I Area 3), hence linking natural sciences with social sciences and humanities.

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 & cultural models) and social (e.g. new participatory concepts and ethical considerations) innovations via systemic approaches. Often, a technological innovation should go hand-in-hand with organisational and social innovations to reach sustainable outcomes; the organic sector may serve as example. Secondly, there is a need to reconsider food processing and supply methods for (re-)valorising forgotten, under-utilized (like pulses) or organic crops or livestock species, saline-tolerant and drought-resistant species (new) aquatic resources, alternative protein sources, (cocktails of) micro-organisms (exploring the microbiomes), cell-culture based food, hydroponic production, etc. The reason is that these may allow creating FS, targeting sustainable healthy diets, revitalising food cultural heritage, etc.. Such re-valorization procedures should follow system approaches verifying their positive environmental, social and economic impacts. Cooperation with other Partnerships in farming and fishing are then imperative.

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

- How can (new) food actors – both private (incL; SMEs) and public parties – sustainably optimize current value chains? The following elements are to be considered: new products and SHDs (incl. microbial-based), new processing technology, smart and efficient food production strategies and technologies, prevention of waste thanks to intelligent or zero packaging and natural preservatives, valorisation or

recycling of co-products (taking into account non-food uses), alternative trade channels (also towards remote areas), innovative logistic, marketing and business models and forums including the development of marketing rules and regulations (and their interactions), eco-labels, code-of-conducts, new (co-)financing schemes (with Activity 'A'), citizen-participatory actions in food development, etc.

- What range of newly designed food (e.g. tasteful alternative-protein-based) and 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, regional 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 or producers and consumers fairly, based on indicator sets and date, without resulting in trade-offs?
- While seeking higher diversity in nutrient-rich resources, how can supply- and demand-driven processing and packaging be modernised and matched in time and place? What does this mean for resource-efficient usage, introducing and phasing out of products, waste recovery, recycling and safety, social appreciation, food and resource pricing economic soundness and dynamics of FS actors? What is the potential usage of digitalization (big data, artificial intelligence, robotics, sensing, information exchange models, transparency etc.) and involvement of non-food actors?
- 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? How do food actors mitigate potential hazards due to new developments? Which leverage points may enable positive interactions and synergies between technical, organizational and social innovations such that food will always be available, also during shocks and crisis (e.g. climate change, elevated food prices, energy shortage, war,)?

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, on –farm/on-ship manufacturing test stations, mobile labs (also for remote areas), simulators for agro logistics, and connecting with the European Digital Innovation Hubs Network, Agro-ecology, Soil Mission Labs, the National Food Technology Platforms, and EIT food innovation and education activities (with Activity C); all are characterized by multi-actor communities or clusters and multi-actor approaches, imperial to the transition towards SFS These also 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; Activity D).

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, R&I Area 4).

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, recycling and distributing 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 and regional FS striving for sustainable outcomes and food security as well as for the EU-wide and global SFS with diverse, healthy, safe and accessible-fair diets. Hereby, it will support the innovation of new food (ingredients), processing, business (in particular for SME) and logistic concepts.

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', in particular also involving SMEs and the National Food Technology Platforms (NFTP)) using down-scaled, mild, (bio-)technologies, new packaging concepts and logistic schemes. They will address different scales, and use recurrent time-series approaches in which actors, citizens' inputs and perceptions 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, regional and global value chain configurations, including potential competition for non-food uses of resources (with CBE_JU). 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 and alignment with the EC's Food2030 Pathways and funders in Activity 'A', R&I projects will be supported that address gaps in existing knowledge and educations programs, and technology for example, in processing, management and logistics that may be crucial for reaching sustainable outcomes together with private (including SMEs) and public actors, often united in the NFTPs.

6.3 R&I Area 3 'Change the way we connect in 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 struggles with lack of harmonized criteria and methods. It has also been established that there are large differences between consumer groups and segments (based on socio-economic, cultural, ethnic, and other factors). 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 diverse segments of citizens /households/stakeholders 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). The sustainable food labeling legislative proposal is part of the foreseen sustainable food systems framework.

There is growing appreciation of the importance of the so-called "Food environment"[9] (and the overall context for both consumers' purchase and consumption choices as well as the options it offers 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. Likewise, a strong focus on engaging consumers in improving (the offer of) convenience food may allow consumers with low interest in cooking to follow a sustainable and healthy diet. Also growing in importance is 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.

[9] The food environment encompasses the total scope of options within which consumers make decisions about which foods to acquire and consume. It contains the wild, the cultivated, and the built (stores etc.) environments. The key elements of the food environment within the food system include the availability, affordability, convenience, promotion and quality, and sustainability of foods and beverages in wild, cultivated, and built spaces (Downs et al., 2020).

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") through co-creation, consumer driven innovation, community action etc., thus finding mechanisms for engaging in transforming the dominant food environment by cooperative actions (Cifuentes & Gugerell, 2021). As such, the (re-)building of food systems include the adoption of democratic principles and practices in food governance to empower citizens to shape them (Bornemann & Weiland, 2019). 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) https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1556-486X.2010.01032.x 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 trust in the other actors in the FS (companies, governance, etc.) can access the information that these actors provide as well as have the (political) power to influence current and emerging FS structures. 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 toward SFS. 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 to choose healthy and sustainable diets, be informed (or in a more passive form "nudged") or incentivised to change diets 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 diverse citizens (socioeconomic, ethnic, cultural etc.) and their access, ability, and willingness to engage with options.

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

A number of points mentioned below 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, incentivising and promoting new foods and sustainable diets), ensuring understandable communication and information flows, raising awareness of various efforts such as fair trade, true cost accounting etc.). *b)* How can we enable informed consumer choices by enhancing transparency and traceability across the different food chains and products, and by for example further developing science-based sustainability related labels or trademarks, fight against green-washing practices, -improve consumers awareness of the impact of marketing standards, on their food choices and the sustainability of these choices. *c)* How may training and educational activities, including digital applications and communication familiarise consumers with sustainable diets and enhance citizens and children's food literacy. 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? Further, how can education and pedagogy be developed to support educational efforts at all levels? *d)* 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? Including better understanding of the mechanisms of behaviour change, i.e. the influence of the food environment versus attitudes. *e)* 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? *f)* 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.).

II. 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 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 as well as different urban, peri-urban and rural systems.

The potential role of social media and IT-supported engagement for improved transparency and involvement should be clarified for different purposes.

III. 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 can co-creation and consumer led innovation shape SFS? Better understanding of the role of food governance actors and different private/public organisations in the FS in (dis)empowering consumer engagement with FS and FS change.

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 trust. Moreover, the improved understanding will allow integrating 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 consumption choices and regulate green-washing? How will these efforts be coordinated across product, industries, academia, FS and across local, national and international (European) levels?
- How will increased awareness of citizens of 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 citizen trust and influencing food choices?
- How does the food environments (and overall contexts) impact food choice and consumption, and how can this be levied for innovation and change?
- How can citizens 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 citizens in different social positions?
- What are the processes underlying engagement of citizens 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 citizens – 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 can 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 and provide solutions 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, fisheries, 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, food industry actors have implemented sustainability strategies that imply assessment, data collection and appropriate governance patterns (Toussaint et al. 2021; Brunori et al., 2016). They are implemented through corporate responsibility, food standards, labelling, traceability, certifications, and many other initiatives. However, many companies are concerned with the costs of transition, and may tend to resist to change. At the same time, concentration in the food industry and the influence of powerful lobbies raises concerns about fairness and equity.

In the civil society domain, the engagement of citizens in local food systems (CSA, etc.) and in cooperative business models (production, retail) is a driver for change as it contributes to break the sectoral barriers and fosters system thinking by focusing on problems.

Moreover, the importance of trade raises attention on the connections with extra-EU system components, as policy internal decisions and governance patterns affect actors and activities outside the EU.

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, the Proposal for a Directive on corporate sustainability due diligence (EC, 2022g.), and the taxonomy for sustainable finance (EC, 2022i.)[10]. If properly coordinated, these policies can become powerful drivers of transformation.

Being transformation an open process, full of barriers, trade-offs and conflicting interests at stake, research will have to support it by improving the capacity of policymaking to frame the problems, to design effective

[10] https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en

policy tools, to assess their impact, to foster participation, to encourage experiments and to learn from them, and to make timely, evidence- and consensus-based decisions.

Governance is key to effective policy design and implementation. Research will have to provide knowledge on how to better coordinate the actors that populate food systems and to align their action around sustainability goals. It will have also to study how governance will evolve with the involvement of new actors such as municipalities, grassroot movements, digital platforms.

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') synthesized 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. Research in this field will also co-design and facilitate the assessment of experiments of food policy governance at local level. 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 key knowledge gap to be addressed is how society and policymaking is organized in relation to food, and what are the strengths and weaknesses of different governance arrangements. The P-SFS aims at understanding how public and private governance in a FS view can improve the capacity of system actors to **appraise** the system (its actors and activities, the barriers, trade-offs and leverage points to transformation). Linked to this aim is a need to assess the performance of food systems (FS observatory, Activity 'B'). Moreover, the P-SFS aims at increasing actors' **commitment** to sustainability. Linked to this aim is a need to support local food policy experiments, to study the effectiveness of corporate responsibility strategies, to assess the uptake of sustainability standards, to improve the participation of citizens to corporate decisions, to encourage the full integration of agroecology into food systems (Activity 'C').

With regard to **appraisal**, effective policies need consistent representations of the systems and useful data to monitor their state and evolution, and to identify emerging risks. This is imperative for a clearer understanding of FS, for a shared vision on SFS, and for policy coherence.

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 of all actors to priority setting, and communication are subject to common rules that avoid deception and build trust. More participation can also balance the influence of powerful lobbies. Research should aim here to a substantial improvement of the transparency of the system.

In the **civil society domain**, access to information, participation to knowledge production and 'voice' on decisions 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.

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. Transition requires participation of all actors, improved coordination between sectors (agriculture and fisheries, food-health-social-environment, sustainability-security-safety), between operations in the value chain (production/processing/retailing), between levels (local-national-EU- global), between functions (science, policy, civil society), and between scientific disciplines. There is a need to co-create governance solutions that can improve coordination, and initiatives that can foster integration between policies.

R&I needs to explore how private and public actors, networks, institutions can be involved in governance with a FS view and committed to transformation. As food policies have no jurisdiction in many member states, there is a need to identify 'institutional entrepreneurs' who can lead the change through leverage points, where policy initiatives may create large shifts in overall governance in private and civil society domains leading to SFS outcomes.

In the **public sector**, the key issue is how to align different policy levels (national, regional, local) and different policy domains around shared goals in a coherent food system planning. To improve the speed and the coherence of transformation, new actors and new fora where issues are debated and coordination is fostered are necessary. 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 civil society actors 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, and how availability and access to information (for example, in relation to the true cost of food) could strengthen their role.

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.

Research can combine retrospective studies that focus on causes, sources of pressure, and drivers; present-day sustainability assessments in different realms of the food system; and prospective studies that envision the future of food systems and advise measures and strategies to foster transitions towards more sustainable agri-food systems.

The partnership will study how to improve coordination between actors of the system, also considering the geographical differences (West-East, North-South, Rural-Urban). As governance is strongly related to knowledge creation, use and communication, the P-SFS aims at creating knowledge ecosystems - involving diverse sources of knowledge - working actively to contribute to break the sectoral barriers and to foster policy coherence. The partnership will actively involve the Agricultural Knowledge and Innovation Systems (AKIS) and will actively pursue their integration with broader food-related knowledge systems, such as those related to marine policies, public health, environment.

Science-policy interfaces are key components of the new knowledge ecosystems. By improving communication between knowledge producers, users and communicators, and by making sense of different knowledges, different values and different interests, science-policy interfaces provide relevant, legitimate, and credible knowledge to address food-related policy problems. At the same time, science-policy interfaces can support scientific research to identify knowledge gaps. P-SFS will operate to develop science-policy interfaces at multiple levels.

The P-SFS will encourage - through strategy, guidelines, communication, evaluation - all actors of knowledge ecosystems to work on policy and 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 and mainstreaming them into regional national policy instruments.

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 (land and sea, 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 respectively in public, private and civil society domains 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.

Besides, supporting the international dimension of food systems research is important and needs to take into account possible negative effects of transformation on non-EU countries and how to mitigate those.

Gaps to be addressed

- Understanding existing differences, barriers and enablers for funding of FS and MA approaches in line with existing national/regional funding practices and legislative frameworks and how to exploit/ combine different funding sources.
- Defining realistic approaches within the Partnership instrument regarding the funding of activities and projects within a FS perspective including portfolio management (section 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.
- Investigating in the potential of less applied co-creation approaches in R&I funding (e.g. using broad collective intelligence and citizen science)

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. Supporting research activities in higher TRL levels, like piloting, field and industrial demonstration, validation, flagship type projects etc, should be planned in close interaction with Activity 'C'.

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, investors or banks 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:

- From systems thinking to applicable concepts and operationalisation of food systems approaches, e.g. during call design, trainings and support for funders, evaluators, researchers;
- Transnational, multi-actor involvement and multi-disciplinarily actions with stronger involvement of social sciences and humanities (e.g. in research projects, networking opportunities, consultations and co-creation spaces, also in collaboration with FS-Labs; Activity 'C') with special emphasis to industry perspectives (involvement of SMEs);
- 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.

Project funding is a classical tool in R&I support, outreach to other relevant Partnerships and Programmes within and beyond the EU should be undertaken in order to align themes, avoid duplication and make use of synergies (e.g. joint calls, collaboration with regard to research projects and living labs, exchanging good practices on monitoring, impact assessment or valorisation etc.).

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 and globally. 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 global and EU food markets, the EU Food Security Crisis preparedness and Response Mechanism (EFSCM) has been established along with 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 systematically collected and curated data on FS are in short supply, hampering coordinated policy processes. 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 (including citizen science, data mining) 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. In part, this is rooted in the lack of a universally agreed operationalization of SFS, which 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. STATUS MONITORING on the sustainability performance of national and EU FS, crucial for measuring progress. The FS Observatory will provide rigour and standardization in defining and operationalizing the outcomes and drivers of sustainable food systems, both in metrics and data. 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. The Observatory will become a source for recurring reporting on the state of food transition in the EU.

II. 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.

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, and will exploit synergy with Partnerships oriented towards sustainable primary production and resource management, notably AELLRI and Blue Economy.

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.
- Coherent monitoring of food systems drivers and outcomes requires a novel methodology for data collection that spans across domains and levels. A set of sentinel sites representative for national and place-based food systems across EU territories (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. This will form the basis for analysing the impact of global and local drivers and EU policies under the Green Deal on FS outcomes at multiple scales.
- By providing coherent data for enhanced modelling of complex interactions within FS, effective entry points for change and areas of trade-off can be determined that require, thus informing social science research around navigation and deliberation of FS trade-off and co-benefits.
- The Observatory will support the scientific advancement under the R&I Areas by contributing methods, metrics and tools to, for example: assess contribution of food environment to SH diets (R&I Area 1); trustworthy data from supply chain actors to support consumer transparency (R&I Area 2/3); analysis of trade-off under future food systems and criteria for decision support (R&I Area 4).
- Improving the methods, metrics and tools for data collection, interpretation and modelling on food systems in the EU can be extended towards geographies in EU association and partner countries. By operating as an international, possibly even global scientific working group on food systems, the Observatory can contribute to enhance scientific capacities and coordination on global food systems.

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 novel and 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?
- How to compare multiple food system configurations, from historical and future perspectives, on their sustainability performance and contribution to true cost or price?

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

1. 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 innovation through FS-labs on systemic innovations at different scales (using a 'vitrine' for demo's) to drive bottom-up innovation processes*

Status

The knowledge hub will be composed by a network of FS-Labs. The Living Labs for Food Systems (FS-Labs) are collaborative, multi-stakeholder-driven R&I approaches to co-create new products and services in the widest sense[11]; 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, including large industries, SMEs, Spin-offs, Spin-outs and clusters (iii) other members of FS (including farmers, retailers, etc.), (iv) the knowledge, solution, service and technology providers (e.g., research and technology centres and universities) from the food-related and other disciplines (digitalisation, Industy4.0, nutrition, health, environmental sustainability and circularity, climate, social sciences, etc.), and other stakeholders, like policy makers and governmental bodies - particularly the local and regional ones. The, united, existing National Technology Platforms Food for Life, housing the diverse stakeholder groups nationally, may play catalysing roles here.

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.

[11] Co-creation refers to the design process of a 'product' or 'service' in which input from a group of different actors plays a central role from beginning to end.

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 (Section 5.3).

It should be noted that the number of publications on (exploiting) Living Labs in the agrifood domain has been increasing in past years (see e.g. Gamache et al., 2020; McPhee et al., 2021). This has been preceded by publications on LL in general (e.g. review by Hossain et al., 2019), well documented on the website of the European Network of Living Labs (ENOLL, 2023).

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, experimenting 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, experimenting and scaling of outcomes. Individual FS-labs together with the knowledge hub will contribute to innovations in FS governance, innovation pathways (along all TRL levels with other like EIT Food and CBE-JU), stakeholder and consumer engagement and policy development via co-creation and knowledge syntheses and thus, play a pivotal role in (a) development of next generation business-science-policy-society interfaces for FS transformation, and (b) the support of all (clusters of) SMEs, Spin-offs, Spin-outs, and other private sector parties contributing to the SFS transition.

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, which have sense at EU level but also reflect needs at a national and regional dimension, with their unique business ecosystems. 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 with their involved stakeholders 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, food-related clusters, food-related research centres, 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 targeted for their ecosystem actors. They can attract several SMEs and start-ups (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.

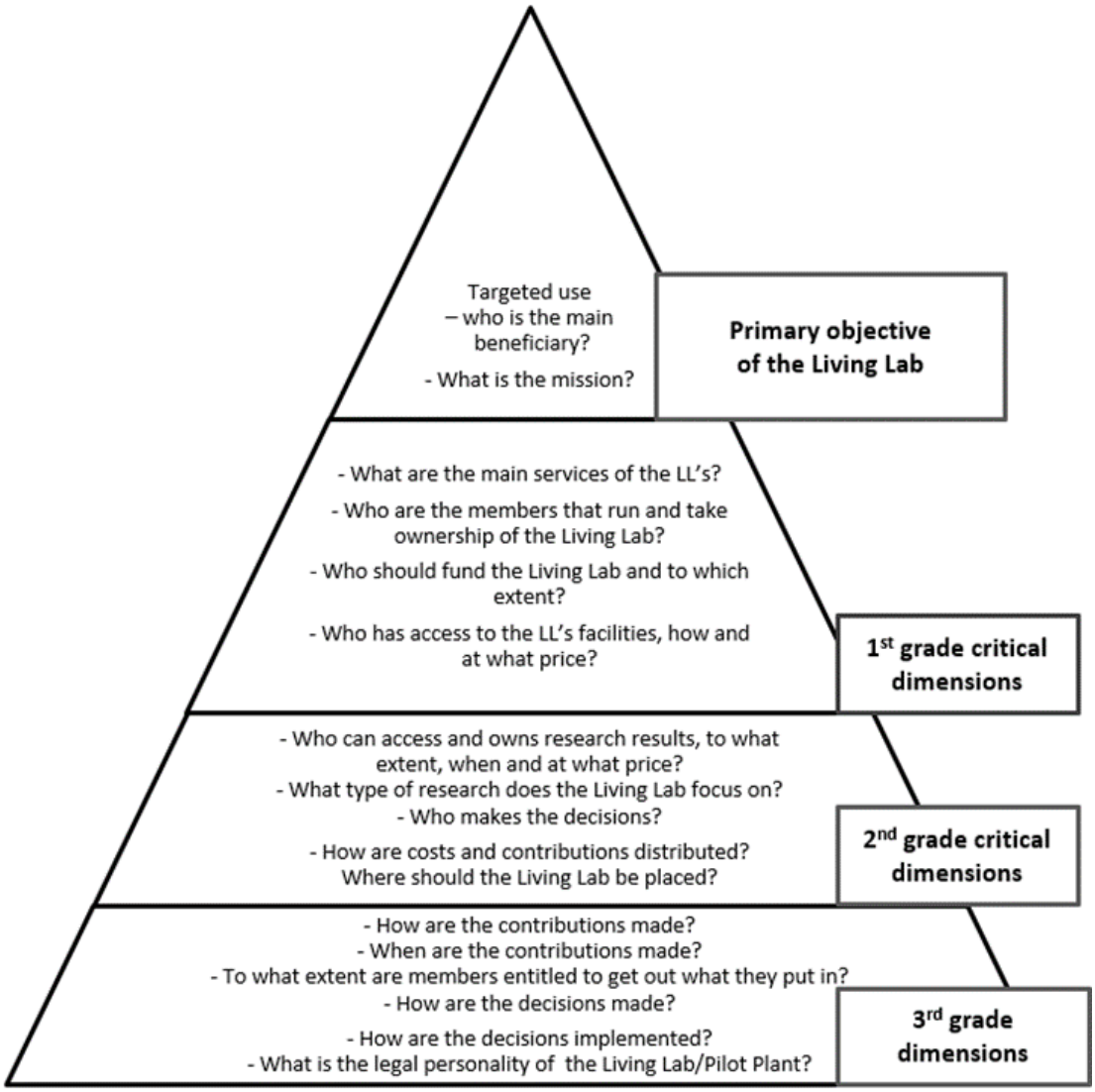

Figure 4. Questions to be answered when orchestrating FS-Labs. Source: "FoodManufuture (2014), draft models for EU Research Infrastructures".

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 EU-wide FS knowledge hub is here proposed acting as a platform ensuring that results and outcomes gained via the FS-labs will be gathered and analysed as best possible. There is an additional focus on scaling. For this purpose, the knowledge hub will provide the FS-labs with common tools to help streamlining their operations. Some supporting activities are:

- Elaborating concepts and models for systemic thinking and acting (see section 5.3);
- Providing scientific insights in the complexity of FS (section 5.4);
- Developing programs 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').
- Linking to existing Living Lab structures (section 8.4) e.g., EIP-AGRI, AELLRI, EIT-Food colocation Centers, S3 Living Labs.

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, 2023; 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. It is relevant to consider the link between with Area 'A', which shall establish the mechanisms for funding and in turn will set the available resources for the Activity Area 'C'. In addition, it should be added that this activity does not intend to build new structures but to build on existing ones, using the existing resources available. Only if there are no existing structures to host FS-labs, new models might be elaborated.

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 and demonstrating co-creation cases with public-private organisations in national & regional FS-Labs (which will be R&I Area specific). Practical solutions will be shared as well as generated thematic knowledge via training sessions and workshops. Possible options for new collaboration models in FS-Labs will be encouraged in community-building trajectories and matchmaking events. 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 investors, service providers, food-related research centres, research organisations, governments, cities, and regions. In all trajectories, the participatory roles of citizens will be strongly encouraged to change consumption habits and reach sustainable consumption. The expert knowledge of scientists in social sciences and humanities will here be mobilized.
- Developing and demonstrating 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, Investors, 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 Activity '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 is strongly recommended 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, CBE-JU, EATIP, FABRE, Manufuture, etc.), research community representatives (EFFoST, ISEKI, etc.), consumer representatives (BEUC), and other partnerships operating in FS domain (see section 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 citizen 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 Area 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 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. Thirdly, transforming food systems is a grand challenge, with the need to include solutions to transform societal, economic and environmental aspects. Finding solutions and implementing them is accelerated by mission-oriented approach: the R&I&P solutions provided should respond to clear problems that arise from the unsustainable FS. The solutions provided should drive change to sustainability across multiple sectors and actors with feedback and monitoring. We can learn from practical experiences to foster a more coherent and cohesive action across sectors, institutions, and nations.

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. The actions take place and create lasting change once political commitment and public legitimacy favor it - this is why knowledge sharing with public, private and 3rd sector actors is a must.

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, CBE-JU 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:

- Foster collaboration to seek synergies with the other relevant partnerships, attention to primary production partnerships, including aquaculture, as they form separate entities. Use the mission-oriented approach: address clear problem common for the others and seek solutions that are useful for all. Test and seek feedback.
- 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 to and from industry organized through the stakeholders and the individual project consortia.
- 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, civil society organisations and other less heard actors.
- Knowledge sharing and scaling activities should be planned and executed in a manner creating links and connections between FS actors. In this the help of social sciences and humanities is valued. Results must be shared in a manner that inform, offer solutions, encourage to test and can be monitored. The best knowledge sharing shape solution further to fix the problem in question and through this gain commitment from the actors. This way the knowledge sharing creates systems transformation.
- 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, by the future P-SFS consortium. Their constitution and activities will be defined by the builders of this consortium and aligned with the FOOD2030 pathway owners of the EC.

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 (like FOOD2030 pathways funded projects, EIT Food priorities, etc.). 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, hence also respecting objectives stated in e.g. the Green Deal, F2F strategy and FOOD2030 agenda. 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.

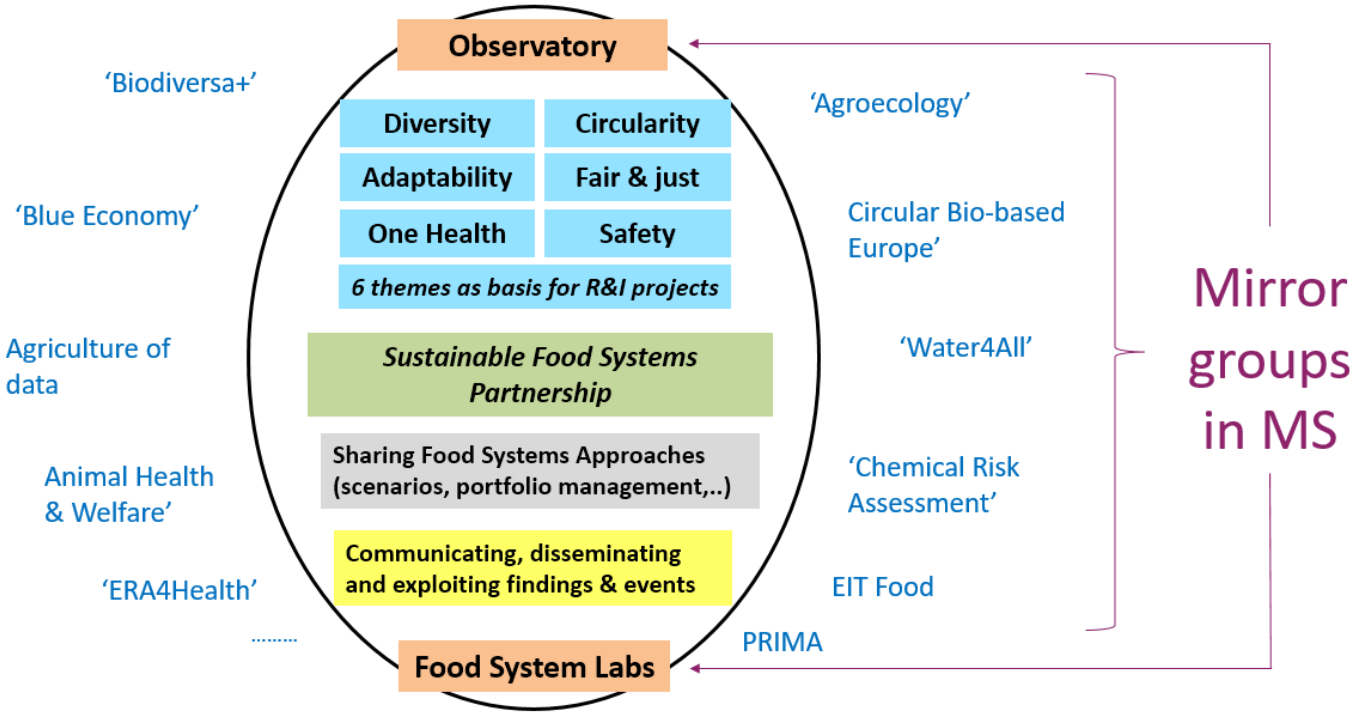

Figure 5. The Partnership SFS has relevant themes and actions to share with other partnerships.

Several ways of cooperation are foreseen (see Fig. 5):

(i) Exploring *key themes* via joint projects on diversity, circularity, fair & just, One Health, etc. Some suggestions for common topics are efficient use of diverse resources and avoiding waste strategies in circular and wider bioeconomy approaches (to tackle to foreseen biomass gap in 2050), new protein-based food and feed, food safety (e.g. pesticide residues and toxins) and IT integration along new food value (short) chains, reducing climate footprint for targeted food systems, evidence for labelling, 'circular' cooperation models for regional and urban development (land and sea), water usage and re-usage in FS, sustainable diets and physical activity (health);

(ii) Mobilizing *FS-(living)-Labs* for system-wide co-creation activities with diverse actors in FS (including training, citizen engagement, procurement experiences, providing guidance for creating socially sustainable work spaces, and new business models);

(iii) Connecting the *Observatory*, including metrics and models (like LCA's), assessments, data transparency, smart sensing systems, holistic views, maps of FS activities and actors, and roadmaps;

(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. Here, also joint scenario development, principles and processes in portfolio management, innovative science-to-policy instruments and knowledge exploitation for innovation and business development – all via a FS lens – are foreseen as key joint activities;

(v) Jointly *communicating, disseminating and exploiting* findings and events for policy makers, the wider public, and FS actors; the establishment of a cross-Partnership Forum is foreseen.

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 all over Europe.

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 section 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. Therefore, interactions with different stakeholders are sought.

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 be approached in an interactive way. They should be capable to translate findings from the P-SFS into actions, but inversely also contribute with their experiences, competences, recommendations and open questions to the further development of the P-SFS. A specific interface – strongly linked to the knowledge hubs (Activity C) – needs thus be developed that guides the information flows in both directions. It also should be able keeping track of communication, dissemination, exploitation and demonstration actions (Activity D). Key examples of intervening stakeholder groups will be:

- Relevant networks at all scales, in particular the ones in the FOODPathS consortium who are active from local (e.g. ICLEI, MilanFoodPact, also others in Driving Urban Transitions), regional (ERIAFF, and related 3S Platforms), national (united via ERANETs Susfood and CoreOrganic, JPI HDHL, National Food Technology Platforms Food for Life, ..), EU-wide (like SCAR FS SWG, BIOEAST, Mission Boards, FoodDrinkEurope, CopaCogeca, Confagricoltura, EFFoST, ISEKI, ETPs, but later also others like EJPs, European Enterprise Network, Policy Evaluation Network, BEUC, IFOAM Organic Europe, Research federations, Green ERA-Hub, Social Movements like SlowFood, Food Waste Movement, European Food Banks, etc.) to global levels (ICLEI World Secretariat and OnePlanet Network and later also others, see below). They all serve to substantially enlarge the impact of P-SFS actions via enrolling (like a snowball) best and worst practices throughout their networks;
- National mirror groups, who are guiding the nationally involved partners and applicants in their SFS actions by seeking synergies, highlight unique contributions, etc. at micro, meso and macro levels;
- An inter-connected network of these national mirror groups, to exchange insights and assessments between countries in terms multi-(interacting)-actor approaches, inter-disciplinary and –sector strategies.
- EC JRCs and EFSA, who provide expertise to the P-SFS Consortium in terms of safety regulations, data monitoring and analysis, science-to-policy recommendations, etc.;
- Experts and expert organisations, who will continuously provide latest insights to the Consortium about the complexity of FS and FS approaches; this also includes representatives of connected sector organisations like the EIT Food, Health, Climate and Digital as well as the CBE-JU for addressing potential resources competition for non-food uses.
- Civil society organisations, including social partners, non-governmental organisations (NGO's) and grassroots organisations, for serving general interests and mediation roles between parties. Exchanges with the European Economic and Social Committee will be regularly sought;
- 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 possibly co-funding targeted P-SFS activities;
- Financers, investing in short and long-term sustainability-oriented activities wherever possible;
- Media in the broadest sense, for local to global communication in different forms.
- Last, but not least, Citizens, and Consumer organisations, revealing their appreciation (or not) of activities, and join participatory actions; the endless number of target groups requires some categorization.

The prioritization for collaboration topics in different regions will recurrently be done under the SRIA of the P-SFS; the policy commitment to shared R&I agenda of key regions is crucial. Here, the National Food Technology Platforms will play a catalyzing role. This includes the EU's associated countries in the South Eastern and Eastern regions of Europe and Africa.

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, UNFSS, PRIMA (Mediterranean focus), EU-Africa Partnership, CGIAR, WHO, UNEP, UNICEF, WFP, GAIN, WEF, Global Young academy, 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?'.

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.

Regarding **Impact**, these sets include in particular sustainable development indicators, both at EU-wide level (making use of the Farm to Fork strategy objectives), and at (sub-)national levels. These will be complemented with KPIs targeting trade-offs and externalities at global level (making reference to SDG's). Hereby, the three dimensions of sustainability (environmental, social and economic) are individually and integrally considered (e.g. energy neutral, healthy, diets that fully respond to cultural preferences and employment locally).

For **Outcomes**, KPIs are defined for an appropriate functioning of the Partnership and, hence targeting levels of cooperation, inclusivity, actionable knowledge and user-friendliness and utility of knowledge by different actors). In addition, KPIs are set for the appropriate functioning of the P-SFS Research Area (post-farming and fishing), its connectivity to global initiatives (how many, how strong, how impacting), its capability to contribute to both EU-wide policies and local priorities.

For the **General Objectives**, KPI's are stated for (I) the stakeholder-verified level of understanding of FS models, (ii) the usability and catalytic value of FS approaches in diverse FS to revolutionary change current unsustainable trajectories, (iii) the capability of the governance model to cope with and provide input to policies, and (iv) the quality and output of co-creation actions. Finally, the KPIs for the **Specific Objectives** are more managerial and operational-output targeted, they serve to appropriately develop models, living labs, system approach concepts and to establish a vibrant P-SFS community, well embedded in their territories.

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. For the R&I Areas, KPI are related to knowledge obtained in each R&I area and in between R&I

areas (e.g. for combined environmental and health impact), transfer of knowledge into potential innovations, and first estimations of the impact of innovations. It is underlined that the P-SFS will not target the highest TRL levels (like EIT Food and CBE-JU), thus not verify impact of each project outcome in practice. Regarding the Activity Areas, KPIs are especially targeting their leverage functions in accelerating knowledge building and transfer in relevant FS pathways, involving cooperating actors (and new jobs created), building the communities of trust, providing accessible data and models, etc.

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 sets still need to be elaborated in the CSA FOODPathS which started in summer 2022; provisional ideas are only foreseen at the end of 2023. Therefore, the future P-SFS consortium builders will develop their first set of KPIs themselves. FOODPathS provide suggestions how to adapt them in a later stage. This also holds for all other suggestions given by FOODPathS regarding the modus operandi, the governance model, the 8 AREAS, potential trade-offs, etc.

In summary, KPIs should guide the P-SFS to reach the high-level ambitions of sustainable FS at the latest in 2050, and well before if feasible. Also, they should radically change our current practices in order to substantially reduce environmental, social and economic negative impacts, while maintaining our rich European food culture and quality of life standards and well-being.

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,

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Anne Brisabois (ANSES, FR); **Beatrice Morio** (JPI HDHL); **Christophe Cordevant** (ANSES, FR); **Igor Pravst** (Nutrition Institute, Ljubljana, SI); **Igor Spiroski** (Institute of Public Health, Skopje, North Macedonia, MK); **Pieter van't Veer** (Wageningen University, NL); **Ricardo Assunção** (National Institute of Health Dr. Ricardo Jorge, PT); **Zvonimir Satalic** (Faculty of Food Technology and Biotechnology, University of Zagreb, HR)

R&I Area 2 – responsible: **Hugo de Vries** (INRAE, FR/ EFFoST)

Erik vd Linden (WUR, NL); **Geert Maesmans** (Cargill, BE); **Jorge Molina Villanueva** (DG RTD); **Lilia Ahrné** (University of Copenhagen, DK); **Linda Salame** (DG RTD); **Peter Eisner** (Fraunhofer Institute for Process Engineering and Packaging IVV, DE); **Saioa Ramos** (AZTI, ES); **Vasilis P Valdramidis** (National and Kapodistrian University of Athens, GR),

R&I Area 3- responsible: **Niels Halberg** (Danish Centre for Food and Agriculture, Aarhus University, DK)

Allison Loconto (One Planet Network (Sustainable FS Programme),FAO); **Diana Banati** (University of Szeged, HU); **Jessica Aschemann-Witzel** (Aarhus University, DK); **Mari Niva** (University of Helsinki, FI); **Peter Defranceschi** (ICLEI - Local Governments for Sustainability)

R&I Area 4- responsible: **Gianluca Brunori** (University of Pisa, IT /FACCE-JPI)

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Activity Area A – responsible: **Nikola Hassan** (Research Center Jülich, DE/ SUSFOOD2)

Alexandre Dubois (Formas, SE); **Helena Pärenson** (Ministry of Rural Affairs, EE); **Hendrik De Ruyck** (ILVO, BE/ SUSFOOD2); **Ivana Trkulja** (ICROFS, DE/ CORE ORGANIC); **Zoya Damianova** (Applied Research and Communications Fund, BG)

Activity Area B- responsible: **Thom Achterbosch** (Wageningen University & Research, NL)

Aida Turrini (formerly CREA, IT); **Annika Fuchs** (Federal Office for Agriculture and Food (BLE), DE); **Henk Westhoek** (PBL Netherlands Environmental Assessment Agency, NL); **Jan Pokrivcak** (Slovak Agricultural University at Nitra, SK); **Sirpa Kurppa** (LUKE, FI);

Activity Area C- responsible: **Jonas Lazaro-Mojica** (ETP 'Food for Life')

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Activity Area D – responsible: **Minna Huttunen** (Ministry of Agriculture and Forestry, FI);

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