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foodpaths

The RIPE concept

DELIVERABLE 6.2

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3	20/1/2025	The contributors listed above & EXCOM members	Final inputs and modifications to their sections, as well as to the overall document
4	29/1/2025	The FOODPathS project coordinator	Final edits.

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1. Executive Summary

RIPE stands for Research and Innovation, science-to-Policy (in short 'Policy'), and Education. In the future, a RIPE concept is **expected to allow aligning** R&I priorities with Policy and Education program priorities, the four pillars of RIPE (Figure 1). This implies that strategic research and innovation agendas (SRIA) are fueled with insights and questions from Policy and Education, and vice versa. In practice, this may be quite challenging for any future Partnership, like the Partnership on Sustainable Food Systems (P-SFS; SCAR, 2023; started mid-2024 as FutureFoodS), or large initiative. Why? Previous approaches were considered food chain approaches, which are in 1st-order 'linear approaches'. Since these have led to over-consumption and over-exploitation of resources, R&I thinking now targets entire food systems, including all elements and potential connections between them as well as interdependencies of food system outcomes. This is phrased as 'food system approaches', in which complex system sciences need to be mobilized (see P-SFS SRIA pp. 14-16, chapter 9 in this D6.2, and D2.4 'FS Obs'. Consequently, R&I, science-to-Policy, and Education now have to be revisited, individually as well as interactively:

- **R&I**; research and innovation priorities are defined and broadly commented in the SRIA of the P-SFS. The main Thematic Areas are: (i) change the way we eat, (ii) change the way we process and supply, (iii) change the way we connect to FS, and (iv) change the way we govern FS (SCAR, 2023). This is further detailed in chapter 5.1.
- **Science-to-Policy** ('Policy'): a Science-Policy Interface (SPI) is needed which on the one hand facilitates improved dialogues and co-creation and on the other hand, ensures research integrity and independence in the advice provided (D6.1). There is a potential to develop new SPI forms in trans-European collaboration. This could also facilitate the future collaboration between researchers across Europe in developing state-of-art science-based policy advice to address common knowledge needs. Thus, joint exchanges of principles and practices in SPI for Food systems transition are asked for, as well as for training of researchers and civil servants in science advice, which fit into a RIPE.
- **Education**: Some key issues are highlighted in Deliverable D5.1 'Assessed skills and knowledge gaps' (Flynn et al., 2023), based on a review of existing educational programs and feedback in FOODPathS workshops. Other findings arise from the Branded Network of Universities and literature. Key ones include the need to foster collaboration between leading universities in SFS, business and administration, with a standardized approach to curricula formulation. This should be in line with the principles of food systems sustainability and responding to industry needs. Flexibility and speed of response to emerging labor market challenges dictate that collaboration with accrediting bodies be undertaken to support universities. For more information, see Deliverable 5.2.

Also, one needs to reconsider which Activities, like a Knowledge Hub of Food System Labs, an Observatory (SCAR, 2023)[1], or a Branded Network of Universities, can be mobilized to support RIPE:

- **Knowledge Hub of Food System Labs:** This Hub, presented as a virtual Platform developed in FOODPathS (https://www.foodpaths.eu/in-action/living-labs/) presents food system cases via seven dominant orientations: research, innovation, policy, education (the 4 RIPE pillars), networking, entrepreneurship, and entrepreneurship. Even if one case has a single dominant orientation, they nearly all reveal other orientations as well. The RIPE concept may here make explicit how the R&I&P&E orientations are interlinked, what are barriers between them and which opportunities arise by combining RIPE activities.
- **Observatory**: The idea of a Food Systems Observatory (FS Obs) is "to gather, analyze, and utilize data on Food Systems from multiple sources to allow for the monitoring of performance and to guide FS transformation efforts" (D2.4). Thus, for its place in the RIPE concept, the FS Obs may contribute with updated information as regards the status of the transition to sustainable food systems and consolidated assessments. These may feed into science-policy interfaces, point to educational needs and new – or modified – R&I topics.
- **A branded Network of universities** may be considered as either a "network" of 'universities each in the center and catalyzer of its local ecosystems or a "network of universities" at the center and

[1] It should be noted that these also fuel the other two transversal activity areas 'Co-funding' and 'Knowledge Sharing' as described in the P-SFS Strategic Research and Innovation Agenda (SRIA), but this is not further elaborated in this Deliverable.

catalyzer of distributed local ecosystems. In the second option, future sustainability topics for R&I, P, and E are commonly handled, while in the first option, these are locally defined and EU-wide discussed, in all cases thanks to the involvement of different stakeholders.

This deliverable is structured as follows. **First**, current findings about R&I, science-to-Policy, and Education have been collected, structured, and discussed to serve as input for this D6.2. **Secondly**, these findings were cross-checked with feedback from experts at the workshop's 'RIPE' session in Budapest, on the 4th of December 2024 (ANNEX I). **Third**, first links between R&I, P, and E (Table 3) have been established. **Fourth**, a RIPE concept has been developed that connects R&I with P and E for partnerships to keep food systems evolving sustainably (see Figure 2 for a simplified version; and Figure 28 for more details). The overall output of human activities endlessly balances between the planetary and societal limits. This keeps our food systems (and any system) in a sustainable operating space (green area, often called safe operating space). Therefore, we need new SFS-oriented education programs, new R&I insights that keep activities within the green space, as well as appropriate policies that avoid entering the red or grey zones respecting chaos and order, respectively. Hence, this simplified concept lets emerge what the drivers are for R&I, P, and E actions. Next to the continuous attention to natural sciences (e.g. concerning planetary limits), further work in social sciences and humanities is imperative for respecting societal limits. This concept is further discussed for its relevance in the development of future Partnerships on SFS.

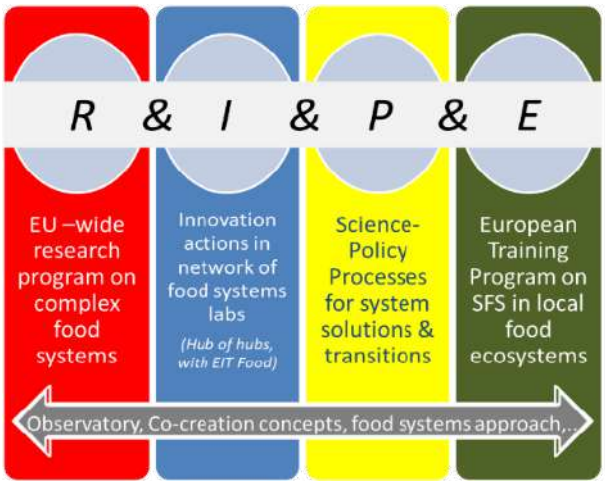

Figure 1. RIPE stands for Research and Innovation, science-to-Policy, and Education.

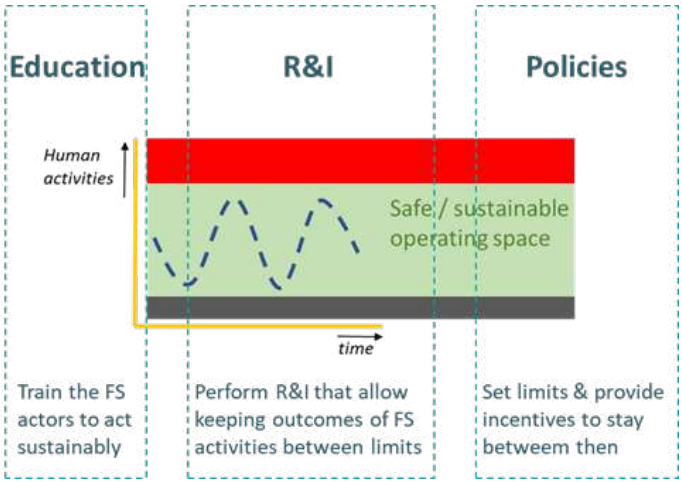

Figure 2. A simplified conceptual RIPE concept: aligning Education, R&I, and policies to keep food systems evolving in the sustainable (green) operating space thanks to appropriate policy guidance and new education programs for all humans (see chapter 9 for details)

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2. Introduction

This deliverable supports a future alignment of Research & Innovation (R&I), science-to-Policy (P), and Education (E) themes that are relevant for Partnerships and large initiatives on Sustainable Food Systems, like FutureFoodS, PRIMA-Med, and the FAO Bioeconomy strategic working group.

Alignment of topics is possible in different ways. In FOODPathS, we have followed three strategies:

i. Aligning themes and sub-themes (content, or 'what' question) as well as signaling barriers and gaps (process or 'how' question); this is based on work elaborated in the SRIA of the P-SFS (D6.1), observed in Education programs and interviews (WP5, D5.1) and discussed in science-to-policy (D6.1).
ii. Verifying if these alignments provide practical guidance for the Knowledge Hub, University Network, and Observatory, and vice versa;
iii. Designing a conceptual framework for SFS that allows integrally reflecting on cross RIPE priorities.

The *first strategy* is based on work performed in the different FOODPathS WPs:

- Research and Innovation (R&I) themes of WP6, and the SRIA of the P-SFS (SCAR, 2023; D6.1);
- science to Policy topics and advice on food systems transitions (WP6, D6.1 & WP2 D2.4);
- Education priorities: WP5 and D5.1 and D5.2.

Also, a first cross-check of R&I themes, P topics, and E priorities has been here carried out to seek synergies, gaps, and critical issues (section 5.4).

The *second strategy* has led to researching if RIPE themes provide practical guidance for:

i. executing and demonstrating case studies via the Knowledge Hub of Food Systems Labs (D2.1 and D4.2)
ii. utilizing effectively the Food System Observatory for sustainability aims (D2.2 & D2.4)
iii. fueling a branded network of universities exemplary in food system sustainability actions (D5.2)
iv. aligning funding calls (not discussed in this deliverable).

This is detailed in chapter 6. Then, feedback from experts has been collected during a RIPE workshop in Budapest, in December 2024 (chapter 7). Also, several examples of RIPE cases are presented (chapter 8; Cases from Milan, CityFood, and Chair Unesco on SFS).

The *third strategy* has been elaborated as a desk study of potentially useful sustainable food system models, obtained via a literature review, and, previously, a first international workshop in Paris, in 2022. The here presented SFS models may be exploitable in partnerships. This is translated into the first conceptual framework for RIPE, which is presented in chapter 9.

3. Objectives of the Deliverable

The main objective of this deliverable is to introduce RIPE (R&I, Policies, & Education) and an innovative conceptual framework for aligning RIPE priorities. This is further detailed in Table 1.

	Objectives	Main actions
1.	Obtaining insights for all four RIPE pillars in FOODPathS tasks	Exchange with WP leaders to incorporate the most relevant elements of the WPs in this D6.2
2.	Verifying relevant external sources regarding the four pillars of RIPE	Discussion with experts in Budapest, 4th of December 2025, with especially WP2,4,5 and 6. Collecting some cases.
3.	Preparing a first conceptual framework for the RIPE concept	INRAE
4.	Review of the Deliverable	FOODPathS EXCOM
5.	Reporting the deliverable	INRAE

Table 1 - Objectives and main actions concerning D6.2 implemented

4. Methodology

The methodological approach of this work on RIPE has been the following:

- An analysis of existing RIPE pillars as elaborated in the SRIA of the P-SFS preparation team (WP6), policies (WP2&6), and education (WP5).
- An analysis of the consequences of RIPE pillars for the Knowledge Hub of FS Labs (WP4&2), the Observatory (WP2), and the Branded Network of Universities (WP5), and vice versa.
- The organization of two workshops with external and internal experts. The first has been with scientific experts on complex food systems (Paris, 2022); this has provided information that has been reflected in the development of the conceptual framework. The Second has been with experts at interfaces of R&I, P, and E, to discuss all relevant alignment issues (Budapest, Dec 2024).
- Literature reviews regarding the food system education options and insights that are relevant for the RIPE conceptual framework. It should be noted that the reviews on the SRIA and the science-policy interface have been carried out within other deliverables by AU and INRAE (D6.1, D2.2, and D2.4).

5. Results and Discussion: RIPE themes

In this chapter, current findings regarding Research and Innovation (R&I), science-to-Policy (P), and Education (ED) are described below.

5.1. Research and Innovation

Regarding R&I, there is consensus about the following themes and thoughts as laid down in the strategic research and innovation agenda (SRIA) of the Partnership on Sustainable Food Systems (P-SFS; Figure 3; SCAR, 2023):

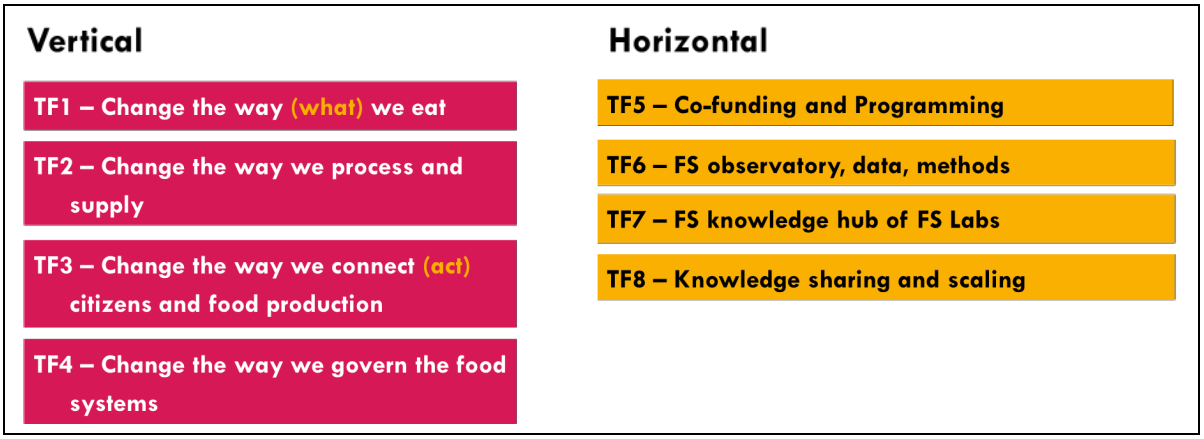


Figure 3. The four thematic R&I areas and four transversal action themes (SRIA of the P-SFS; source: SCAR, 2023)

The R&I areas are targeting the post-harvest domain of food systems. However, sustainability can only be reached by considering all parts of food systems, and especially also production. The following R&I focus areas have been selected as a starting point for R&I:

(i) *Change the way we eat* > As stated in the Brundtland report (WCED, 1987), sustainability means that we cannot compromise future generations; this implies that needed and appreciated food should be available for all, anytime, and anywhere. This is the starting point for R&I in this theme and thus should relate quality and nutritional properties of diets with sustainability implications. This is to be done in different geographic areas, cultures, dinner environments, etc. to establish appropriate, but context-dependent guidelines.

(ii) *Change the way we process and supply* > Since current processing and supply activities (and also production, consumption, and recycling) are resulting in overexploitation of our planetary resources capacities, mass production, and consumption as well as uncontrollable planetary outputs (greenhouse gases, plastic...), the full cycle of handling biomass for food should be redesigned to remain within planetary and societal limits. This is the core of this R&I theme.

(iii) *Change the way we connect to FS* > This thematic area targets the behavior of actors, either as citizens, consumers, or professionals in their different jobs. One of the key research questions is how to reach an overall balanced outcome – between planetary and societal limits – of all behaviors of FS actors. This implies that the behavior of individuals as well as of collectives and inter-groupings needed to be addressed.

(iv) *Change the way we govern FS* (related to the Science-to-Policy topic below) > This area targets the (in)formal rules, but also the interactions and power balances between actors and the overall orchestration of activities of multiple food systems. This is detailed in D2.6's 'Innovative

Governance model' and poses numerous questions in the governance R&I domain (Donner et al., 2024).

Key research questions per Area have been elaborated in the P-SFS SRIA (SCAR, 2023), partly revisited here, and are summarized in Table 2 below:

R&I Area	Short description	Some key R&I – and cross R&I areas – focus points relevant to science-to-Policy and Education:
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 & culturally accepted foods.	- 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? - What are 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 Food-based Dietary Guidelines (FBDGs) across Europe become better aligned with guiding principles for sustainable diets and how may LCA methodology be improved to assess sustainable diets? What other tools, like meal planning or labelling, could be used? - Which barriers and opportunities will policy makers and citizens face to compose diets sustainably produced? What are possible trade-offs between nutritional, environmental, and climate objectives under different conditions (e.g. socio-economic status/income and geographic location)? - Are there risks of developing territorial inequalities in access to Sustainable and Healthy Diets and how may EU and MS policies impact global food systems? - What are the leverage points for citizens to change the way they eat? What role for education? - What are the leverage points for food professionals (like chefs/cooks, public procurers,…) to change their views and actions on the way we eat? What role for life-long learning courses? - Which innovative communication forms (e.g. AI-based apps, labels) and messages (personalized vs general dietary recommendations) should be used to influence consumption choices and consumer perception? And how to use big data to assess demands, willingness to pay, nudging, and cultural and social barriers? - How to combine health and sustainability aspects in strategies to balance criteria in culturally and culinary-diverse dietary habits while adapting to lifestyle changes and physical needs? - What are roles of shaping food environments in the EU, MS, regions, cities to facilitate acceptable and affordable, healthy, and environmentally sustainable choices while reducing inequalities? - To what extent are today's niche consumption strategies (vegan, vegetarian, flexitarian, organic, prosumer) efficient ways to help achieve sustainable diets at local and global levels tomorrow? - 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? What are the possible synergies between policy/governance (R&I Area 4); citizen engagement (R&I Area 3), changes in the 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?
Change the way we process and supply.	Supply-and-demand-side research and innovation topics reorienting the activities in post-farming & fishing to reach sustainable healthy diets.	- 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, valorization 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, 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 dates, without resulting in trade-offs? - While seeking higher diversity in nutrient-rich resources, how can supply- and demand-driven processing and packaging be modernized 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 processing, 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 from an 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 crises (e.g. climate change, elevated food prices, energy shortage, war,)? - What is the impact of the leverage points above on economic development and jobs in the largest economic sector of Europe (namely the food sector)?
Change the way we connect to FS.	Citizen engagement and consumer trust in reoriented food systems delivering sustainable diets.	- To what extent may improving transparency and traceability enable informed and responsible consumption choices and regulate green-washing? How will these efforts be coordinated across producers, 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 do food environments (and overall contexts of where food is accessed, consumed, and disposed of) impact food choices and consumption? - How can citizens be better involved in large-scale FS to advance their sustainability views: e.g., development of consumers and manufacturers platforms, or cooperatively owned businesses? - Which analysis should be done of local and alternative food networks that may empower citizens in different social positions? How should lessons learned be translated in training programs? - What processes are underlying citizen engagement in the development of sustainability labelling? - How will public catering advance engagement and provide possibilities for consumers to familiarise themselves with more sustainable dishes? How can policies help? - Which forms of digitalization (including monitoring, wearables, and 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? - How can urban food environments be redesigned using 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 neighborhoods? - What incentives do Cooperatives in food processing and retail (e.g. COOP supermarkets and their brands) offer to engage members in policy setting and influencing food systems? (e.g. promoting sustainable brands, alternative products, and reducing food waste). - How can Food Cities networks foster mutual learning living labs?
Change the way we govern FS.	Leverage points for local, national, EU, and global transition pathways, public procurement, F2F code of conduct & local initiatives (incl. cities).	- 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), and functions (science, policy, business, and civil society) in an FS approach enabling policy coherence? - What lessons can be learned from the comparison of governance patterns? What are the most promising governance patterns of food systems? How can we transfer them broadly? - What are the scientific principles of transformative FS governance? How can these principles be applied to public, private, and 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 and communicate? - Which key governance initiatives in public, private, and civil society domains could act as leverage points in transforming FS? How could this be translated into appropriate training courses? - How will private governance adapt to the new food-related policies (public governance) planned with the Green Deal? How could this process be accelerated? - How did governance following an 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? - How to balance top-down and bottom-up initiatives that are effective in reaching sustainability goals?

Table 2. Key themes and topics listed in the SRIA of the Partnership on SFS (SCAR, 2023)

Research: a partial change in doing Research while including more attention to SSH and digitalization:

Research is requested to reconsider the way we address questions in the food area. Previously, food chain approaches were followed, which are in first-order 'linear approaches'. Now, we observe that these have led to the over-exploitation of resources, hence we are reconsidering R&I thinking. Today, this targets entire food systems, including all elements and all potential connections between them as well as the interdependencies of outcomes (dietary health, environmental impact, climate change, biodiversity loss, fresh water shortage, …). We call these 'food system approaches', in which complex system sciences will be mobilized (see SRIA P-SFS page 14-16, chapter 9 below, and D2.4 on the FS obs). The above-mentioned thematic areas should all be considered from this angle. This also fits with the ideas behind the European FOOD2030 priorities: (i) nutrition for sustainable and healthy diets, (ii) food systems supporting a healthy planet, (iii) circularity and resource efficiency, and (iv) innovation and empowering communities.

This implies that research will become more multi-, inter-, and trans-disciplinary to cover multiple aspects of food systems. It should be noted that disciplinary sciences remain crucial to deepen knowledge in scientific domains. It should also be underlined that this asks for more attention to social sciences and humanities (SSH). Respecting not only planetary but also societal limits requires an in-depth understanding of natural as well as social sciences and humanities. Finally, the rapid developments in digitalization should here help us in understanding the evolution of complex food systems, and their outputs concerning limits, as well as empowering us to take the appropriate measures. Quite some topics listed in the table above refer to SSH and digitalization. Therefore, these domains can be considered transversal.

Innovation

In a simplified way, innovation concerns the translation of scientific insights (from the themes mentioned in Table 1 and other sources) into societal practices (new products, services, organizations, ..) that allow remaining in the sustainable operating space. However, also vice versa, innovation pathways should include capabilities of translating challenges into relevant innovations and needed scientific insights. In particular, combined social, organizational, and technological innovations are targeted that jointly allow remaining between the limits.

5.2. science-to-Policy

There is a need to establish well-functioning and efficient processes for research communities to provide science-based advice to policy makers/civil servants in support of the transition to sustainable, healthy food systems (Halberg & Westhoek, 2019; SAPEA, 2020; Webb et al., 2022; Singh et al., 2021; von Braun et al, 2021). This is a challenge especially concerning the complex societal objectives for – at the same time – improving dietary health, and environmental sustainability and reducing climate impact from food production and consumption as described in FOODPathS D6.1. D6.1 focuses on how to develop practices for improving science-based advice to policy making: *Science policy interfaces in Food systems transformation*. Such efforts should be seen through the lens of the RIPE concept since it contributes to linking the science and innovation efforts with the policy cycles (those reaching back to research by SRIA activities and those implemented in public support and regulation of the actors and elements in food systems).

Science advice for a food systems transition and hence for forthcoming policies poses numerous points of reflection (further explained in D6.1), such as:

- How to support policy coherence (OECD, 2021) and ensure that science advice is consistent across thematic areas in a food systems approach? In this context, food policy coherence is defined as the alignment of policies that affect the food system intending to achieve health, environmental, social, and economic goals, to ensure that policies designed to improve one food system outcome do not undermine others (United Nations System Standing Committee on Nutrition)
- Currently, the Science Policy Interfaces (SPI) follow mostly linear processes – where researchers formulate and provide advice in processes separate from the policy definition and implementation - to ensure research integrity and independence. In light of the complexities and non-linear developments in food systems such processes carry a risk that the advice provided does not respond effectively and sufficiently to the questions and challenges facing policy makers; e.g. because the science advice is used in a context not anticipated by the researcher, or because the advice requested does not sufficiently consider feedback loops, path dependencies or lock-ins in the food system. Other challenges in this SPI model are linked to the fact that often the policymakers request advice, where the state-of-art research is not well established. Since science advice is affected by values, conventions, and preferences, there is a risk that science advice too often supports what is called the values representing dominant regimes (Turnhout et al, 2021). Thus, the effectiveness of scientific advice depends on the right composition of advisers and the quality of the dialogues between advisers and policymakers in a type of co-creation – which in the opinion of some experts and stakeholders, also should include wider society (SAPEA, 2020; Webb et al., 2022; Singh et al., 2021). This raises the question of how to overcome these barriers and organize an SPI – including co-creation - capable of dealing with the complex policy needs for the food systems transition.
- How to organize and ensure research integrity while dealing with co-creation in SPI that addresses complexities and wicked problems in policies for food system transitions?
- Which scales should be targeted? From metropole to region to member states (MS) to European and global levels? And what is the role of Food System labs then?
- Moreover, besides the obvious interest in science advice at the EU level, the requirement for the implementation of EU laws, directives, etc. in the Member States (MS) creates a need for policy advice at national and regional levels (depending on the division of competent authorities). Therefore, efficient SPI would include collaboration between research environments in different MS to provide state-of-art knowledge areas relevant to Food systems transformation for reasons of efficiency and capabilities. Moreover, the European food systems are integrated across

borders in the open market building on regional strengths and traditions in primary production, processing, etc. Therefore, a pertinent question is, how to organize trans-European collaboration in the provision of science advice across MS and regions?

These reflection points are all relevant within the RIPE concept because next to science-to-policy, innovation and education are impacted and vice versa. Consequently, can we rethink the typical science-to-policy process in food system transformation, while also immediately taking into account consequences for education (life-long learning) and innovation trajectories?

A proposition has been provided by Halberg and de Jonge, which was presented at the Budapest workshop on the 3rd of December 2024 (see Chapter 7). Figure 4 presents the first version of a revised model for SPI, which allows for processes including dialogues between the researchers and civil servants. This will enable a better mutual understanding of the background and intention of the request from the policy side as well as the available science-based knowledge – and lack of knowledge, uncertainties, and other limitations in the advice provided. Moreover, the processes should enable reformulation of the requests based on these insights while ensuring transparency and research integrity - and opportunities for researchers to reflect on their knowledge and advice vis-à-vis the policy regimes and dominant framings vs. alternatives in SPIs framings of the questions. As described in D6.1, the challenges of science-advice and experiences and principles in SPIs from different European countries and institutions as well as co-creation have been discussed within the informal Ghent-group. This has confirmed the above-mentioned challenges and ideas for improved SPI governance are part of a RIPE concept.

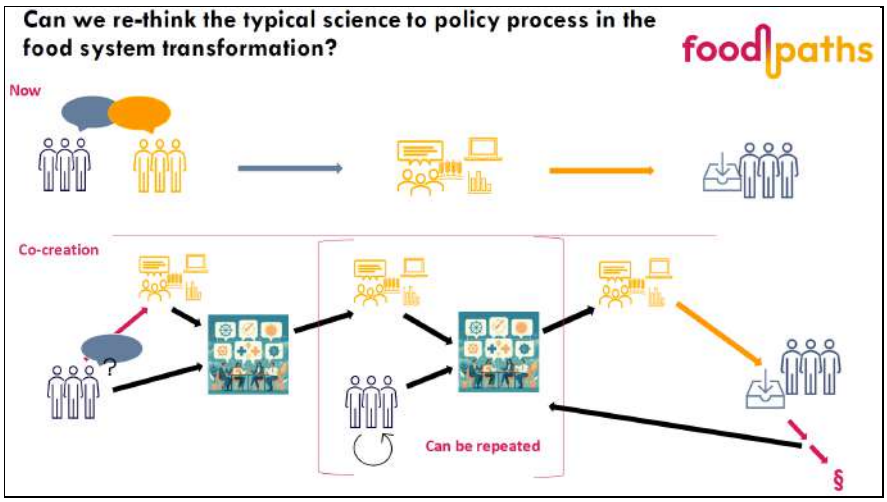


Figure 4. Re-thinking science to policy processes from linear to interactive processes (Design: Hegelund & Halberg, for the workshop between AU science advisors and Civil servants in Plant production Agency, Copenhagen, June 2024)

Based on the above process of providing a preliminary state-of-art European SPI for the food systems transition, the initial considerations and recommendations relevant to a RIPE and a Sustainable Food systems partnership are the following:

a. Policy measures require SPI which may integrate scientific evidence in light of the complexity of food systems to avoid trade-offs and seek co-benefits. Such evidence may – potentially - be provided in co-creation processes where knowledge and experience from, say, Food Systems Labs and education could be integrated.
b. The many knowledge and research aspects of the Food systems transition and the – likewise – multiple policy-relevant challenges and goals call for (i) inter-disciplinarity in science advice and (ii) being able to ensure consistency and overview of specific science advice requested over time

towards a certain national or regional ambition. D6.1. provides a discussion of this and examples of how an overall national ambition of a transition to sustainable food systems may request multiple single advisory reports from science, but linked consistently. This capability should be addressed as part of the RIPE concept.

c. Since the complexity of food systems is overwhelming, policy measures should be able to handle (increasing) uncertainty, "butterfly effects", feedback loops, side effects/broader consequences, etc. – which again requires that researchers are aware of these and may report them as part of the advice. The SPI should therefore include phases to ensure openness. The researchers use the "principle of probability" and uncertainty, however, the civil servants' – most often – request for "exactness" and precise estimates for regulations. How this dilemma may be solved is an open question that needs further development in trans-European collaboration.
d. Thus, there is a need for developing joint exchanges of principles and practices in SPI for Food systems transition – and for training of researchers and civil servants in the discipline of science advice. D6.1. has provided a proposal for a process of clarification among members of an SFS partnership of their SPIs. Moreover, a preliminary proposal for training needs and course development would also naturally fit into a RIPE.

A practical example that may serve others is given by Halberg and de Jonge (2024) during the Budapest Workshop on 4 December 2024 (see Figure 5). It concerns a Danish example that targets food-based dietary guidelines with a focus on both health and sustainability. It distinguishes several science advice tasks that have all contributed to informing the Ministry's Food Agency (DKs competent authority for food regulation and EFSA member) on different aspects of combining dietary health and GHG reduction into so-called Food Based dietary guidelines, with an improved understanding of how consumers, professional kitchens and food processors may benefit from alternative (to meat) protein sources – and their willingness and barriers for this transition. One science advice report annually takes the temperature on how representative consumer segments perceived food quality, which is described in the so-called Kvalitetsindeks 2020. More details on the science advice in a food systems lens are in Box 1 of D6.1.

Figure 5. A Game changer action that revealed concrete science advice tasks (Source AU; Design: Halberg and de Jonge).

5.3. Education

Education drivers emerging from WP5 tasks.

Regarding Education, the first findings have been provided by the WP5 team. They reviewed SFS educational programs at Elementary, Secondary, University, Postgrad, and Lifelong levels and reported limited information at the early levels, with an increasing focus on SFS at the University, but then few Postgrad opportunities (Reis et al., in preparation).

They held workshops with representatives from this review of programs and listed the following key 190 SFS Education drivers that emerged (D5.1; Figure 6, Flynn et al., 2023):

Figure 6: *Word cloud analysis from driver comments from all educational levels (retrieved from Flynn et al., 2023)*

Here we recognize that the word 'garden' is most often associated with food systems as drivers. Then, quite some 'operational actions' are listed like activities, projects, involvement, courses, learnings, funding, schools, etc. Thereafter, again more 'content-oriented' drivers are emerging like cooking, food, health, waste, etc. Overall, the cloud provides an enormous broadness in drivers, which can be coupled especially to the transversal activity areas of the SRIA (funding, knowledge hub of FS labs, observatory, and knowledge sharing), and to a lesser extent to the R&I priority areas (change the way we eat, process, connect and govern).

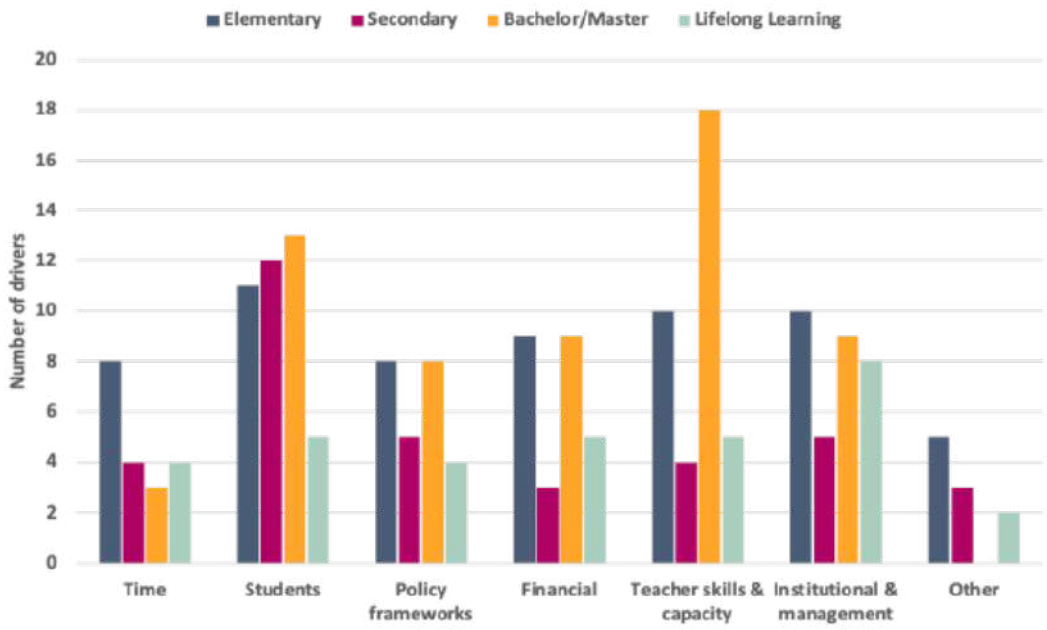


Figure 7. *Analysis of driver categories at all educational levels (retrieved from Flynn et al., 2023)*

Teacher skills and capacity are extreme drivers at the Bachelor Master level and are the highest drivers of any category and educational level (Figure 7). This figure shows how, at this level, teachers can "make or break" a program. If they are not engaged in SFS or are not interested, there is a high risk that the subject won't be touched unless it is part of the curriculum. This is also true at the elementary level where teachers are the ones promoting innovative initiatives related to SFS, and are here to be considered valuable drivers.

Observations about education & FS from literature

From literature and FOODPathS discussions, some interesting observations are:

- Education is foreseen to continue to provide a sound knowledge base in major disciplines, however, should also target multi-, inter-, and trans-disciplinary knowledge. Some education programs in complex systems (at least for groups of scholars) in the agrifood domain are deemed necessary. Notions about adaptability, emerging properties, resilience, etc. become a must. Also, teaching the consequences of challenges, stressors, shocks, or crises on food systems is recommended (internal project discussions).
- Regarding expectations of students, the following values, motives, and topics have been considered important in Europe, based on an extensive online-survey amongst eight European Universities in seven European Union (EU) countries to which 1,122 students responded (Migliorini et al., 2019): Taste and Health are the most important values and motives that influence students' food buying and consumption decisions, but significant differences were found amongst students from different universities and countries. The most important topics for students for future teaching courses are "organic food", "fair trade", and "organic agriculture" and the most important skills to learn are the "ability to make a judgment and justify decisions" and the "ability to create and innovate". Excursions and field trips as teaching methods were given the highest ranks.
- Another study reveals that reflection on sustainable food systems has evoked expanded interest from students in some domains, like fisheries, engineering related to FS, human-centered design, food law,

supply chains, urban planning, agricultural economics, food culture, and food entrepreneurship. Other domains remained of interest however didn't reveal significant expanded interests (Collier et al., 2024).

- Based on exchanges with students, Institut Agro, Montpellier, France (InstitutAgro, 2024) has prioritized topics for training in sustainable food system themes like:
    - Designing new agricultural production systems: reduced use of inputs and energy in particular
    - Valorizing by-products, especially non-food: green energy production...
    - Reducing losses and waste
    - Understanding market regulation mechanisms
    - Developing methods and tools to assess the sustainability of food systems
- A very detailed Delphi study has been performed on the development of the Food Systems Literacy Competencies Framework for youth (Martin et al., 2024), revealing a highly rich landscape in required competences. In Figure 8, a simplified version of the main categories is shown.

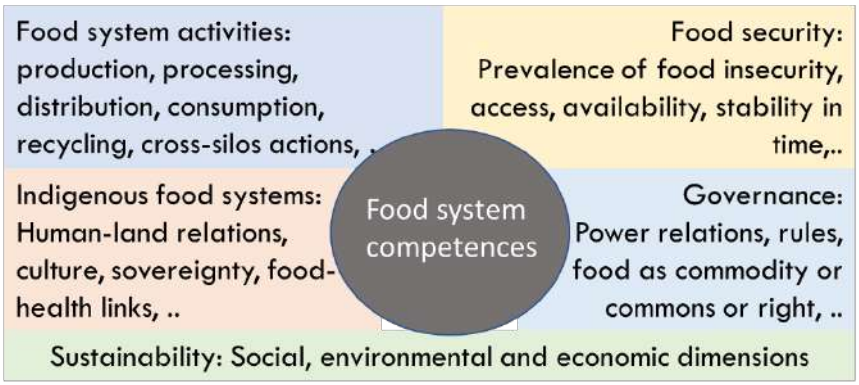


Figure 8. A simplified version of the development of the 'Food Systems Literacy Competencies Framework for youth' (Source: Martin et al., 2024; simplified version by authors)

- Others state that the options for education are so large, that a framework is needed to trigger feedback from students. Campbell and Feldpausch (2023) used the Sustainable, Resilient, Healthy Food and Water System (SRHFWS) framework, developed by Caspi et al., (2012). They argue that it can support the use of system thinking. Also, they state that this framework can be used and applied in higher education to help critically evaluation of the sustainability of individual food products, compare foods with varying methods of production and processing, those grown in different geographic locations, as well as to compare whole dietary patterns (Figure 9, a simplified version of the framework of Campbell and Feldpausch, 2023).

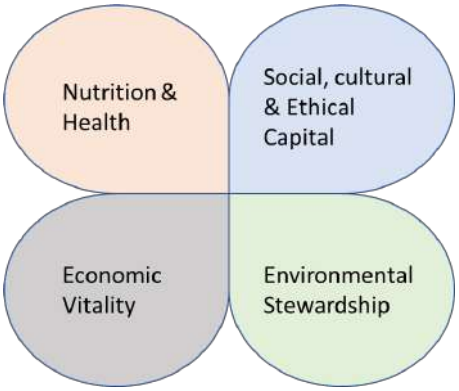


Figure 9. A simplified version of the Sustainable, Resilient, Healthy Food and Water System (SRHFWS) framework developed by Campbell and Feldpausch (2023); authors.

5.4. R&I, Policies & Education interactions

'Common themes' (this concerns the content or 'what' questions)

If a first cross-check between R&I, Policies, and Education programs and priorities is carried out, one gets the following Table 3, with a few suggestions, which deserve future attention and elaboration.

R&I	Policies	Education
Change the way we eat	Formulate target-group-specific policies and dietary guidelines	Develop school and other professional education programs on food and FS in canteens and experimental gardens.
Change the way we process and supply	Reconsider novel food legislation and global trade arrangement from a food systems perspective at different scales.	Include sustainable food 'manufacturing' training courses in the gastronomic professional area (restaurants, collective kitchens, school canteens).
Change the way we connect to FS	Include citizens and professionals via Food System Labs (like policy or city labs) in policy-making processes.	Reconsider life-long-education programs from a social perspective, including cultural values, and context-specific features in new FS courses.
Change the way we govern FS	Consider policies along scales, and with different public institutions operating from city, and region up to global levels; include scale-dependent network organizations in policy-making.	Make education interdisciplinary without compromising current disciplinary training programs; include the range of stakeholders in the development of courses and in teaching itself. Guarantee a balanced input from stakeholders, providing broadness of narratives.

Table 3. Some links between R&I focus areas, Policies, and Education topics

It is strongly recommended to more intensively discuss the interfaces between R&I, P, and E with the future Partnership(s) on SFS, the Pact4Skill-Food partnership in preparation, the Ghent Group, and the relevant SCAR working groups.

In Chapter 9 (check) three examples of linkages between policies, education, and R&I are given. The work on the Knowledge Hub of FS Labs also revealed several examples that have been described in D2.1 and de Vries et al. (2024); another example has already been included in the science-to-Policy advice chapter 5.2 (Figure 5).

'Barriers and gaps' (this concerns the 'how' question)

Next to listing common themes, we here address the question 'how can R&I, education, and policy themes be aligned?'. In some cases, this may be quite straightforward if the themes are (i) interpreted in the same manner by researchers, innovators, teachers, and policymakers and (ii) the contextual conditions allow immediate elaboration of them.

However, it may also be that barriers and gaps exist that don't yet facilitate their elaboration or inclusion in curricula, strategic R&I agendas, and policy plans.

D5.1 has explicitly listed 140 barriers to SFS education (Flynn et al., 2023), see Figure 10. Here we recognize that the words 'time' and 'curriculum' are most often associated with food systems as barriers. Early educational levels identified the most important barriers as i) Lack of time in the curriculum, ii) Silos that block cooperation amongst sectors and hinder multi-disciplinarity, and iii) lack of infrastructure to create activities such as gardening. University and PostGrad levels similarly identified i) rigid institutional programs and fixed curricula, and ii) lack of communication and collaboration among disciplines. A third group had a different perspective, identifying i) lack of time in adult students' lives, and ii) employers do not invest time or resources in training personnel.

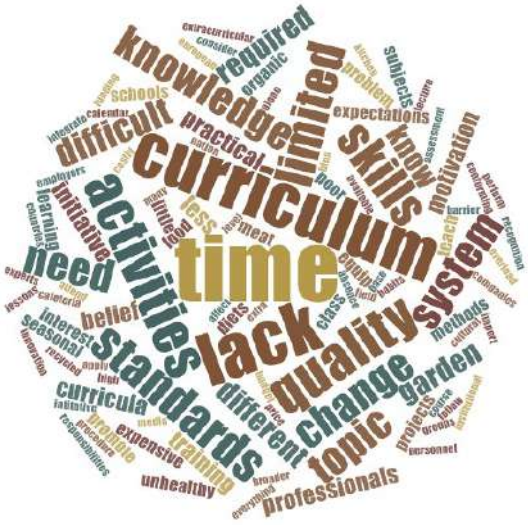


Figure 10. Word cloud analysis from barrier comments from all educational levels (retrieved from D5.1, Flynn et al., 2023)

If one cross-checks these barriers with R&I, as well as science-to-Policy interfaces, the following table emerges (Table 4).

Barriers	**R&I**	**Policy**	**Education**
Time	The time scales of R&I trajectories are highly different (from very long in genetics to very short in product marketing)	Development of policies & legal trajectories requires time and multiple feedback steps; this should be taken into account in an early stage.	The modification and testing of new curricula and accreditation systems is time-consuming. Hence, only well-evidenced propositions can be taken into account.
Limited knowledge/skills/ expertise/curricula	The transition towards SFS and 'partnerships' yields options for new R&I topics. This process should be transparently aligned, including experts from other-than-food areas.	Policies require evidence-based scientific work. This is challenged if one deals with food systems that may reveal many potential trade-offs or unforeseen gaps.	New inter-disciplinary and inter-sector education topics need robust examples and new knowledge that require additional training programs.
	The road towards complex food systems contributing to sustainability thanks to new partnerships and ways of collaborating asks for new skills in all RIPE pillars.		
Quality levels	Next to the standardized quality levels (like for methodologies or originality), new quality levels in R&I (related to the degree of complexity of studied examples) implies policy- & education programs.	A stronger scientific evidence base and also a translation into required new (soft & hard) skills are to be expected; this may require new science-to-policy processes.	Challenging tasks are balancing disciplinary & inter/trans-disciplinary education programs fed by R&I insights and (foreseen) new policies; this impacts accreditation processes and final requested quality levels.
Existing Standards	Existing standards are quite often focused on disciplinary R&I & education programs and silo-formulated policies supporting food chain activities. The transition towards FS approaches requires reconsidering standards, while including trade-offs and co-benefits for multiple actors and contexts.		
Complexity ('difficult')	The complex system science community needs to rapidly be mobilized to research and explain that also in complex systems, relatively recognizable and understandable patterns (or system properties) may emerge (un example is our increasing (complex) body temperature after a viral infection) at different scales and contexts.		

	If not, talking about complex food systems may demotivate scholars and receive negative feedback from public and private partners on needed sustainable practices.		
Equipment/facilities	Experimental living labs may better support the involvement of diverse actors in sustainable co-creation trajectories. If linked to P&E, new skills are more rapidly identified and policies better evidenced.	Policy labs are today considered environments in which policy consequences can be effectively discussed in terms of new R&I&E needs and potential impact for a wide range of RIPE actors.	The branded network of universities, surrounded by open accessible university campuses, may serve as more interactive teaching environments, including also R&I&P actors to better adopt new teaching skills.
Initiatives/entrepreneurship	The transition towards sustainable food systems asks for new entrepreneurship, especially in the forms of collaborative business and public-private cooperation models to address multiple-resources-transformations-logistics-markets.	Future policies are suggested to support these multi-actor entrepreneurial activities, to verify whether current legislative measures are still adequate or not (e.g. competition principles) and what policy skills should then be developed.	Making entrepreneurial thinking and acting a part of future curricula, may increase the level of entrepreneurship in Europe. This can start already in school teaching programs, benefiting from innovative 'school living lab' experiments and exploiting nearby university-ecosystems.
Funding/costs	The transition to SFS – partly thanks to the creation and running of new partnerships – has certain costs but are – if well managed – overshadowed by co-benefits for multiple actors in all RIPE pillars in the long run, in particular for our future generations.		
Citizen attitudes or View	This concerns reaching a critical mass of people interested in SFS.		

Table 4. Barriers and potential solutions for R&I, Policy, and Education.

6. Activity areas to work with RIPE

6.1. Knowledge Hub of Food System Labs

(Note: Work in this section is extensively described in D4.2)

What is the Knowledge Hub of Food Systems Lab? It is a centralized, collaborative platform for a broad range of stakeholders in food systems, which aims to:

- *Unite stakeholders* from across the food system value chain, including food producers, retailers, policymakers, educators, tech providers, etc. Hence, it represents all actors involved in the four RIPE pillars;
- *Facilitate collaboration* between different regions and sectors, creating a space for exchanging ideas and co-creating solutions;
- *Promote sustainability* by focusing on innovations that support e.g. circular economy practices, reduce environmental impact, and improve public health;
- *Foster innovation and policy-making* by connecting food system living labs and leveraging the best *research* and development practices across Europe
- *Through its network of Food System (Living) Labs, the Knowledge Hub offers the following key benefits*:
    - *Share best practices* allowing learning from the experiences of other labs, translate these in *education* programs, and apply these insights to local contexts;
    - *Scale innovations* by promoting solutions that work in one region across the broader European food system(s);
    - *Collaborate across borders* via establishing cross-border partnerships that enhance both national and regional efforts.

The Knowledge Hub of FS labs is already operational – thanks to work in WP4 of FOODPathS – as a virtual platform with some FS cases included (see Figure 11):

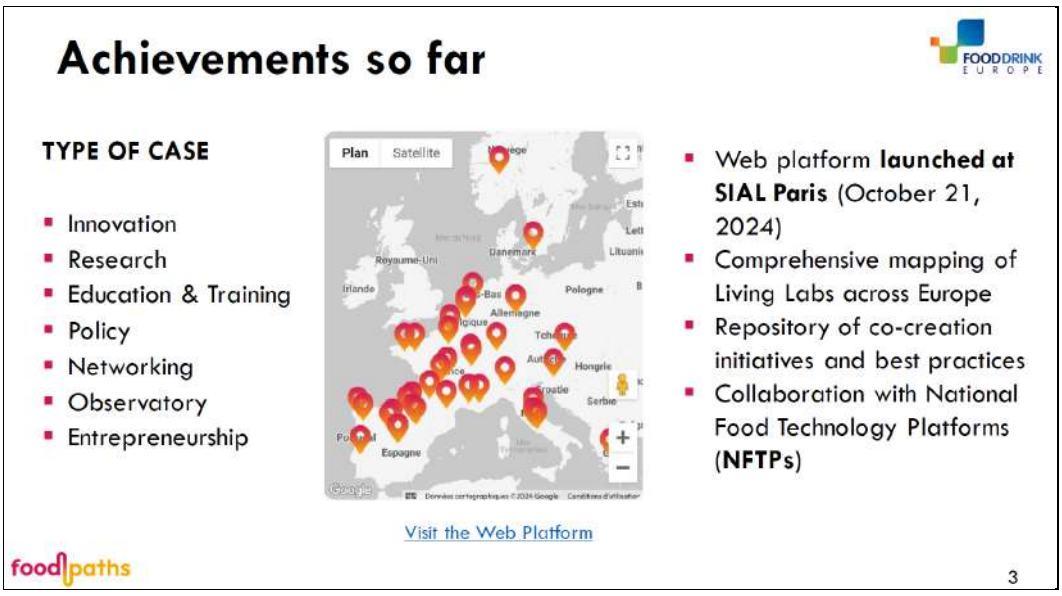


Figure 11. A screenshot of the Knowledge Hub of FS Labs showing FS cases according to their 'type' or dominant-orientation and their geographical scale (Design; Voyatzakis and Sabini; retrieved from foodpaths.eu)

As can be seen in the Figure above and thanks to a study of 52 cases on food systems contributing to sustainability, seven main orientations for FS partnerships have been identified. These are research, innovation, policy, and education, - **hence the RIPE pillars are visible** – and also networking, entrepreneurship, and observatory (see Figure 12 below; retrieved from de Vries et al., 2024).

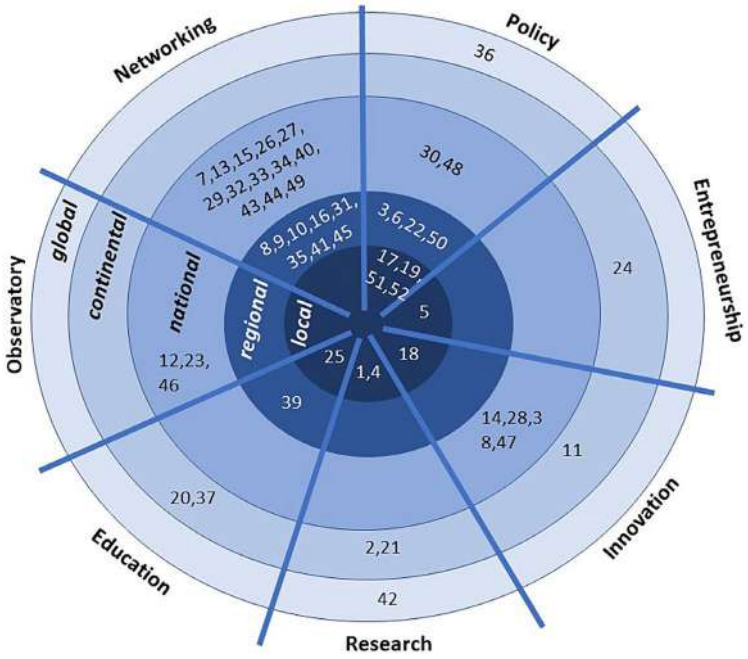


Figure 12. Seven main orientations for food system partnerships contributing to SFS (source: de Vries et al., 2024)

The analysis of the spider web reveals the following points:

- The most dominant partnership types are networking-oriented, at national/regional scales followed by ***policy-oriented*** partnerships at local and regional scales
- The diversity of actors in the 52 cases is substantial, however, dominated by private sector-driven cases. This is because most cases have been collected by private-sector network organizations. It underlines that the private sector is willing to participate in long-lasting partnerships if the objectives remain of interest to them. Also, their interest in co-creation – open innovation processes – with other stakeholder groups should be noted here.
- The number of ***R, I, and E-oriented cases*** is rather low; this is partly due to the exclusion of many funded national or European R&I projects and Education programs. However, it remains important to underline that in long-lasting partnerships R&I and E are not often the main orientation; if partnerships like to remain viable (and competitive) this may need to receive a strong impulse in the future.

Recommendation:

- The last point suggests that the Knowledge Hub of FS Labs should be actively involved in future RIPE actions. Also, the branded network of universities can play an inspiring role in motivating diverse actors and guarantee connections between R&I, E, and P.
- If one targets a sustainability objective as a 'partnership', it may be preferable to choose one of the seven dominant orientations first. If the partnership is well established, then it may put all joint efforts in reaching the sustainability objective.

6.2. The Branded Network of Universities

(Note: Work in this section is extensively described in D5.2)

The branded network of universities can be considered as either a "network" of 'universities each in the center and catalyzer of its local ecosystem or a "network of universities" at the center and catalyzer of distributed local ecosystems. In the second option, key sustainability topics are commonly handled, while in the first option, these are locally defined and EU-wide discussed.

Work in WP5 has revealed that there is a clear need for the involvement of different stakeholders in future education programs. One should better understand stakeholders' needs and also align education programs with these needs to build sustainable, inclusive, and future-ready educational ecosystems (e.g. around universities; see Figure 13)

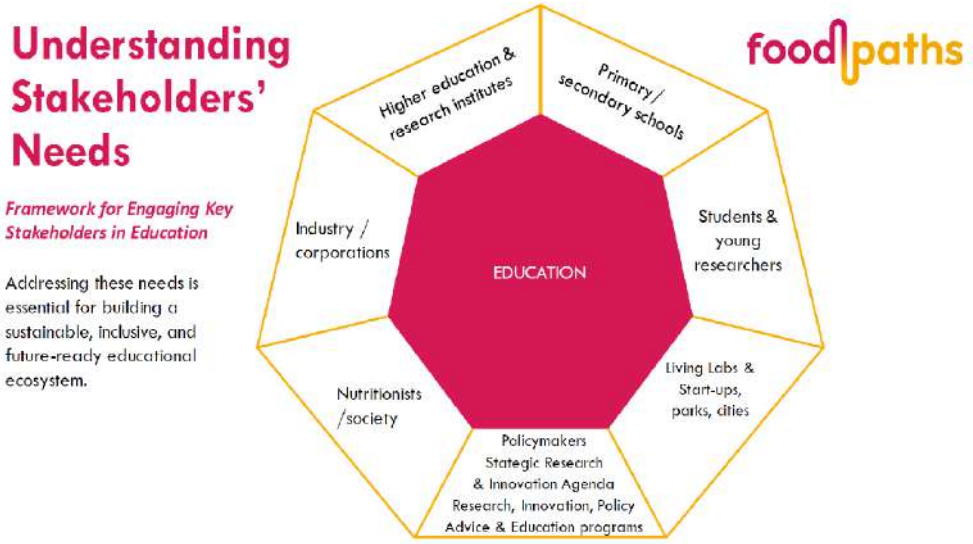


Figure 13. The relevant stakeholders for future education programs on SFS, and understanding their needs. (Design: Versteeg and Chmielinski)

This is further clarified by figure 14 expressing how the branded network of universities incorporates other organizations that support e.g. skills developments (like in the EU Pact for Skills initiative and in micro-credentials, as shown in the following figure) emphasizing a specific field within SFS education.

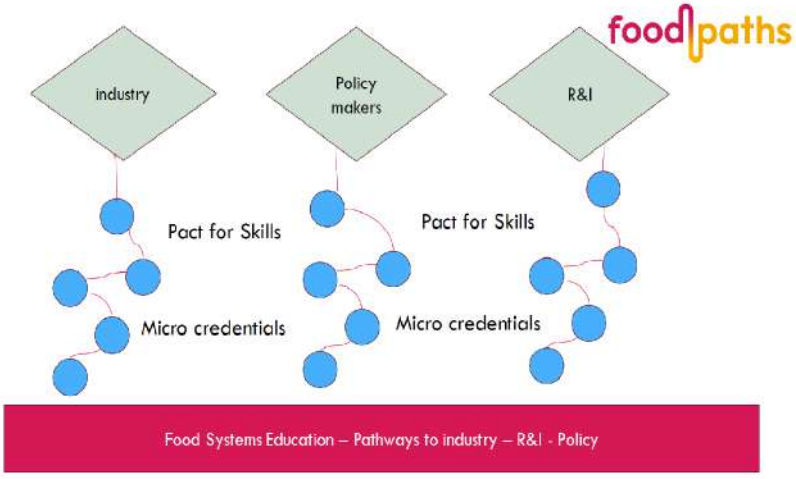


Figure 14. Possible connections between actors in education, R&I, and policymaking. (Source: Versteeg and Chmielinski)

Additionally, existing successful examples such as the **EIT Food Master**[2] (interdisciplinary, cross-border education model), **ELLS**[3] (joint teaching, student and staff mobility, and quality assurance), and **EWUU Alliance**[4] (transdisciplinary learning and enabling inter-institutional education through a matrix structure to strengthen collaboration and streamline learning processes) offer replicable models that other institutions can adapt to their unique contexts.

To support this, **the expressed needs are** (Versteeg and Chmielinski, 2025, D5.2):

- continuously researching the possibility of a portfolio of courses and joint degrees with the support of ECA[5] for accreditation;
- further researching administrative and legislative barriers while promoting inclusivity for diverse institutions;
- prioritizing a **Code of Conduct** and **Sustainability Charter** to ensure shared values and goals across participating universities;
- establishing collaborative frameworks like the **European Degree** and flexible course portfolios which provide scalable solutions for enhancing educational mobility and innovation;
- demonstrating successful examples, such as the **EIT Food Master** and **ELLS**, which offer replicable models that other institutions can adapt to their unique contexts;
- giving a clear focus on **lifelong learning**, **microcredentials**, and transdisciplinary collaboration that will ensure that branded networks remain focused and aligned with global challenges.

Recommendation: RIPE topics for the branded network of universities should be intensively analyzed. It can play an inspiring role in motivating diverse actors and guarantee connections between R&I, E, and P in local university-driven ecosystems.

Next, it is recommended to create a follow-up project that builds upon and further elaborates on the ongoing efforts in promoting EU trans-national collaboration between leading universities in sustainable food systems (SFS) curricula and campus organization. This is needed to facilitate cooperation (networking) among leading universities, as well as to align their curricula and campus activities with sustainable food systems principles. However, the project should as well be openly accessible to others.

The objectives of such a project are for example:

- A broad collaborative network of universities leading SFS education.
- A unified or adaptable model curriculum aligned with SFS principles.
- Unified guidelines for sustainable campus management.
- Stronger connections between academia, industry, and accreditation systems.

[2] The Programme "Master in Food Systems" (MFS) is an integrated graduate degree programme organized by academic institutions and industrial partners from across EIT Food pan-European partner network. The six participating universities have developed distinct in-depth blocks that cover specific areas of the food system. By combining three of these blocks or tracks, students gain an integrated knowledge on the food system through various tracks combinations (e.g. primary production + food processing + consumer sciences, or food production + logistics + digitization).

[3] The Euroleague for Life Sciences (ELLS) is a prestigious network of leading universities collaborating in Natural Resource Management, Agricultural and Forestry Sciences, Life Sciences, Animal Sciences, Food Sciences, Environmental Sciences, and Rural Development, including Agricultural Economics and Rural Sociology.
ELLS is a distinguished European network, open to membership for universities in EU countries and prospective EU member states.

[4] The institutions also challenge themselves by allowing researchers to take unconventional approaches. The partners thus want to enable shared scientific breakthroughs, such as in molecular life sciences and artificial intelligence, and to find solutions to challenges related to the social themes of health, food, energy and the circular society. The ambition is considerable: to solve that which appears to have no solution.
The four institutions cooperate in a cross-disciplinary way in those fields in which they complement each other. This strengthens each of the individual institutions as well as the partnership itself.

[5] ECA is an association of recognised accreditation and quality assurance agencies in Europe. The vision of ECA is to act as an internationally-acknowledged driver of innovation in accreditation and quality assurance in higher education.

6.3. The Observatory

(Note: Work in this section is extensively described in D2.4)

The idea of a Food Systems Observatory (FS Obs) is "*to gather, analyze, and utilize data on Food Systems from multiple sources to allow monitoring of performance and guiding FS transformation efforts*" (D2.4). The rationale for this idea was given in more detail in the SRIA for the P-SFS (SCAR, 2023). Basic requirements for the Observatory take into consideration the necessary food systems approaches as explained in D6.1, D2.2, and D2.4. Moreover, the FOODPathS conceptual proposal for an FS Obs (D2.4) builds on a review of existing observatories, literature studies of knowledge and information needs, and development activities within a food systems approach from the perspectives of policy, industry, NGOs, and research, as well as input from focus groups with experts and other stakeholders. Moreover, a preliminary concept was discussed at a workshop with researchers and potential users from organizations. Recommendations from this workshop were "*that from a governance point of view, developing a new FS Obs should include four steps: (1) define the overall aim and strategy, and formulate the pertinent questions that the FSO should be able to answer; (2) observe and analyze existing data sources, then choose and collect indicators that together have an added value compared to existing databases/observatories; (3) analyze the interactions and interdependencies within the food system, that address the pertinent questions to be asked, using the indicators and a modeling approach; (4) report results based on the interpretation of indicators e.g. in the form of consolidated reports*" (D2.4).

Based on these inputs, FOODPathS proposes a procedure for delineating the food system to be inventoried by the FS Obs data sets and to focus on a European scale with opportunities for national and regional levels. Hereby, it is suggested to take into account imports and exports as well as land use and related outcomes, because contemporary European diets include products not being produced in the same area as consumed. Thus, this implies reflecting on the dietary footprint ("foodpaths") outside Europe as well. This might have interesting implications from policy and education perspectives.

Next is considered the question of which *outcomes* should be included in the FS Obs data (indicators). This should include – but not be limited to – environmental aspects (land use, climate impact - divided by land use, primary production, nutrient loads/eutrophication, water quality, pesticide use, biodiversity in agricultural landscapes; socio-economic indicators (food prices, farmers income, consumer satisfaction,..); and indicators for dietary health (non-communicable diseases or food composition, assumed links to health outcomes,..). Again, there is presumably an interest in the selection of indicators from the other pillars in RIPE.

Equally important is to demonstrate how these outcomes are coupled through the activities of FS actors and, thus, become *interdependent*. From an FS perspective, this includes providing as much as possible an understanding of the interactions between the actors and elements of the food system in question, which will be challenging in terms of data. However, as mentioned, the stakeholder input suggested that part of the FS Obs governance is a facility, which may provide consolidated assessments from different perspectives, which would – as a hypothesis – reflect how the mentioned interactions impact the – interdependent – outcomes and provide positive and negative feedback loops. These feedback loops and possible lock-ins are important to identify and understand also from the viewpoints of the RIPE pillars, not the least science-policy interfaces and initiatives in education.

Hence, concerning its place in the RIPE concept, the FS Obs may contribute updated information as regards the status of the transition to sustainable food systems and consolidated assessments, which may feed into science-policy interfaces and point to educational needs. As discussed in D2.4, the "consolidated assessments" or "narratives" should – ideally- reflect the main policy objectives for the transition to sustainable healthy food systems in terms of:

I. The interdependent outcomes such as dietary health and food access, environmental sustainability indicators, climate impact, food sovereignty, the food environment, and power balances between food systems stakeholders;
II. Activities of key stakeholder groups and interactions between elements of the food systems including – where possible – interpretations on positive feedback loops and leverage points as well as lock-ins and path dependencies of importance for the transition.

These assessments would be valuable for the interpretation of current educational and policy initiatives, for the formulation of needs and new initiatives in support of the food systems transition, and for setting R&I priorities. Examples could be insights re. the citizens role as consumers in the food environment as well as inputs to requirements for policy initiatives (information, regulation..),

Thus, knowledge gained from an FS Obs may inform the update of the current SRIA of the P-SFS by highlighting opportunities and challenges in different elements of the food system. These are for example: non-communicable diseases, the retail sector's vs. out-of-home meals' influence on diets via the food environment, the food industry's role in healthy food processing and product development, and logistic actors' roles in food access vis-à-vis local seasonal produce. Such highlights may improve the understanding of the need for accounting for food systems interactions when designing policies (policy coherence) and education programs.

There is a two-way relation between these parts of a RIPE concept in the sense that questions and challenges defined by stakeholders/actors in Policy or Education may inspire the actors behind the FS Obs to enrich the data recording – where available - and assessments to these needs.

7. Feedback from Food System actors

The program of the RIPE workshop in Budapest, Dec 2024 (Annex I):

The aim of the workshop: presenting the RIPE concept 1.0 with cross-checks of findings for R, I, P, and E and inputs & outputs for the Knowledge Hub of FS Labs, the Branded Network of Universities, and for the Observatory.

These are addressed from the following angles:

I. Becoming familiar with the R&I, P, and E pillars as well as with the Knowledge Hub of FS Labs, the Branded Network of Universities, and the Observatory:

i. 4 R&I topics as described in the SRIA, all from an FS lens and the science-to-Policy deliverable;
ii. Presentation of the virtual platform of the Knowledge Hub of FS Labs, the Branded Network of Universities, and the Observatory (the latter has also been discussed in an additional workshop in Budapest).

II. Reflecting on cross-checks via a series of questions.

The following questions have been posed to the participants, working in sub-groups:

1. How can the complexity of food systems be considered in the organization and provision of science advice to policymakers?
2. How can policymakers facilitate regulations and foster dialogues between regulators (e.g. EFSA), Research, Innovation, and Education (and companies) to facilitate solutions?
3. Would training in serious games help FS actors to collectively change our pathways?
4. What specific resources or tools would make the Knowledge Hub a valuable asset for your work within the food system?

III. Plenary feedback and final discussions

The note-takers for each group have presented their main findings. Their notes have been collected and integrated into this deliverable. Based on these, the following summary is made:

Results from the workshop:

First, the main answers to the questions are summarized below. Additional feedback for the Knowledge Hub, Branded Network, and Observatory are then listed.

How can the complexity of food systems be considered in the organization and provision of science advice to policy makers?

- Observatories should be created that provide objective data and conceptual models.
- These should be a point of reference for policymakers: Guide policymakers with science-based baselines and references.
- Stakeholders are recommended to be engaged through specialized focus groups.
- Align objectives using simulations, scenario writing, or serious games.
- There are no – or not many known – current food system policies, so it should be realized that references may most likely not exist.
- The primordial question to answer is: what does a food system policy consist of?

- Can some of the basic human rights be used as the center of making policies (for example, health and access to healthy foods)?
- Can the food systems complexity be integrated into S-to-P by scaling from local to regional to national levels, and even to EU-level?
- There is a clear need for examples of the implementation of food system policies.
- An in-depth reflection is necessary on the sequencing of science to policy processes.
  Make use of examples like of Switzerland that is already developing a food system policy, which is supposed to be operational in 2027.

How can policy makers facilitate regulations and foster dialogue between regulators (e.g., EFSA) and Research, and Innovation and Education (and companies) to facilitate solutions?

- It is recommended to assign experts to topic groups for structured discussions, regularly.
- Stakeholders are requested to be engaged to validate ideas and solutions.
- It is further underlined to promote international agreements on shared problems like food waste.
- A collaborative platform for data sharing and feedback is needed.
- Regarding communication, make statements like 'food is everyone's business'.
- The latter also holds for inter-ministerial communication and coordination activities.
- There is an expressed need for centralized anchoring of new initiatives.
- It is important to favor pull strategies instead of push strategies.
- Citizen science and mobilization are essential themes to be addressed. There are examples of initiatives, where citizens for example have started measuring their blood and water sources for pesticide residues (in Bretagne, France). This could convince politicians to look at new policies and initiatives together with citizens.

Would training in serious games help FS actors to collectively change our pathways?

- Use serious games to simulate scenarios and align objectives. However, this implies that trainings are provided that enable sharing observations and collaboration efforts.
- Build frameworks for stakeholder engagement by using games.
- Promote gaming as an educational tool for collective action.
- Play catastrophe scenarios, which could push politicians.
- However, take care with using games: it depends on the setup and context – for example playing two scenarios could be not realistic.
- Overall, playing serious games may raise awareness about the need to reach SFS.

What specific resources or tools would make the Knowledge Hub a valuable asset for your work within the food systems?

- The Hub is recommended to include data-sharing agreements to ensure collaboration.
- It is strongly recommended to promote the hub widely to maximize accessibility.
- The latter will require structured and actionable data systems like dashboards.
- It asks for a collaborative platform for knowledge exchange and feedback, including mapping of cases for living labs for sustainable food systems.
- The knowledge hub should be open to everyone.
- It is very important to make it transparent to identify and connect with other stakeholders.
- It can be used to find peers, who have implemented sustainability measures.
- It serves as a tool to get to know, what you did not know.
- It can be used to nudge users in a complex system.

- It is recommended to include experts from all stakeholders for longer times in specific topic-oriented groups (e.g. on bee products) and come together regularly, to discuss regulations updates (change, missing…).
- It is also recommended to create an overarching group, with strong ties to more specialized groups to handle the complexity of FS.

Additional points regarding the Knowledge Hub: remarks from the workshop underline that there are too many existing initiatives, which leads to fragmentation and high complexity for innovators. Hence, it is strongly recommended to avoid creating new tools, but use existing ones, and focus on:

- Mapping of best practices of sustainable food cases. The priority is proposed to be on Education and Innovation. Then, there should be easy access to communication material like videos, leaflets, and awards...
- The Knowledge Hub should be a depository place of current European projects, with categorized criteria of projects as proposed here. Promote knowledge hubs widely so they are widely accessible.
- An annual meeting is suggested to present and discuss updates.
- During the year, it will then function as an online exchange platform of best practices.
- It is also recommended to provide an Artificial Intelligence (AI) matchmaking interface.
- Underline the cases between University/Research (solution providers) and Industry/Farmers (expression of needs) to reveal options for valorizing the latest insights. Then, specific guidelines and methodologies should be developed and available online to replicate the concept locally.
- It is suggested to foster public consultations and to link with EC policy and the SCAR.
- Since these actions need a specific budget, it is recommended to include these in the operations of the future Partnership on Sustainable Food Systems.
- Align the objectives of each stakeholder thanks to a coherent framework; the spider web was considered helpful (see Figure 12).
- Include data-sharing agreements and consider a collaborative platform to share knowledge like a FOOD-Wikipedia, which needs data, quality control, etc. Connect it to the Observatory e.g. via a joint food system dashboard (as recently developed by the JRCs).
- Support for National Food Technology Platforms (NFTPs): The Knowledge Hub actively collaborates with NFTPs to integrate its activities at the national level, promoting tailored initiatives that meet regional challenges and opportunities.

Additional points regarding the Branded Network of Universities: During the workshop, several factors were mentioned that influence the connection between R&I, E, and P:

- Need for collaboration between universities and industry on R&I topics;
- Concerns about intellectual property (IP) rights;
- Approval of processes, novel foods, or specific technologies;
- The Need for a societal challenge approach in education and the prioritization of long-term sustainability goals as a driver for education programs;
- The gap between academic knowledge and industry expectations;
- The need for governmental support and legislation to drive sustainability in the industry and make sustainability initiatives well perceived by the industry without negatively impacting competitiveness;
- Needed digitalization and optimization in food processing to reduce environmental impact, both in education programs and R&I experiments;
- The currently (too) slow accreditation processes;

- Connect primary education to university programs, and use e.g. food programs in schools to show links between R&I, P and E. Consider lifelong learning as a real leverage;
- Include communication, exhibitions (like SIAL or Cleverfood exhibitions in musea), and education via the internet, while avoiding fake news, etc.
- Education on FS should be related to digitalization, e.g., Singapore invests massively in AI training for people now;
- Explain to all actors, including the industry, that they have a role to play in education which is the starting point, and set up positive reinforcement measures: make it pleasant to connect again with food, e.g., having a healthy meal together;
- Consider the contribution of social sciences, and the moral dimension of science-based solutions, which may differ culturally and geographically. Consider food as cultural markers in RIPE pillars;
- Include the young generations in setting up and functioning the Branded Network;
- Consider existing programs like EIT Food Masters, OnePlanet SFS training program, and Chair Unesco SFS master program (see below), … and include who is educated and who will train.

Additional points regarding the Observatory:

- Science advice to policymakers concerns political decisions. They are not all based on science. Also, some policies are impacted by others, like several Green Deal objectives that were removed as a result of protests. Observatories may play a key role in making information transparent and evidence-based.
- Science: offer the baselines, the objective data, the conceptual models, and the appropriate references. They keep the politicians guided by the 'right' side when they make decisions.
- European societies are increasingly removed from 'food and how it is produced' (e.g., think of salmon as a commodity and no longer as a fish), while at the same time having strong opinions on GMOs and CRISPR technology that very few understand. Here, the Observatory may shed light.
- The Observatory may serve to gain time by simulating situations and letting them unfold virtually. Key elements are then scenario-writing, serious games, and gaming approaches to reach a shared observation.
- An international policy effort should agree on shared problems to be first prioritized in the Observatory, e.g., food waste and its management.
- One should consider also that policies do and will often contradict each other, e.g. national security vs. economics. So there is no pure policy decision, as it will always go contrary to another stakeholder's need. This is recommended to be taken into account in the data provision.
- Consider scales: e.g., on a regional scale, changes can be made, because of easier to align common interests based on transparent data. However, often national, EU-wide, or global data are required as the Valencia flooding example showed. Hence, consider how a European Observatory operates in a global food system and what are potential political frontiers.
- Regarding the Observatory and Science-to-Policy: include a reflection about 'what *NOT*-science-based-policies mean (the inverse) and what are the potential consequences'.
- In the Observatory, the 'time' dimension needs to get specific attention because we talk about different time scales for the challenges we face, the time needed to adapt ourselves, the time needed to change RIPE activities (e.g. changes in education programs), etc.
- Keep cultural food heritage and diversity in Europe as key observational elements.
- Specific feedback has been given regarding food safety regulators and their potential contribution to sustainability solutions. A periodic dialogue with regulators of the European Food Safety Authority (EFSA) is recommended to address the following points of attention:

- Need for simplification of procedures and administration, in order not to hinder sustainability-oriented innovations;
- Need to be open to dialogues/communication, to meet the applicants, to speed up innovation trajectories that seek sustainable solutions;
- Need to involve stakeholders in regulations, since these may become rather complex in a legislative framework for sustainable food systems;
- Need to make surveys of regulation impacts to receive feedback. This is even more important since in SFS legislative measures may mutually influence each other or trade-offs may arise that impact other food-related laws.
- Need to fund the public consultations to allow stakeholders to attend the meetings. This may be considered in the future Partnership in their annual budgets.
- The results of the consultation should be more effective/impact the processes in a transparent process. This creates trust and willingness to collectively improve the legislative framework for sustainable food systems.

8. Examples of RIPE cases

8.1. UNESCO chair on World Food Systems, the IPAD master program

The UNESCO Chair on World Food Systems, housed by the Institut Agro in Montpellier, France, is a unique advanced Master of Science program embedded in an R&I intensive agrifood valley (https://en.institut-agro-montpellier.fr/business-alliances-and-services/research-business-alliances/unesco-chair-world-food-systems; Unesco Chair WFS, 2024). First, a description of the program and administrative issues is given (Figures 15 and 16). Then a first-order cross-check between education priorities, R&I themes, and policy options is presented.

Advanced M.Sc® Innovations and Policies for Sustainable Food Systems (IPAD)

Objective

Developing sustainable food systems and ensuring global food security are crucial challenges that must be addressed in coming decades by a wide range of public and private actors in the North and South. These systems must guarantee that all people have access to an adequate amount of quality food and remain healthy. The systems also must minimize their ecological footprint, reduce waste, ensure fair wages within sectors and generate jobs.

Graduates will be equipped to contribute to the efforts required to strengthen the sustainability of food systems in France, Europe and abroad, and will be able to:

1. understand the issues at stake in the sustainability of contemporary food systems
2. propose and use sustainability assessment tools
3. analyse organizational and/or technical innovations and policies that can help build more sustainable food systems
4. support these innovations and policies

THEMES

- agriculture and rural development, farms and farm organizations
- markets, sectors and agricultural and agrifood companies
- collaborative networks and practices (methods and tools)
- agricultural and environmental policies
- natural resources, environment, territories

Figure 15. Objectives and themes of the Master IPAD (source: Unesco Chair WFS, 2024)

Number of ECTS credits : 75 ECTS

Language of instruction : In French

THE COURSE IS ORGANIZED IN THREE PARTS

The first seeks to understand the evolution of food systems, take stock of the current situation an analyze the issues at stake (UE 1 & 2):

- Understanding family farming through a systemic approach
- Agriculture and food, sustainability in question
- International organizations and negotiations on agriculture and the environment
- Retrospective and prospective analysis of national governance of food systems

The second is dedicated to acquiring tools to assess different impact categories and interventior tools (UE 3):

- Tools to evaluate the sustainable development of food systems
- Assessment of the environmental footprint of food systems
- Supporting innovations in food systems

The final part enables an exploration of innovation frontiers in different fields (UE 4):

- Re-territorialisation of agriculture and food
- Innovations for food and nutrition security
- Standardization of food systems, expectations and consumer practices
- Urban planning, sustainable food and health
- Lobbying and advocacy

During the year, students also must carry out a study of an innovation, one that is technical or organizational, and analyze its impact and change of scale capacity (UE 5).

INTERNSHIP (COMPULSORY)

Students undertake a professional assignment between May and October. This may focus on one of the following themes:

- strengthening the sustainability of a production, a local or national development process...
- sector development (chain of stakeholders, strategies and coordination, distribution of value added, strengthening cooperation between stakeholders within a sector...),
- development of producers' organization/coordination, capacity-building for collective action (collective mark, collective response to a demand...),
- determining factors behind the development and endurance of an innovation network
- market study (evolution of food behaviour, ethical consumption...)
- development of innovative resource management systems
- development of sustainability indicators

Figure 16. Main parts of the IPAD course (source: (source: Unesco Chair WFS, 2024)

Admissions: To be accepted for this course, one must hold a Bachelor's degree. Also, one must provide proof of 2 years of postgraduate studies such as a master's degree or equivalent, or a 1 year of post-graduate study, with at least 3 years of professional experience in the field of life, human, or social sciences. Via a derogation process, some applicants with a Bachelor's degree and at least three years

of experience, or with a Bachelor's and 1 year of post-graduate study, can also be admitted. The communicated **fees are communicated on the website.**

Future careers: Actors engaged in improving the performance of a company, a producers' organization, a territory, or an agricultural or food sector at the national level… increasingly face economic challenges and balance these against other objectives related to sustainable development. These trends require various food system actors to develop new skills within their teams.
Graduates develop strategic expertise and prospective analysis capacities that they can offer to many public and private employers: companies, consulting firms, associations, NGOs, local public authorities, government agencies, international organizations… Graduates also can help create or develop start-ups and social enterprises.

Links with R&I topics:
Change the way we eat:

- Raising awareness on nutrition (food quality, diversity of diets) and factors of malnutrition (non-access to food, food deserts, gender gaps, low-incomes…);
- Assessing the environmental impact of food through Life Cycle Assessments and other impact-measuring tools;
- Learning about consumer concerns and sustainability.

Change the way we process and supply food.

- Studying diverse alternative practices within food systems (agroecology, urban agriculture green processes, eco-friendly processing at small-scale, new commercial outlets,…);
- Studying different innovation approaches with a special focus on collaborative approaches and interviews with diverse actors (start-ups, multi-stakeholder programs…);
- Raising awareness of global international food systems and the re-territorialization of food production; finding new balances between them.

Change the way we connect in food systems

- Learning about consumer concerns and food democracy;
- Raising awareness on sustainable normalization (Fairtrade labels, environmental certification…) and its short-comings (too many labels on the markets);
- Analyzing alternative collaborative initiatives such as public canteens, zero waste solidarity groceries, and common food funds, as well as professionals' interventions.

Change the way we govern food systems.

- Introducing theories of change (such as the installation theory of Saadi Lahlou);
- Learning about French (Plan Alimentaire Territoriaux, taxes…), European (CAP, Farm-to-Fork…) and international (Codex Alimentarius…) policies;
- Training in lobbying and advocacy (campaign simulations for NGOs and the private sector), and in professional interventions;
- Training in animation tools focused on inviting food actors to work together on a common topic.

Relevance of this formation to policymakers:

- Global comprehension of food systems at different scales, from local to global, through various food actors' viewpoints (producers, small & big companies, public institutions, NGOs, lobbies…);
- Raising awareness on important topics that need policy developments (food democracy, healthy diets, payments to producers…);
- Various visits and meetings at farms/initiatives provide concrete examples and opportunities to connect to and learn from 'on-the-ground' actors.
- A toolkit of animation techniques, a lobbying campaign tool, environment and social impact assessment methodologies, and prospective analysis guidance.

8.2. Milan Food Policy links policies to education and literacy, with a focus on children.

The Municipality of Milan, together with Milano Ristorazione, in collaboration with Fondazione Cariplo and other local entities such as ATS, local farms, and third-sector organizations, carries out various food education activities aimed at children, families, teachers, and educators. Over time, the approach to education within the Food Policy has evolved, working across multiple levels. This includes education through food at the table, as well as broader forms of education and literacy focused on enhancing knowledge and improving food education.

Thanks to European projects like Horizon 2020 "Food Trails" and "School Food 4 Change," pilot actions have been launched, including the refurbishment of dining halls, which also featured an educational component with storytelling about the raw ingredients displayed on the walls of the renovated spaces. Similarly, a themed hackathon on legumes was organized in collaboration with Cariplo Factory, where children were asked to design their favorite legume-based recipe and present it to the chef.

The educational initiatives promoted by the Municipality of Milan and Milano Ristorazione as part of the "School Food 4 Change" project and in collaboration with Fondazione Cariplo focused on pilot activities for preschools in 2023/2024. These included training sessions for educators, organized with the support of Milano Ristorazione and ATS Milano Città Metropolitana, on healthy and sustainable menus; a program on educational gardens developed with Fondazione Acra; visits to Cascina Battivacco, thanks to the collaboration with the Fedeli agricultural company, which supplies rice for the city's school canteens, and to Cascina Linterno, with Apicoltura Veca offering a bee discovery program. Additionally, four evening events called "From the Garden to the Table" were held to connect families, children, and Milano Ristorazione chefs through kitchen visits and a food education workshop at the Ravenna cooking center.

This year, educational activities will once again feature a variety of initiatives involving families, children, and teachers, organized by Milano Ristorazione and the Municipality of Milan as part of the city's Food Policy. The goal is to increase transparency in service delivery while promoting taste education and healthy eating habits. The "Tutti a tavola: mangiando si impara" ("Everyone to the Table: Learning Through Eating") program will engage primary schools, nurseries, and preschools with training sessions for teachers and educators, visits to Milano Ristorazione's cooking centers, and informational webinars for families. There will also be a new edition of the "From the Garden to the Table" evening events and the popular "A Chef as a Friend" program, which brings Milano Ristorazione chefs to about 200 schools, allowing children to satisfy their curiosity about meal preparation and service.

The initiatives also include special menu days, printed "InfoMenus" with seasonal updates, and educational booklets to help children and parents explore Milano Ristorazione's world, the city's Food Policy, and the values of food.

Additionally, Milano Ristorazione's longstanding programs continue, such as "Fruit for Mid-Morning," which, during the 2023/2024 school year, involved 66 facilities, over 790 primary and secondary school classes, and approximately 16,000 children. This program is being extended as a trial to some preschools starting mid-October, incorporating feedback received last year. The "Snack-Saving Bag" initiative also continues, with 28,000 bags delivered to 124 schools last year.

8.3. CityFood: How the City of Wroclaw ensures resilience and food security

CityFood is ICLEI's Global Food Program, established in 2013. It brings together urban food experts from across the globe to support cities in their transition towards sustainable food systems. From food procurement to fresh food markets and waste, CityFood helps address the most pressing food challenges cities are facing. CityFood seeks to **unlock the potential of multi-level food governance** - both vertically, bringing together governments at different scales, and horizontally, involving different sectors, departments, and stakeholders in food policy development to accelerate food system transformation.

To support local and sub-national governments in their transition towards sustainable food systems, CityFood's Triple **H** Approach - **Healthy People**, **Healthy Climate**, and **Healthy Landscape** - addresses the complex challenges that the food systems present and guides how those challenges could be addressed from a city's perspective. There is no silver bullet to respond to those challenges. The Triple H approach can be achieved by co-developing and implementing locally relevant and creative solutions with the support of action planning that the city defines for each of the components.

Over the past years, ICLEI CityFood collaborated closely with the Polish City of Wroclaw, which successfully addressed the complex challenges of climate, nature, and health. By prioritizing food within its sustainability agenda, fostering partnerships, and leveraging EU frameworks, Wrocław is paving the way for a resilient and inclusive future. Wroclaw's Deputy Mayor Jacub Mazur is also an active member of ICLEI's European Board. This case study serves as an example of how cities can proactively prepare for crises while advancing sustainable development goals and promoting sustainable food systems.

Links with R&I topics

Change the way we eat:

- Raising awareness about food nutrition
- Raising awareness about where food comes from
- Changing food habits by supplying food to public canteens and schools

Change the way we process and supply food:

- Preventing pollution; shortening supply chains by minimizing the carbon footprint and promoting organic farming. Protecting biodiversity and ecosystems
- Supporting education in the area of sustainable development and raising awareness of residents in the food system - sustainable production, marketing, and consumption of food
- Gradually increasing the share of local food production in the city's food system, securing local food supplies to urban units, and preventing food waste

Change the way we connect in food systems:

- Bringing together people of all ages and from all backgrounds
- Uniting researchers, policymakers, producers, and eaters to create projects and initiatives
- Achieving social benefits by reintegrating and activating people at risk of unemployment and/or social exclusion.

Change the way we govern food systems:

- Introducing interdisciplinary, local partnerships to align with national and EU frameworks
- Connecting bottom-up and top-down priorities and bringing citizens, researchers, and policymakers together through the Fair Local Green Deal, Food Manifesto, and other boards and initiatives
- Developing policy specifically impacting food and agriculture, especially food waste.

Science-Policy-Education initiatives for Wroclaw's food system

Context and Challenges

Poland has recently faced a series of crises, underscoring the need for cities to build resilience in the face of climate change, geopolitical conflicts, and other emergencies. Among the most pressing challenges, the influx of three million Ukrainian refugees in 2022 and the severe floods in southwest Poland during the autumn of 2024 revealed the vulnerabilities of urban systems. The City of Wrocław has taken proactive measures to address these challenges by investing in sustainable urban development, with food security emerging as a cornerstone of its resilience strategy.

Partnerships in Wroclaw

In 2022, Wrocław's ability to respond effectively to the Ukrainian refugee crisis demonstrated the importance of preparedness and collaboration. By partnering with non-governmental organizations (NGOs), local activity centers, and residents, the city ensured dignified access to food for all. For these efforts, Wrocław received a special mention at the Milan Pact Awards in the same year.

Citizen engagement meets policy: The Fair Local Green Deal.

Recognizing the significance of inclusive planning, Wrocław has held multi-stakeholder dialogues over the past three years to prioritize food in its sustainability agenda. These discussions led to the development of the Fair Local Green Deal on food, aligning the city's policies with EU priorities and creating pathways for collaboration. In October 2024, Wrocław introduced its Food Manifesto (2025), further solidifying its commitment to sustainable food systems. Building on the European Union's sustainability frameworks, particularly the Farm to Fork Strategy, the city is developing its first urban food policy. The policy aims to provide all residents with access to safe, nutritious, and culturally appropriate food, even during times of disruption.

Miejska Farma: A Model Urban Organic Farm

One of Wrocław's flagship initiatives is Miejska Farma (City-Farm, 2025), the first urban organic farm in Poland. This project addresses food security while promoting social inclusion and environmental sustainability. Producing 70 tons of food annually, the farm supplies 16 public kindergartens in the Wrocław Nursery Complex.

Miejska Farma is a collaborative effort managed by Wrocław's Division of Climate and Energy in partnership with Wrocław University and six additional organizations. It serves as a model for interdisciplinary projects, combining food production with employment opportunities for individuals at risk of social exclusion and offering on-site educational programs.

Collaborating Across Cities and Regions

Food security challenges require collective action. Wrocław has joined forces with Warsaw, Krakow, and other cities to advance urban food policies and advocate for supportive national legislation. Additionally, the city participates in the European ICLEI network, which fosters sustainability initiatives through the Global CityFood Programme and EU-funded projects. These partnerships are creating a community of experts working on interconnected topics to bolster resilience in Wrocław and cities across the globe.

9. Conclusions & Forward Look: a new RIPE concept

Conclusions

The connection between R&I topics, Policies, and Education programs is imperative for the Partnership on Sustainable Food Systems. This both concerns an alignment of topics that are equally relevant for R&I, Policy, and Education (hence the 'what question') as well as the way of elaboration on these topics (the 'how' question). The latter deals with how to overcome barriers and gaps in all four RIPE pillars.

We have noticed that already quite some convergence between the four RIPE pillars is visible. We have also realized that common RIPE topics and approaches are of use for the Knowledge Hub of FS Labs, the Branded Network of Universities, and the Observatory. The first, the classifications and presentation of FS cases – via the virtual Knowledge Hub of FS Labs tool of FOODPathS (please see www.foodpaths.eu) follow the four RIPE pillars as well as networking, entrepreneurship, and observatory as three additional dominant orientations. For the second, the Branded Network of Universities embedded in local ecosystems automatically links actors in R&I, education, and policymaking. For the third, namely the 'Observatory', the data and dashboard are relevant in R&I agenda settings, Policies, and Education programs.

Still, we realize that our conclusions are mainly based on our work in FOODPathS. In follow-up activities, it is strongly recommended to align for example FutureFoodS activities with the foreseen Partnership on the Pact for Skills, EIT Food, PRIMA or any other Partnership and with activities of networks like the Ghent group or ICA. It may even be considered by the EC to call for a next Coordination and Support Action (CSA) project, particularly addressing the interconnected RIPE pillars.

For such a follow-up activity, the FOODPathS coordinating team considers a conceptual framework that allows continuous exchange between the RIPE pillars, and especially understanding the rationale for exchange. Hence, this framework is intended for both practical and intellectual usage, or – in other words – consistently perform portfolio management. In the next section, a first-order concept is ste-wise introduced, based on previous work on food systems in literature and own research.

Forward Look: a new RIPE concept.

As stated in the task description, FOODPathS should go one step further, namely the development of a new complex Food Systems Conceptual Framework. This framework should allow for analyzing RIPE insights obtained in projects and future partnership actions. In the integrative tasks of WP2, this framework will then become a core 'organ' of the prototype Partnership. A first version of such a framework is presented in this deliverable.

In this section, a complex sustainable food systems Conceptual Framework for RIPE is stepwise introduced.

i. A generic food system concept targeting sustainability outcomes
ii. A schematic presentation of a food system approach
iii. A graphical representation of sustainability
iv. A first-order connection between sustainability and RIPE
v. A conceptual framework for sustainable food systems for RIPE

Each section is elaborated below, including relevant references and, if applicable, links to other FOODPathS Deliverables.

i. A generic food system concept targeting sustainability outcomes

In 2008, one of the first concepts of food systems that are seeking food security, environmental, and social outcomes was presented by Ericksen (2008). Many other FS concepts have been based on this scheme. A few are presented in Figure 17.

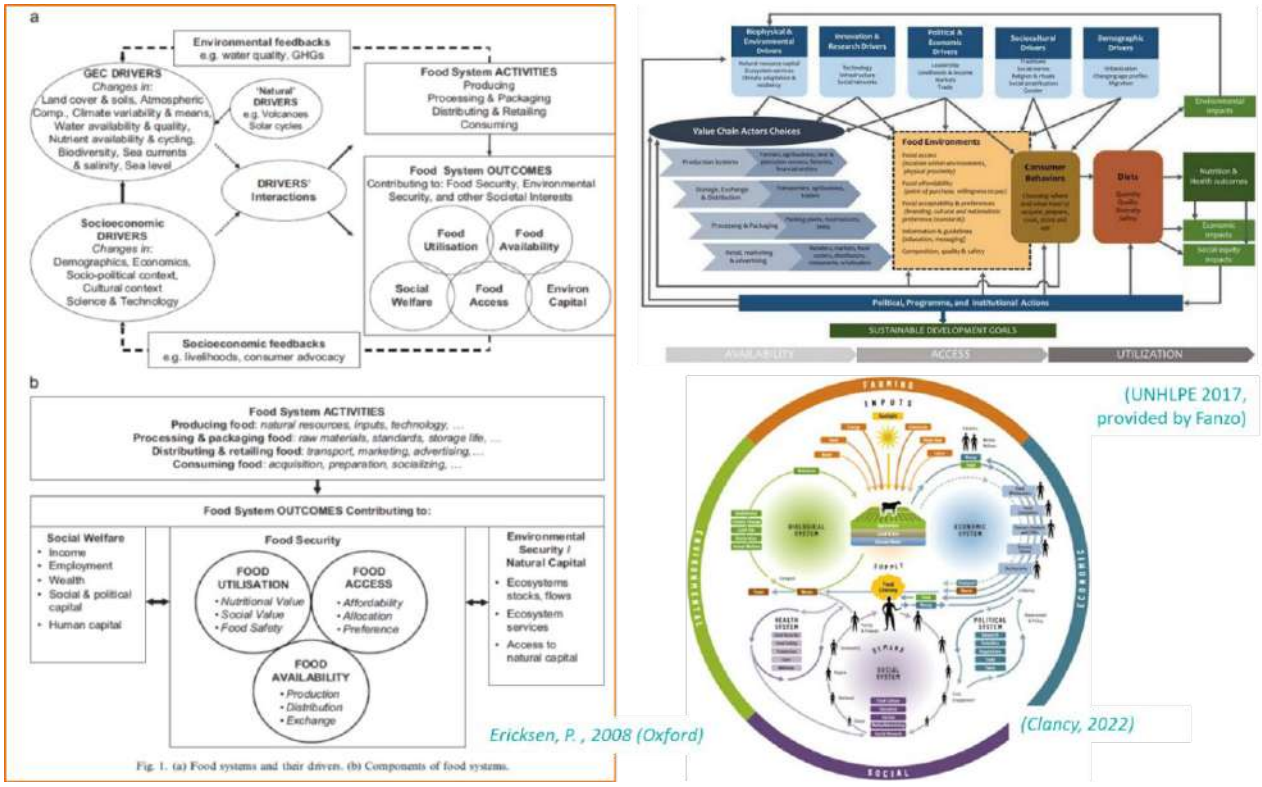


Figure 17. Comparable food systems concepts that target sustainability outcomes. (Figure retrieved from Ericksen, 2008 (left); UNHKPE, 2017 (right above) and Clancy, 2022 (right below)

Schematically, these concepts are highly simplified in Figure 18, indicating that a series of drivers influence food system activities resulting in outcomes (positive or negative). Via feedback loops, activities can be adapted if necessary.

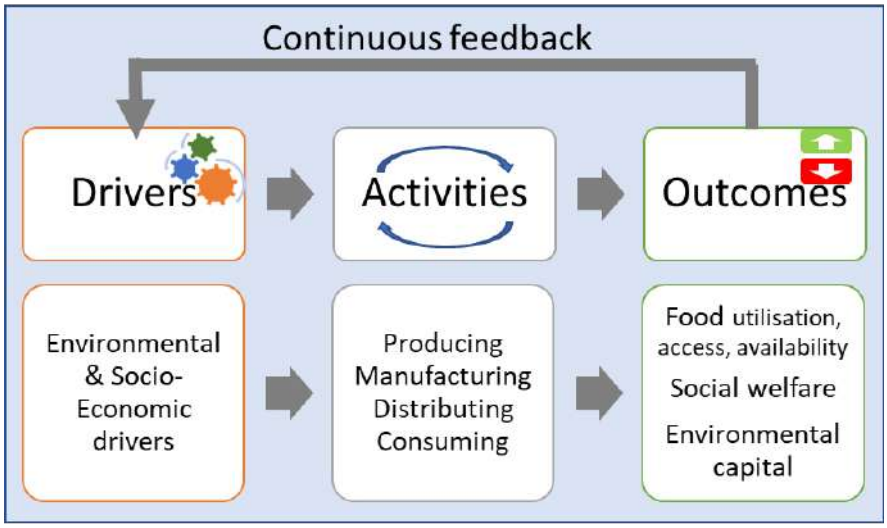


Figure 18. A simplified concept for Food systems targeting sustainability outcomes (Design: de Vries)

ii. A schematic presentation of a food system approach

The schematic presentation of a food system approach has been given by Halberg and Westhoek (2019; Figure 19).

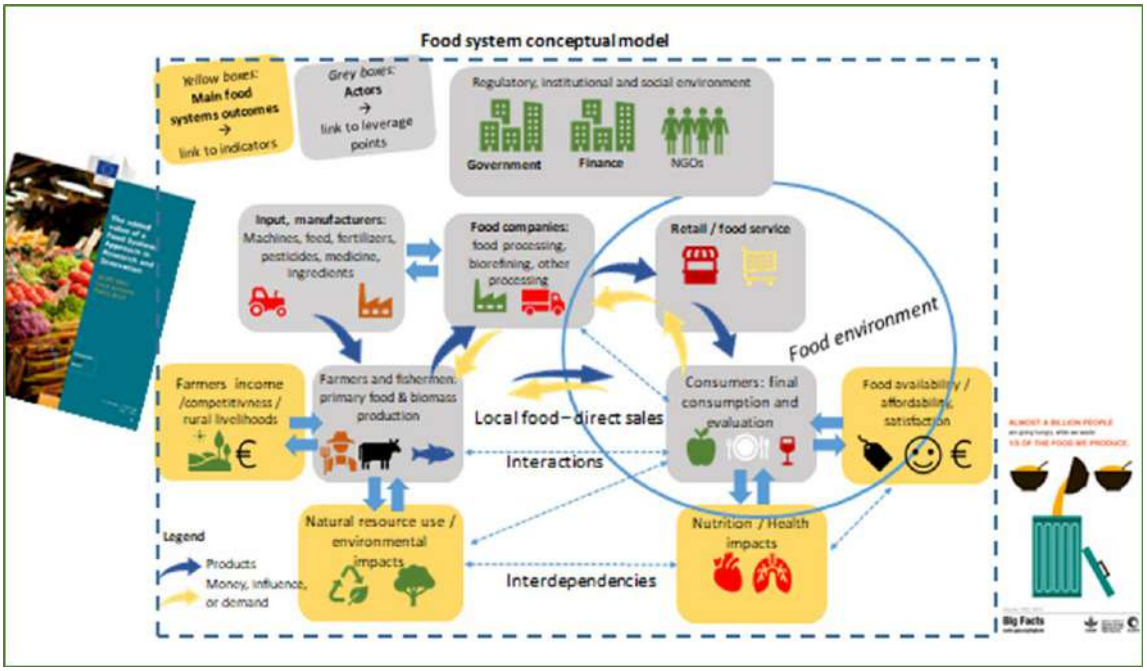


Figure 19. A food system conceptual model (Retrieved from Halberg and Westhoek, 2019)

They define a food system approach as follows: *A food systems approach attempts to understand the natural, technical, economic, and social aspects of several interlinked activity areas from primary agriculture including crop and livestock production and their inputs, yields, and emissions to logistics, processing, transforming and packaging of food to marketing, consuming and disposing of waste and the linkages between these elements* (Halberg and Westhoek, 2019).

A highly detailed scheme is given by ShiftN (2009), which is rich in all possible connections between major system parts (Figure 20).

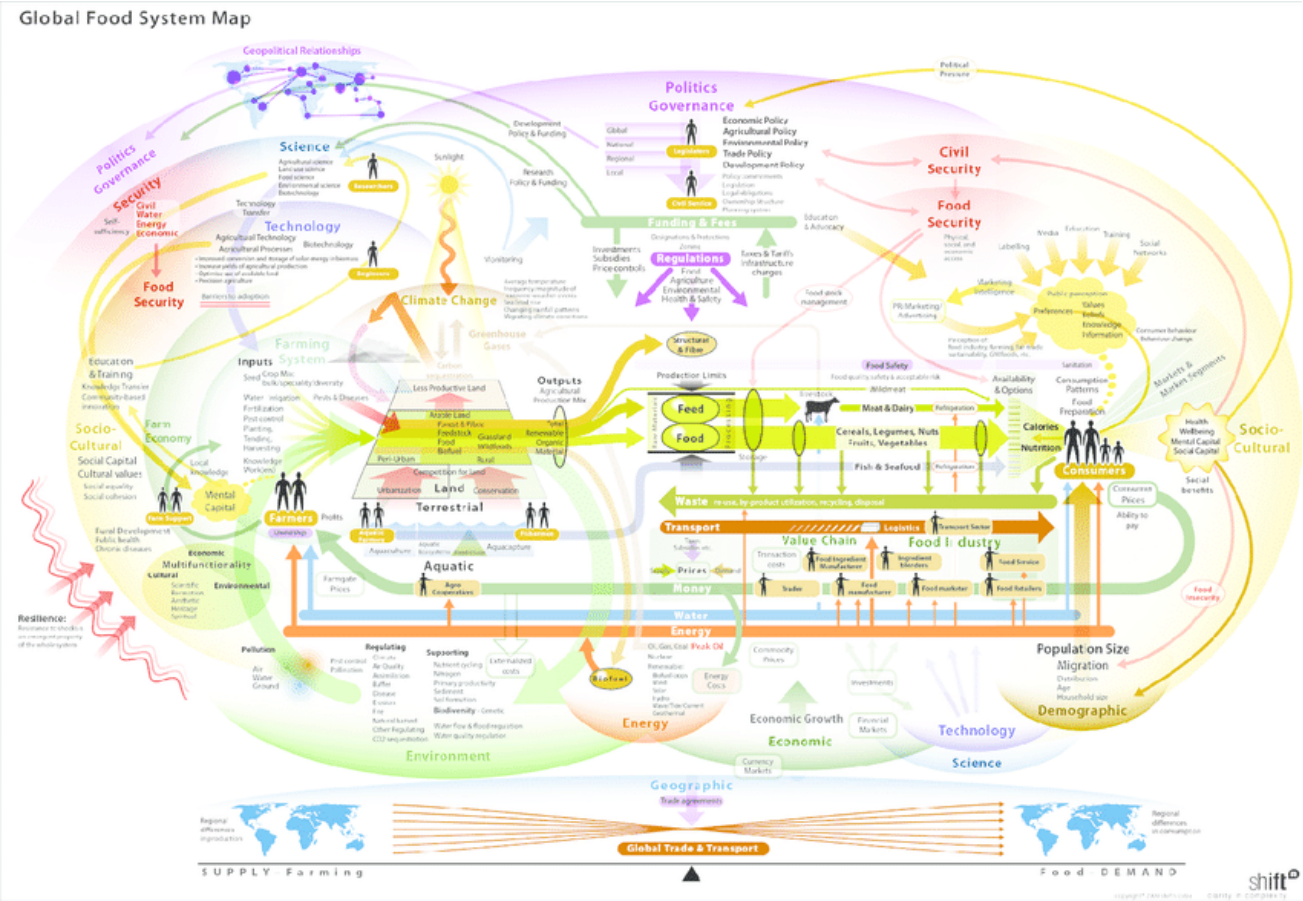
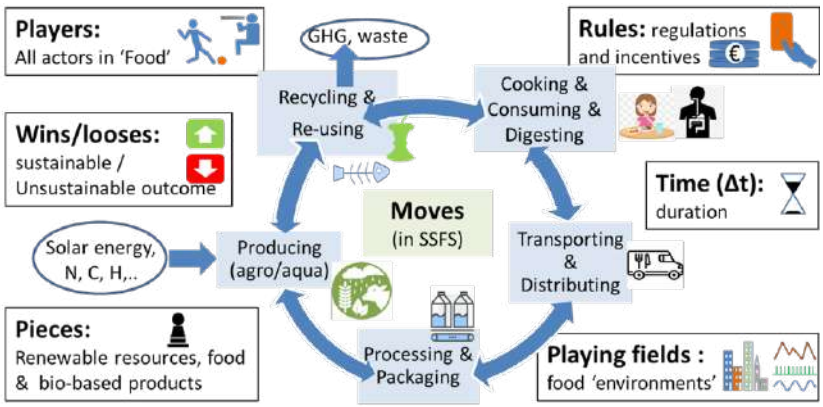


Figure 20. A global food system map (Source: Global Food System Map 3. Source: ShiftN, 2009)

In a simplified way, food systems are described using a game structure (de Vries et al., 2022), see Figure 21. This has been further developed by the FOODPathS team and exploited in case studies (de Vries et al., 2024) because all stakeholders (and citizens) are familiar with the structure of a game. The game structure is based on 7 building blocks: players, playing field, pieces, moves, rules, time, and outcomes.



Modified from: https://doi.org/10.1016/j.tifs.2022.03.027

Figure 21. A simplified description of a food system in terms of 7 building blocks of a game structure (Source: https://doi.org/10.1016/j.tifs.2022.03.027 and https://doi.org/10.3389/fsufs.2024.1399275)

If such a game-based structure is impacted, e.g. by a certain rule, incentives, stress factor, etc. then the consequences evolve within the entire structure (see Figure 22). Hence, describing a food system with the structure of a game, allows some understanding of the dynamics of food systems upon external changes, (again, in a very simplified manner). A shortcoming of this game structure is that it doesn't describe the behavior of players (e.g. think about the way players act in a prisoner's dilemma case).

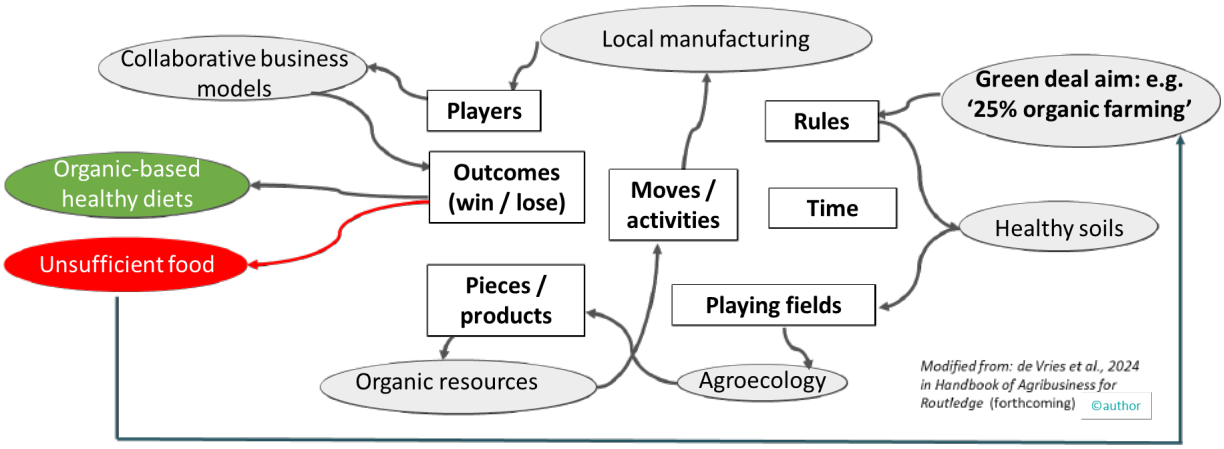


Figure 22. A food system based on a simplified and generic game structure; here, an example of the effect of an external objective on all seven game building blocks is given (retrieved from de Vries et al., 2025 forthcoming)

The schemes above represent all important elements of and interactions within food systems, both holistically and dynamically. However, these schemes did not explicitly reveal whether or not food system outcomes are sustainable or not. This poses the question of 'what is meant by sustainability?' and what are 'sustainable food systems?'.

iii. A graphical representation of sustainability

The definition of sustainability has been provided by the Brundtland report 'a Common Future' (WCED, 1987). Herein, sustainability is defined as: '*meeting the needs of the present* ***without compromising the ability of future generations to meet their own needs***'.

This definition is used by the High-Level Panel Experts of the FAO for the food domain, resulting in: '*Sustainable Food Systems refers to the long-term ability of food systems to provide food security and nutrition in a way that does not compromise the economic, social and environmental bases that generate food security and nutrition for future generations (HLPE, 2020).*

If one considers the definition of the WCED (1987), it may be best graphically presented as an endlessly evolving wave between boundary conditions, all with a lower and upper limit to avoid ending up in frozen states or deep chaos (de Vries et al., 2021), see Figure 23. This zone is often called a 'safe operating space' (Anderies et al., 2019). This is in contrast to current systems revealing endless growth patterns, deemed to end up in chaos (Prigogine and Stengers, 1985). Rapid action should be taken today to change the course of our food systems respecting planetary and societal limits (Rockström et al., 2009; Ostrom, 2009; Raworth, 2017; Chaudhary et al., 2018; Springmann et al., 2018) and reach balancing outcomes between these limits (de Vries et al., 2021).

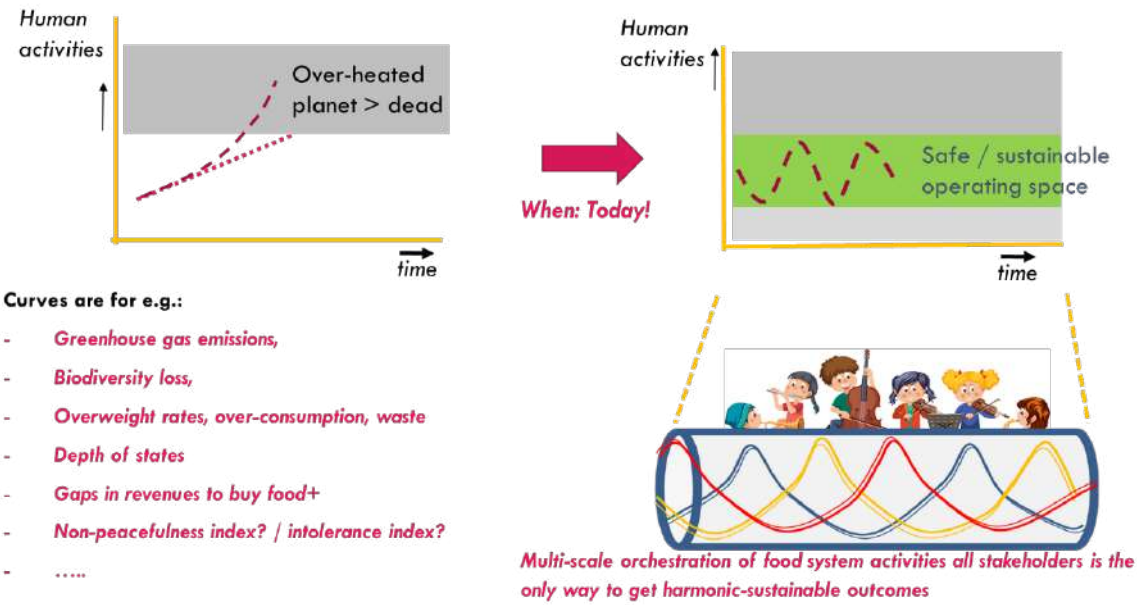


Figure 23. A transition is needed from unsustainable systems revealing endless growth curves for human activities to balancing curves between planetary and societal limits; the latter may be imagined as an orchestra in which (groups of) musicians play harmonically together (de Vries et al., 2021; & https://hal.inrae.fr/hal-04454434).

It should be underlined that multiscale orchestration is needed that allow harmonic outcomes of our global food systems, as well as all food sub-systems with their variety of actors. Multiscale orchestration is considered as a new, and primordial element in **food systems governance for sustainability**, where the fine-tuning of interactions between all actors resembles the four forces in physics (Donner et al., 2024). Therefore it has led to the following definition '*the continuous process of orchestration of policies and (multiple) food systems consisting of diverse interacting actors, respecting (in)formal rules and striving to provide food for all, in equitable and environmentally-friendly ways, at any time and in any context*'.

iv. A first-order connection between sustainability and RIPE

Now, we combine the graphical representation of sustainability with RIPE. This results in Figure 24.

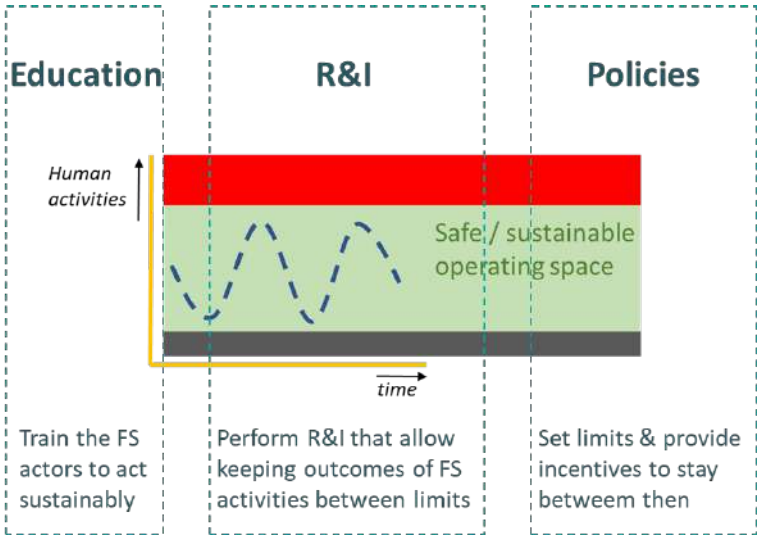


Figure 24. A connection between RIPE and Sustainably evolving food systems (Design: de Vries)

This figure is built on the following reasoning:

1. R&I should help actors to create solutions in such a way that their food systems endlessly balance between planetary and societal boundaries;
2. Policies should be developed such that FS respects these boundaries and gets impulses to evolve between them;
3. Education should train people to realize that balancing between boundaries is a necessity to guarantee that our future FS also provides food for their children.

What does this imply for RIPE themes?

(i) R&I: the focus areas 'change the way we eat, produce & process & supply, connect and govern' are well-chosen, but should lead to new solutions that dynamically keep us between the planetary and societal limits. Hence, they not only should be considered from a food systems lens but also from a complex sustainable (adaptive) system science perspective.

(ii) Policies: Here, the establishment of a new SFS framework is requested that guarantees that all, interacting, food systems respect the healthy planet conditions.

(iii) Education: the focus is on training people to play serious games and to optimally perform, but respect the game conditions. Hence, this asks for training in gaming, collective actions thanks to complimentary skills (as team players), complex systems, sustainability sciences, inter- and trans-disciplinary topics, cross-sector approaches (NEXUS thoughts), etc.

v. A conceptual framework for sustainable food systems for RIPE

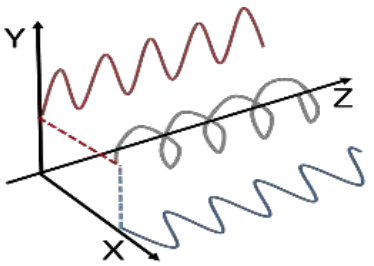
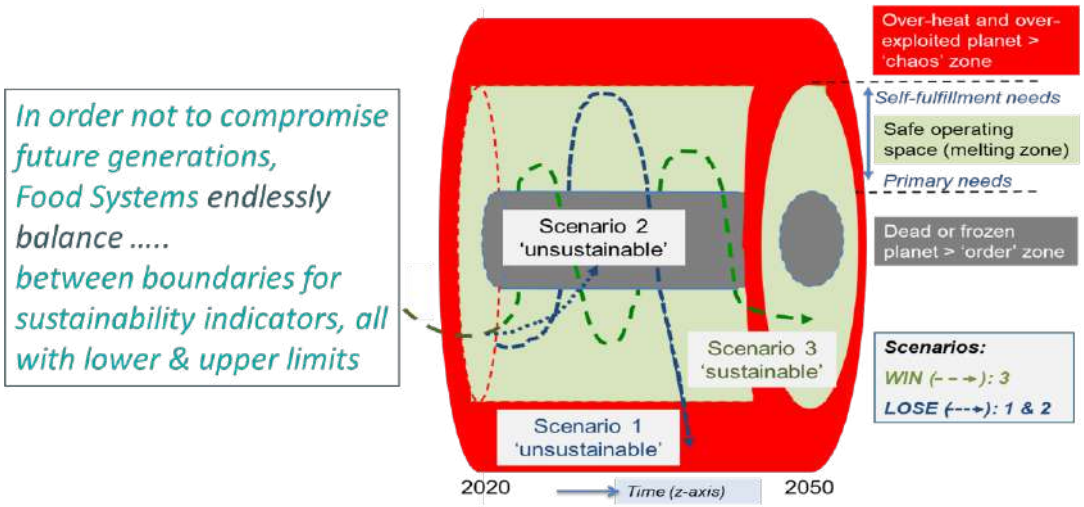
Before being able to use the schematic representation of sustainably evolving patterns, one needs to get insights in the complexity of food systems. The literature on complex system science is far too broad to discuss here in detail, and also not extensively elaborated for food systems. The first workshop in Paris, in May 2022, shed light on some topics like scales & scaling, modelling complexity, food systems and digitalization, agent-based modelling of consumer behaviour, diversity, adaptability, resilience, etc.

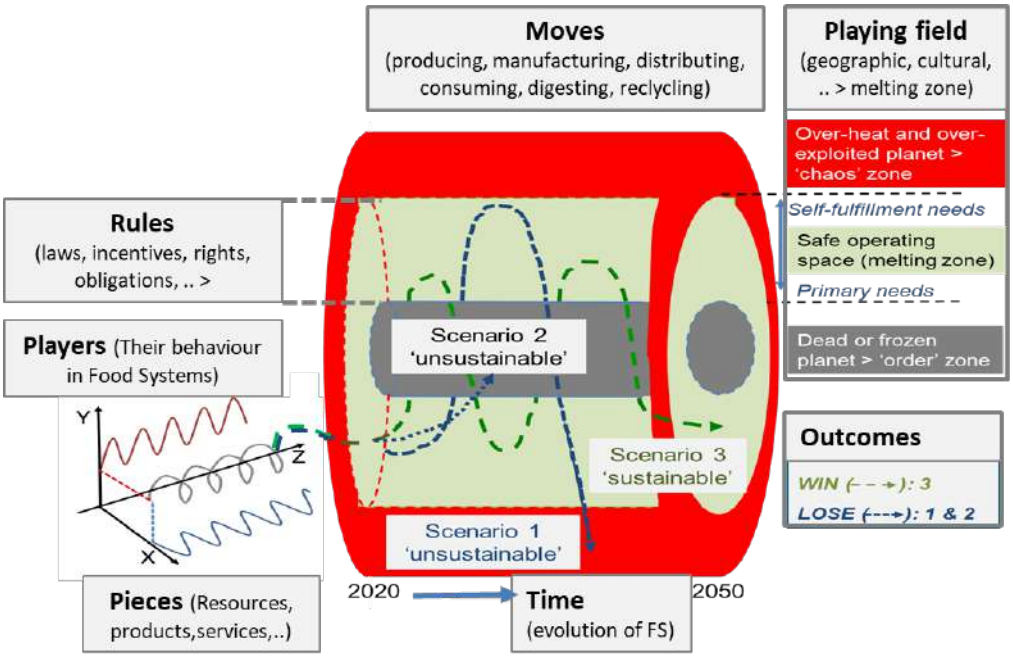
Here, we 'simplify' food systems that intend to behave sustainably as complex adaptive systems (Holland, 1992; Kauffman, 1995; de Vries, 2017; Chapman et al., 2017; de Vries et al., 2018, 2021 & 2022; Jackson et al., 2021 page 69). That means that they can be characterized by seven mean features (Carbonara et al., 2010). These are (i) heterogeneous agents, (ii) co-evolution, (iii) melting zone, (iv) self-organization & emerging properties, (v) non-linearity, (vi) scalability, and (vii) butterfly effects.

In complex food systems, heterogeneous agents (i) are the variety of FS actors. By interacting they co-evolve (ii) in food systems in such a way that they continuously can provide food. At least, this holds if they are operating endlessly in a safe operating space (Anderies et al., 2019) or melting zone (iii). This is only possible if they are capable of self-organizing their actions and jointly reach sustainably preferential emerging properties (iv). Since their interactions are numerous and not predictable in terms of outcomes, they form a non-linear system with numerous feedback loops often requiring digital approaches to understand them (v). However, their fields of operations should also be considered from a scales and scaling perspective (vi) to reach an overall globally sustainable food system (there is only ONE Planet). Still, all systems remain subjected to butterfly effects (vii) that they need to withstand to endlessly provide food for future generations; hence, insights in butterfly effects are primordial.

Referring back to our game structure, how can we construct a conceptual framework for sustainably evolving food systems that is also of use for RIPE?

Therefore, we follow the following reasoning:

Step 1	**What is the generic description of sustainably evolving systems?** The outcomes of human activities in Sustainable Food Systems follow balancing – sinusoidal-like – patterns between lower and upper limits for each sustainability indicator (see Figures 23 & 24).
Step 2	**What do sustainable outcomes ask for in a <u>single</u> food system?** 1. An endless provision of resources (sinus) 2. A continuous, balanced, utilization of resources by food system actors (sinus) Since, these 2 points concern two different dimensions, one may ask what the sum is of two sinusoidal curves in two different dimensions. Here, mathematics may help us as visually presented (Figure 25).  *Figure 25 Two sinusoidal curves form a Helix* (Modified image of https://www.radartutorial.eu/06.antennas/pic/zirkulanim.gif); another source: de Vries et al., 2021). As elaborated in de Vries, Donner & Axelos (2021), it is not surprising that helical patterns are 'omnipresent' in nature. Points 1. & 2. request the understanding of interactions between the behaviour of FS actors & usage of resources.
Step 3	**What do sustainable outcomes ask for in <u>multiple</u>, interacting, food systems?** 1. Please think about a large orchestra with groups of musicians 2. If one (group of) musician(s) plays out-of-tune, the output of the full orchestra is enharmonic. 3. The same holds for food systems (FS): if a single FS 'plays' out-of-tune ('unsustainable'), the global FS *may be* 'unsustainable'. 4. *If all play harmonic, the overall outcome <u>can be harmonic</u>, i.e. multiple helices can form a helicoid. However, this requires the intervention of an orchestrator (a single person or group of stakeholder representatives in inclusive partnerships; Donner et al., 2024; see also Figure 23)* *Note: scientifically, point 4 is elucidated by Serna et al., 2019 in fluid dynamics. Three helical-evolving particle streams in a cylinder form a helicoid structure.*
Step 4	**What does this imply for visualizing sustainably evolving food systems?** Then, one needs to transform the 2-dimensional sinusoidal patterns into 3-dimensional ones (Figure 26):  Figure 26. Sustainable (1 scenario) or unsustainable (2 scenarios) evolving food systems (Modified from: de Vries, Donner, Axelos 2021: https://doi.org/10.1007/s10806-021-09850-7)

Step 5	**Could the concept of (un)sustainably evolving food systems be related to the game structure representation of food systems?** This is done in Figure 27. Herein, the rules define the boundaries. The moves are the activities in the playing fields – which are either safe operating spaces (green) or spaces beyond the limits (grey or red) – The behavior of actors and the utilization of resources result in the dotted lines. The time reveals the dynamics of food systems, and the outcomes are either 'win' (sustainable) or 'lose' (unsustainable).  Figure 27. The concept of sustainably evolving food systems using seven building blocks describing a single food system concerning their sustainable or unsustainably outcomes (Modified from: de Vries, Donner, Axelos 2021: https://doi.org/10.1007/s10806-021-09850-7)
Step 6	How does the RIPE concept relate to this conceptual framework of (un)sustainably evolving food systems? **Research** provides insights into the structure, properties, functionalities, and evolutions, of all interacting elements of food systems. Hence Research touches upon all the game's building blocks shown in the figure above. **Innovation** reveals the potential to reach concrete and meaningful results either from a product, technological, organizational, or social perspective. Hence innovation touches also upon all building blocks. **Policies** address playing fields, rules, and behavior of players (e.g. power balances) that are setting the scene for food system actions. **Education** targets players and their capacity to act. All four pillars are possible to include in the concept of sustainably evolving food systems (Figure 28).

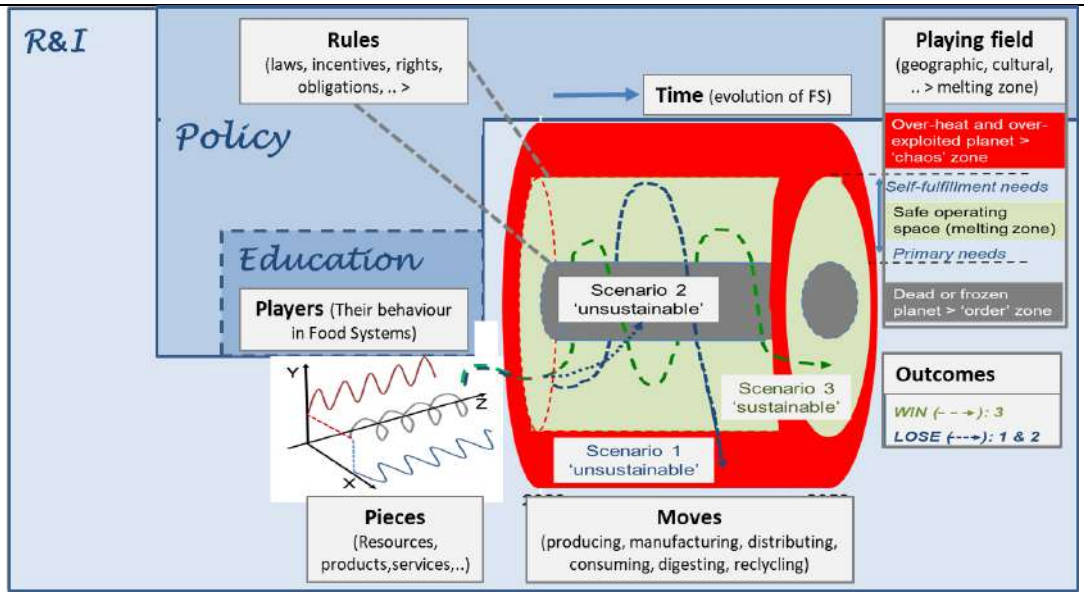


Figure 28. Using the concept of sustainably evolving food systems, one remarks that R&I tough upon all building blocks of food systems, Policy at rules, playing fields and players, and Education at Players. (Modified from: de Vries, Donner, Axelos 2021: https://doi.org/10.1007/s10806-021-09850-7)

Step 7	All transversal activities like Knowledge Hub of Food System Labs, Branded Network of Universities, and Observatory allow addressing all building blocks of food systems evolving sustainably, hence all four pillars of RIPE. It is recommended to test this and elaborate further in the last year of FOODPathS and beyond.

10. Target audience

The target audience is the FOODPathS Consortium, the Advisory Board members, the FutureFoodS team, the SCAR Strategic Working Group on Food Systems (SCAR SWG FS), actors involved in other Partnerships or large collaborative clusters, as well as all other invited experts like the participants in the Budapest meeting.

11. Timeline

The start of thinking about the RIPE concept by FOODPathS partners already started in mid-2021 while preparing the proposal for the FOODPathS project. Then, the RIPE pillars have been drafted, as well as their interactions. These have been elaborated in the course of the FOODPathS project.

The content of the R&I pillars had been defined in the SRIA of the Partnership on Sustainable Food Systems (P-SFS; see SCAR, 2023). Some steps are presented in Table 5 below:

Date	Topic	Who involved	Reference
2021	Elaboration of the FOODPathS proposal with the RIPE concept for a work package	All FOODPathS partners	
Mid-2022	Complex Food System Science Workshop	INRAE and several universities	INRAE Paris meeting;
Jan 2023	Finalization and publishing of the SRIA of the P-SFS, with the four R&I areas	INRAE, AU, FDE, FZJ,..	https://scar-europe.org/images/FOOD/Main_actions/SFS_Partnership_SRIA_31012023.pdf
June 2022 – Jan 2025	Since the kick-off of FOODPathS work on WP6 focused on the SRIA, science to Policy, WP5 on Education and University Network, WP4 on Knowledge Hub, and WP2 on Observatory	WP5 & WP6 teams with support of WP4 and WP2 teams	Deliverable D5.1; Deliverable D6.1; Deliverable D5.2; Deliverable D2.2, D2.4; Deliverable D4.1 and D4.2; Annual meeting 2024, with a world café discussing pillars of RIPE.
Oct-Dec 2024	Preparation and execution of workshop on RIPE concept, and preparation of RIPE cases	All partners; ICLEI, Cariplo, INRAE	Budapest workshop, 4/12/2024; Annex I Elaborated cases (chapter 8)
Jun 2022 – Jan 2025	Literature review of complex food system science themes and food system education programs	INRAE	See chapters 9 and 15

Table 5. Timeline of activities within this Deliverable

12. Next steps

All further input on the Deliverable – and implications of the RIPE conceptual framework – will be included in the Final Deliverable D2.7 of the FOODPathS project called the 'Manual of the Prototype Partnership, final version' and in the Deliverable D2.8 summarizing the overall recommendations of the FOODPathS project as guidelines for future Partnerships.

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ANNEX I International FOODPathS workshop on RIPE, Budapest, 4/12/2024

Workshop 3: The Knowledge Hub of Food System Labs unites R&I, science-to-Policy and Education (RIPE) (13.30-15.30)

The recently launched virtual Knowledge Hub of Food System Labs presents numerous examples of food system cases across Europe. These cases represent various orientations, including research-, innovation-, policy-, education-, entrepreneurship-, observatory- and networks. Some cases also highlight multiple orientations, reflecting the complexity of food systems. In this session, participants will work in groups to explore whether these different orientations are converging or diverging in terms of the topics they address. The goal is to generate a set of recommendations that will guide the further development of the RIPE and strengthen the Knowledge Hub. This collaborative effort will help identify synergies, gaps, and potential new cases that can be included to ensure the Hub remains a valuable resource for driving sustainable food systems forward.

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