FOODLEVERS

Summary of Results

Research Project on “Leverage Points for Organic and Sustainable Food Systems”

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Project Summary

Food systems continue to move on unsustainable trajectories. This can be explained by many sustainability interventions focus on obvious, but less powerful, leverage points rather than addressing the root causes. Instead, FOODLEVERS aim was to identify key leverage points that go far beyond the common practice of treating symptoms and thus, show high potential to further develop and scale up existing organic and sustainable food systems. It was based on the framework of Abson et al. (2017) who proposed three realms of "deep leverage" to address in sustainability transition: firstly, reconnecting people to nature, secondly, restructuring institutions, and thirdly, rethinking how knowledge is created and used. Therefore, the project was structured in three parts: (i) the system definition of several case studies representing innovative organic and sustainable food systems, (ii) their holistic sustainability assessment, and (iii) the development of scenarios.

Within the system definition, seven European case studies were selected, covering innovations in products, production techniques, marketing and governance, and contextualized by characterizing their respective counterparts describing "mainstream" organic food systems.

The sustainability assessment of these case studies has revealed where there is leverage potential for systematic change in food systems by focusing on the farm, the product, the value chain and consumption. On farm level, the case studies performance with regard to ecosystem services provision is particularly strong in "farm business resilience" and "social capital". However, in areas such as "energy and carbon" and "water management" could be improved. The life cycle assessment indicates that products from innovative farms – with the exception of beef - have a lower climate impact per kilogram than those from reference farms. Moreover, generally innovative farms occupy more agricultural land but use less fossil fuel per kilogram of product. Interventions in innovative agri-food value chains mostly address structures, mainly distribution and consumption. While knowledge tends to be particularly relevant for the production of food, mindful connections between people and nature are promoted in production as well as distribution and consumption. The most common leverage points with regard to consumers' behavior in food system transformation are: price equality, income and produce availability. Perceived barriers to increase organic consumption concerned higher price and low personal income, lack of variety and stores unavailability.

The scenario development investigated key levers towards sustainability transition under different conditions. In stakeholders' decision-making processes, a commonly perceived goal is the farmers' quality of life, including, but not limited to, their income and economic stability. The improved resistance and resilience of biodiversity-oriented organic farming could be seen as a lever. The agent-based model identified the main parameters for scaling out innovative organic food systems: the trend of innovative and organic food, opportunity window threshold, economic orientation, number of available public institutions, distance to consumers, subsidies, and farm links probability. Finally, as an outlook, qualitative scenarios describe variants for the future design of food systems regarding biodiversity, climate, consumption, innovation and food production as a means to revitalize rural areas.

General facts on FOODLEVERS

FOODLEVERS in 5 facts

- FOODLEVERS is a three-year **research project** (2020 - 2023) funded under the **SUSFOOD2** and **CORE Organic** Co-fund.
- FOODLEVERS unites **transnational** research centres and universities from **7 European countries**: Italy, Germany, Romania, United Kingdom, Finland, Poland, Belgium. (Figure 1)
- FOODLEVERS is the acronym for "**Leverage points** for organic and sustainable **food systems**".
- FOODLEVERS analyses **case studies** of **innovative organic** and **sustainable food systems** throughout Europe and identifies **best practice** processes.
- FOODLEVERS aims to **identify** the **leverage potential** of different food systems to **improve the performance** of food production systems and **accelerate sustainability transitions**.

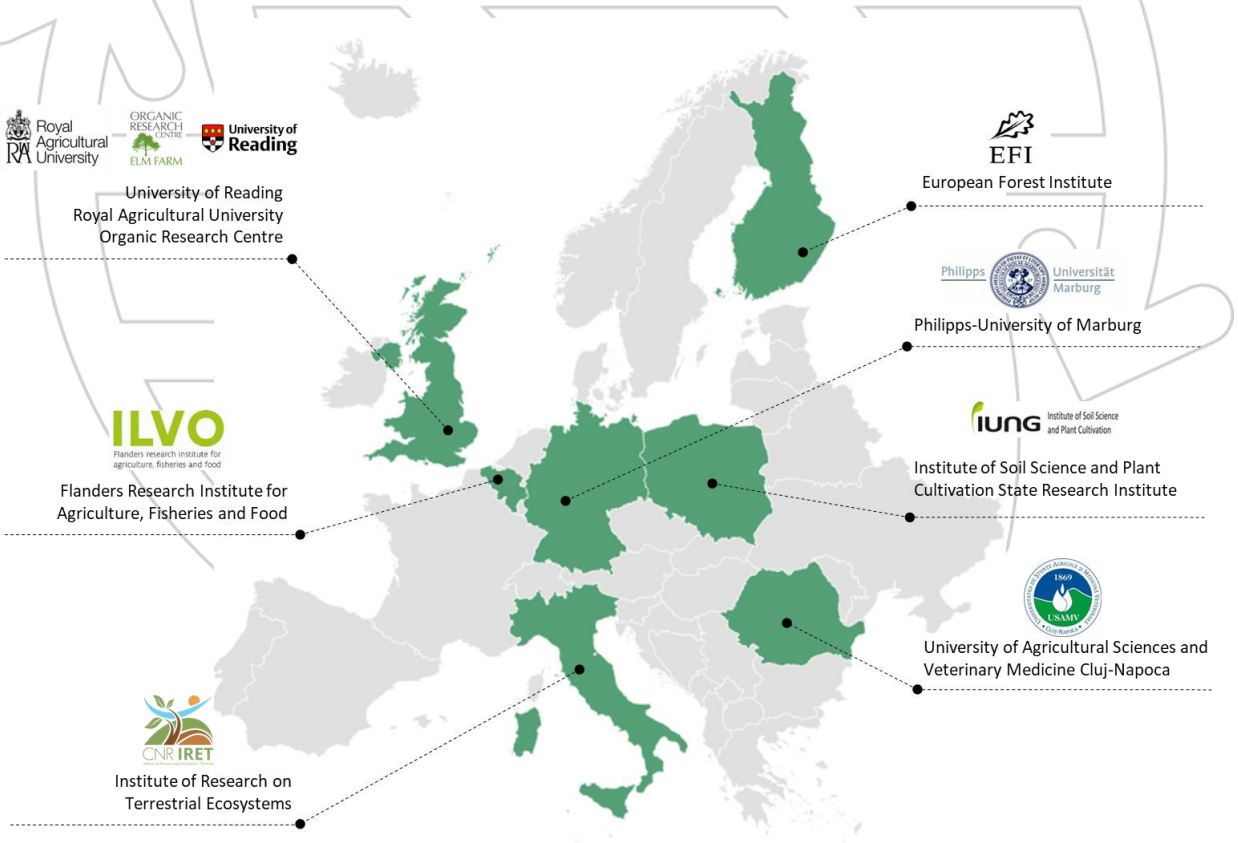

Figure 1. Project Consortium of FOODLEVERS.

WHY – Motivation

Despite numerous innovations, food systems are still on development paths that **often fail to achieve sustainability**. This can be explained by the fact that many sustainability measures only target obvious, but **less effective** interventions, **instead of** addressing the **root causes** of the unsustainability.

To address the urgent need for a paradigm shift in food systems, FOODLEVERS focuses on identifying those **levers** in food production systems that go beyond the common practice of treating symptoms and thus promise a much **higher potential for a sustainability transition** in food systems.

WHAT – Aim

The aim of FOODLEVERS is to identify **"deep" leverage points** for the further development and upscaling of organic and sustainable food systems in order to promote greater resource efficiency, highlight inefficiencies and specify the reasons for the decision-making processes that have led to the configuration of food systems.

The focus of the research is on three pillars and their leverage potential for a reorientation of food systems:

1. The production and use of **knowledge** ("re-think");
2. a stronger connection between **people** and **nature** (between actors in the value chain, including consumers, retailers, producers and processors) ("re-connect");
3. **institutional** changes for efficient sustainability promotion ("re-structure").

The investigation of these three areas will shed light on how, where and why opportunities for systematic change in food systems arise and where interventions have an impact.

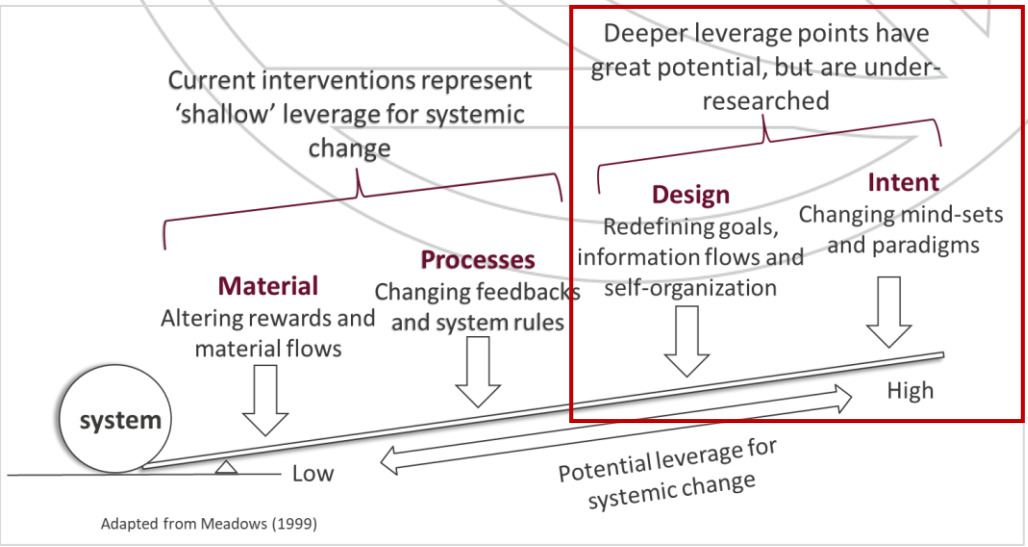

Figure 2. Conceptual background, the focus on deep leverage points is highlighted in red (Abson et al. 2017).

HOW - Structure

FOODLEVERS was structured in three research-based parts: (i) the system definition of several case studies representing innovative organic and sustainable food systems, (ii) their holistic sustainability assessment, and (iii) the development of scenarios.

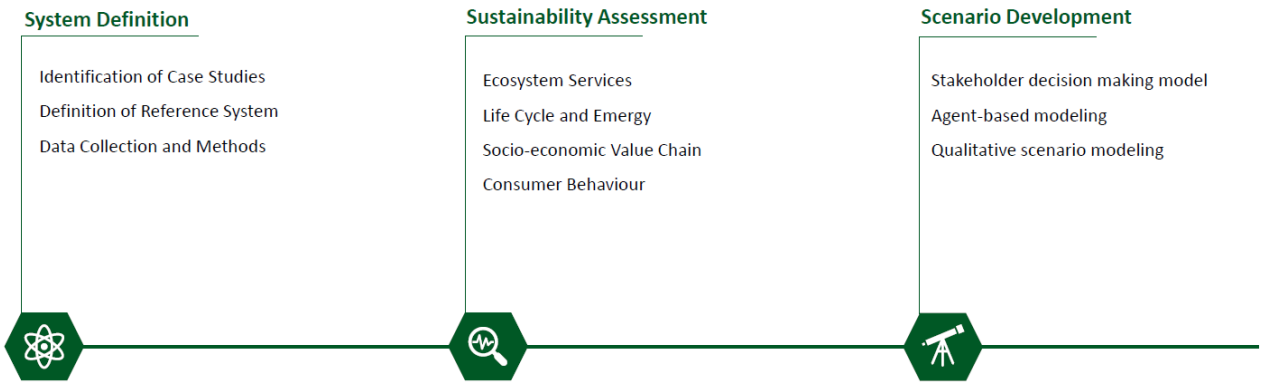

Figure 3. Three-part structure of FOODLEVERS' research.

1) System Definition

First, we defined the system theoretically and methodologically. It served as a starting point and reference framework for the project: for data collection, the subsequent assessment of sustainability and the development of scenarios.

a) Identification of Innovative Case Studies

Key to achieve the project's aim was the in-depth analysis of innovations in European food production systems. To do so, the project's initial activities comprised the careful selection of innovative organic and sustainable food systems in seven European countries covering the four OECD innovation areas in different ways: products, production techniques, marketing, organisation and governance.

Through an outranking process, eight national case studies representing innovative sustainable and organic food systems were carefully selected. They are summarized in Table 1.

Description of European case studies

Finland

Forest farming in Finland includes a shiitake mushroom farm cultivating organic edible mushrooms in forests. The case study covers the more efficient use of forestry side products, such as small diameter trees, to grow food.

Italy

Fattoria Cupidi is an organic farm (UAA 15 ha) managing silvopastoral systems where walnut plantations and olive orchards are grazed by laying hens. The farm is included in an agreement on the sustainable management of local resources, based on organic principles and practices, aiming at the fulfilment of the economic and sociocultural resources of the territory. The farm promotes educational programmes addressed to people interested in live rural farms, students, organised groups and disadvantaged people. The farm has strong and constructive relationships with different organisations and public institutions, and it has stable partnerships and networks with local services, consumers, young people and other stakeholders.

Germany

Die Kooperative is a community supported agriculture that is led as a cooperative. By cooperating with a large network of organic producers, it connects urban consumers with regional food production. Additionally, it manages a city farm in Frankfurt am Main which, in addition to production, serves as a space for community action and consumers' contact with growing food.

Poland

The Polish case study represents a network of 28 local farms built to penetrate the market and get a "grass-fed" standard for beef. Furthermore, the initiative aims to improve short value chains and create joint shops for community farmers. Besides beef, the community produces fruits, vegetables and wood.

Romania

Ferma Ecologica Topa is a biodynamic farm cooperating with a large network of regional organic farms. It is characterized by consumer-driven decision making, innovative method of distribution, volunteer program, on site learning for local school children.

Belgium

Het Polderveld Community-Shared-Agriculture is providing organic meals for a local hospital. The agroforestry plot within the farm also serves as a 'healing garden' for patients. The production technique is organic. CSA Principle: At the beginning of the season, the cultivation plan is made in consultation with the hospital. The hospital kitchen prepares about 1200 meals a day. With a number of vegetables such as pumpkin, celeriac and courgette, Het Polderveld can meet almost the entire annual requirement. The CSA principle is used both for private customers (self-harvesting) and for the local hospital.

The second Belgian case study is a converted Flemish traditional mixed family farm, prioritizing circularity and self-sufficiency. With 3 hectares dedicated to vegetables and potatoes, the farm's primary income source, they also raise beef cattle and maintain laying hens. Direct sales to consumers occur through diverse channels, including their farm shop; subscription-based food packages delivered to pick-up points; and an online shop. The farm, committed to consumer engagement through in-person and online communication, also functions as a care farm, providing employment for those with autism, and contributes to social initiatives through vegetable and potato donations.

	**United Kingdom** The Stroud CSA is a biodynamic mixed farm and a community supported agriculture with over 350 members produces vegetables, beef, pork, poultry meat, eggs and dairy products. With its CSA structure it provides an innovative governance structure for restructuring local distribution channels.

Table 1. Selected European case studies of innovative organic and sustainable food systems.

b) Definition of a Reference System

To contextualize the specific characteristics of FOODLEVERS innovative case studies, we described reference systems characterizing "mainstream" organic food systems that serve as comparable counterparts. Drawing on data and literature review, the state of the art was demonstrated with regard to trends of organic farming in the FOODLEVERS' participating countries, the sustainability of organic food production and analyses of organic food systems at farm level and by farm type.

The results can be found in our Report on Reference Farming Systems.

c) Defining Data collection and Methods

The endeavour of defining data collection and methods had a supportive role. It coordinated data needs and data collection for the entire project. Many tasks included meetings with food chain stakeholders to collect either qualitative data and/or quantitative data. For doing so in a consistent way, while putting as little burden as possible on the actors involved, a project-wide protocol was developed.

It can be found in our Data Collection Protocols.

2) Holistic sustainability assessment

An essential part of FOODLEVERS was to holistically assess the sustainability of innovative food systems. Since sustainability in agriculture is complex, comprising different, often interlinked dimensions, we developed and implemented a multi-criterion approach able to adequately cover system-level characteristics. Hence, in addition to scientific results, our endeavor within WP2 also contributed to the development and fine-tuning of methods and tools capable of capturing and evaluating the specific nature of sustainable and organic food systems. According to our multi-criterion approach, the seven FOODLEVERS food systems have been analyzed under different perspectives: (i) ecosystem service provision, (ii) life cycle and emergy assessment, (iii) value chain analysis, and (iv) consumer behavior.

a) Ecosystem Service Assessment

For the ecosystem service assessment we analysed eight European innovative organic food systems using an existing tool named the Public Goods Tool to assess sustainability across environmental, economic, social, and governance dimensions. Before the evaluation, the tool was adapted using a participatory approach including literature review by the research team and an indicator survey across all case studies. The results indicate that all innovative organic case study farms performed well across all dimensions of sustainability (Figure. However, the results indicate that in areas such as “energy and carbon” and “water management” some improvements could be considered. The case study farms performed particularly strong in “farm business resilience” and “social capital” which could be highlighted as key leverage points.

For detailed results read our full Report on Ecosystem Service Assessment.

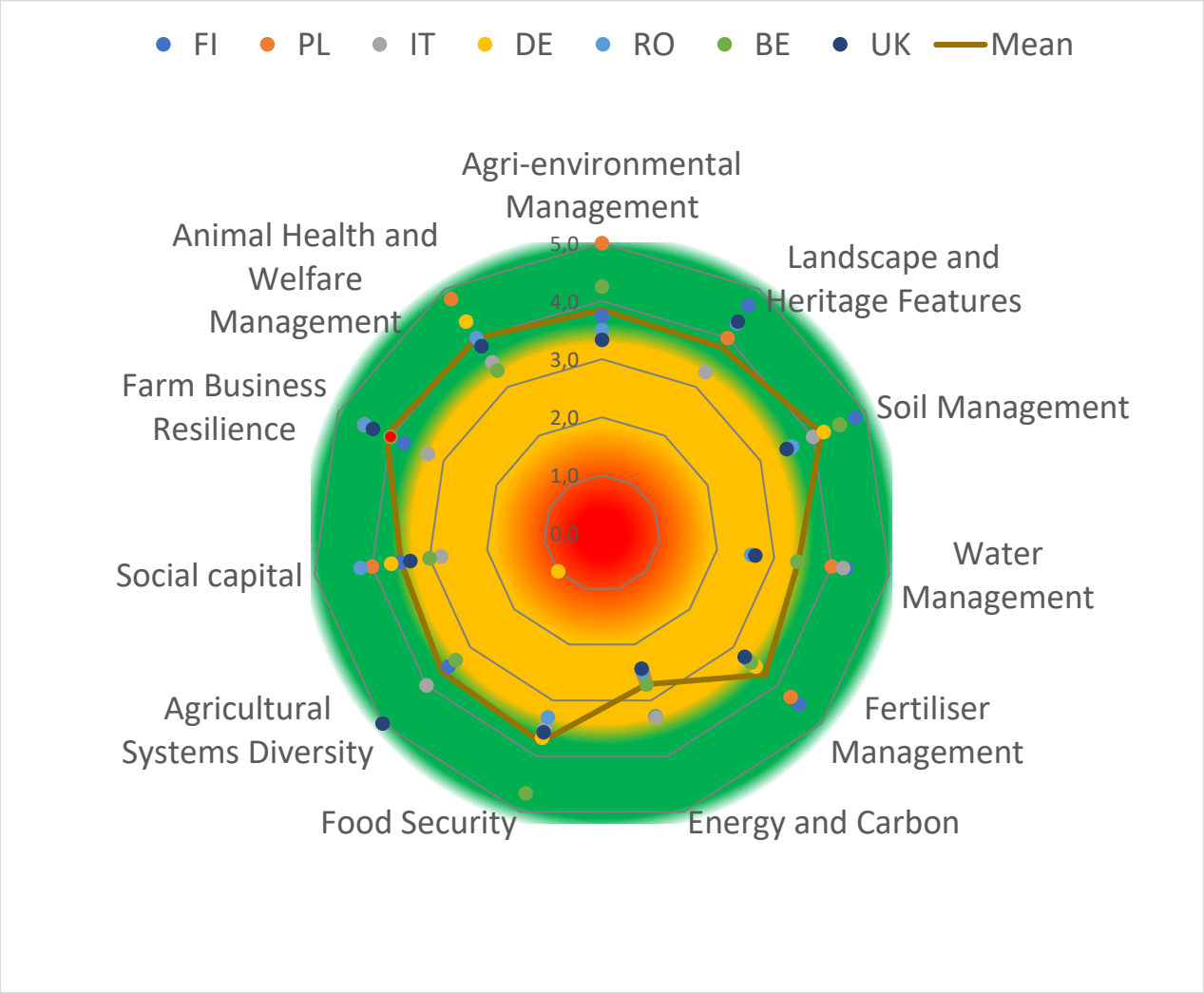

Figure 4. Performance of FOODLEVERS innovative Case study farms in different dimensions of sustainability.

b) Life Cycle and Emergy Assessment

The aim of this study was to compare the environmental impact of products from innovative organic farming systems with those from conventional organic production systems. It needs to be highlighted that FOODLEVERS' life cycle and emergy assessment is probably the first attempt to compare innovative organic farms with mainstream organic systems. The results of our research indicate that the farm phase is usually the most significant for most of the main LCA impact categories. Products such as vegetables, shiitake mushrooms and eggs from innovative farms had a lower climate impact per kilogram than those from reference farms. However, beef production on innovative farms had higher GHG emissions mainly due to lower productivity. In addition, generally innovative farms occupy more agricultural land but use less fossil fuel per kilogram of product. Additional indicators adopted (beyond the 'classical' LCA impact categories): Social LCA, biodiversity, animal welfare and nutrition indices generally indicate an acceptable level of achievement, but it should be noted that they require further development and standardization.

All relevant results can be found in the Report on the Life Cyle and Emergy Assessment.

Product	Functional Unit	System boundary	Case study system	Comparative system	Country
Milk (fresh)	1 kg	cradle to grave	biodynamic mixed farm	organic milk system	Romania
Eggs (fresh)	1 kg	cradle to grave	silvopastoral farm	organic egg system	Italy
Courgette (fresh)	1 kg	cradle to grave	organic mixed farm	organic vegetables farm	Belgium
Brussels sprouts (fresh on stalk)	1 kg	cradle to grave	biodynamic horticulture	organic vegetables farm	Germany
Beef (bone free)	1 kg	cradle to grave	organic beef farm	organic beef system	Poland
Shiitake mushrooms (fresh)	1 kg	cradle to grave	outdoor shiitake cultivation in forests	indoor shiitake cultivation	Finland
Beef (bone free)	1 kg	cradle to grave	biodynamic mixed farm	typical lowland livestock farm (organic)	UK

Table 2. Products and Scope of FOODLEVERS Life Cycle and Emergy Assessment.

c) Socio-economic Value Chain Analysis

The qualitative value chain analysis provides in-depth insights in the design of innovative agri-food value chains in Europe and uncovers where in these value chains interventions to leverage transformative system change are applied. Overall, the value chains show by far the most interventions in the realm of *re-structure*, while the human-nature nexus is just as important as knowledge. Most interventions to adapt and change system structures are made downstream, targeting distribution and consumption. However, several structural interventions also target the way of how food is produced. Mindful connections between people and natural processes are promoted in production as well as distribution and consumption, but tend to be less important in the upstream value chain (production inputs). This is mainly because all innovative food systems focus on short supply chains with the aim to reinitiate a direct and personal tie between consumption and organic production. The way how knowledge is produced, used and shared tends to be particularly relevant for the production stage of food. In the upstream value chain, several structural changes are made with regard to production input, while knowledge plays a lesser role and the human-nature nexus plays no role at all. The fewest leverage points were found in the stage of processing because most of the case studies sell fresh, unprocessed goods. As the majority of the value chains are producer-driven the results seem to be most relevant for organic farmers. However, the user group might extend to all kinds of actors along the value chain as well as for other stakeholders (e.g. policy) who want to incentivize sustainable food systems.

All results can be found in the Report on the Value Chain Assessment.

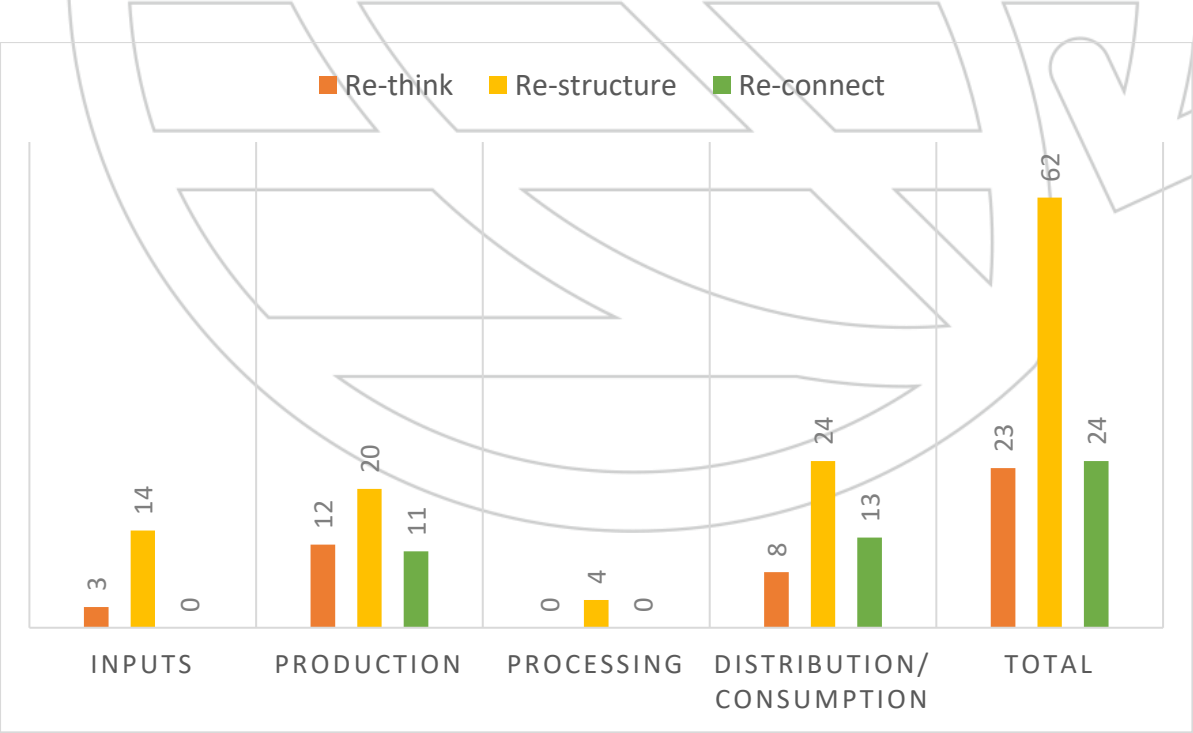

Figure 5: Deep leverage points in innovative agri-food value chains by frequency (results based on value chain analysis of seven innovative case studies in Europe).

d) Consumer Behaviour Assessment

Here, we investigated the role of consumers in transforming food systems based on the Theory of Planned Behavior (TPB). According to TPB we assessed cognitive factors affecting consumers' behavior concerning innovation in organic farming and the related distribution chain(s). Consumers act as pivotal agents towards the transformation of food systems: an extensive web-based consumers survey has been conducted in all the participating countries, each partner contributing the local language translation of the survey items.

The focal point of the TPB survey is the consumers' behavior associated with organic food shopping. Data collection resulted in a total of 1186 responses from Belgium (310), Finland (86), Germany (286), Italy (201), Poland (206), Romania (67) and UK (34). The questions spread various aspects of the organic food consumption like production, marketing, transport and customer behavior like intention, attitude and beliefs. Generally speaking, there are more female than male respondents in all countries, from nearly 50% (Belgium, Romania, UK) to more than 70% (Germany and Poland). Less than 1% is non-binary and less than 1% did not declare a gender. Other census-related parameters regarding age, family, housing, education and employment status. The main results involve shopping behavior (where, when and how), organic food perception (what) and consumer's self-perception as an organic food buyer. A finer subdivision in vegetables, meat, eggs, etc. Following the principles of TPB, Consumers were also asked about their attitude about a potential increase in organic consumption and their sensitivity to food price and peers behavior. The perception of market shocks influence, as the Covid19 pandemics, was also taken into account in terms of economic resources availability in a wide range of utilities and commodities other than food.

Coming to leverage points, the TPB highlighted the most common perceived barriers against an increase of organic consumption: higher price and low personal income, not surprisingly, lead the share, followed by lack of variety and stores unavailability. Lower scores are related to insufficient quality, taste and variety, and to plastic packaging. On the other hand, the leveraging factors are identified as price equality, higher income and wider organic products availability: an obvious lever to increase organic consumption would be the reduction of the gap between organic and conventional food prices to attract more consumers. It also emerged a general concern about the lack of trust / fear of fraud in organic production. Different statistical hypotheses have been tested, finding highly significant statistics ($p<0.001$) for: 1) Attitude has a positive effect on the organic buying intention; 2) Subjective norms have a positive effect on the organic buying intention; 3) Perceived behavioral control has a positive effect on the organic buying behavior.

All the relevant figures can be found in the Report on Consumer Behaviour.

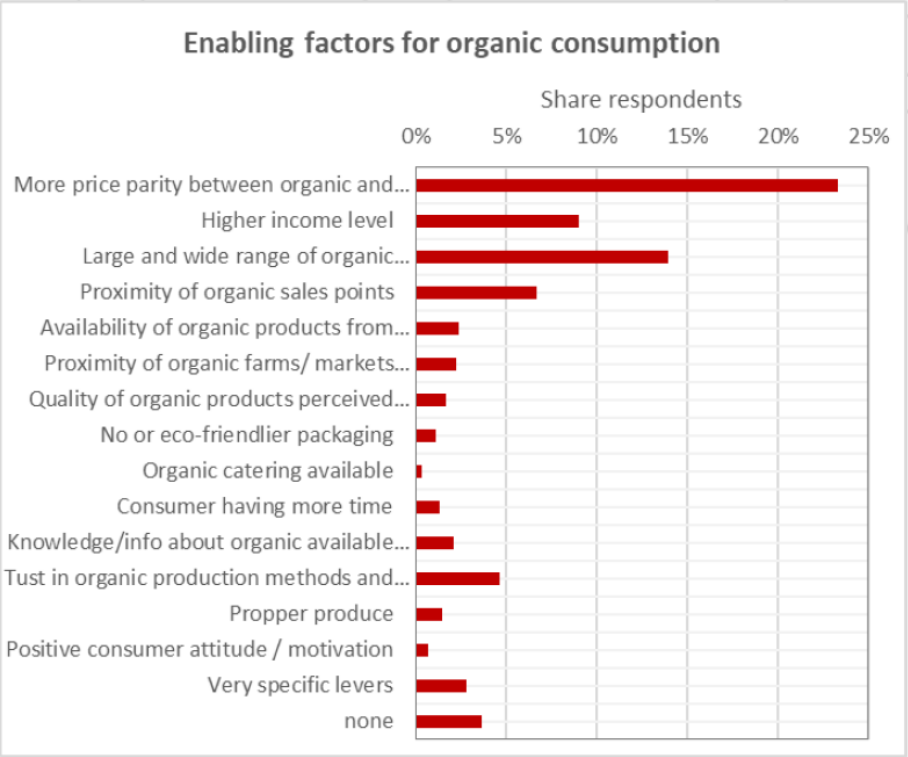

Figure 6: Enabling factors for organic consumption as stated by all respondents to the survey.

3) Holistic Scenario Development

FOODLEVERS developed holistic scenarios in the identification of leverage points for sustainable food system transformation. It investigated key levers towards sustainability transition under different conditions, strongly considering how stakeholders perceive the system and behave within changing system dynamics. It included the development of (i) a stakeholder decision-making model based on the knowledge and perceptions of relevant food system actors, (ii) an agent-based model to investigate the effects of behavioral changes on system structures, and (iii) qualitative scenarios defining future corridors for sustainable food systems.

a) Stakeholder decision-making Model

The Stakeholder Decision Making Model (T3.1) has been investigated by means of Fuzzy Cognitive Mapping techniques (FCM). The Stakeholder Decision Making Model plays a central role in the holistic organic farming scenarios investigated in WP3. The FCM is a semi-quantitative technique that bridges the gap between physical variables and perceived values assessment. All the project partners conducted FCM workshops in their respective countries. In each workshop the participants were encouraged to: 1) pick the variables/concepts that describe the system; 2) define the connections among said variables in terms of a network of causal links; 3) discuss the role of driving forces (e.g. climate change) in terms of links among variables. One or more facilitators helped the stakeholders staying focused on the variables' relationships. Optionally, 4) a synthetic fuzzy map has been produced for some partners, depending on the number of stakeholders and the complexity of the resulting map(s). The workshop participants were divided in homogeneous

groups composed by farmers, researchers, advisors and policy makers. The aim of this study, together with agent-based and qualitative scenario modelling, is meant to establish the stakeholders' perception of the diverse aspects of organic farming and the relative value chains.

All results can be found in the Report on the Stakeholder decision-making Model.

b) Agent-based Modeling

A generic agent-based model (ABM) was developed that is able to represent 3 different innovative mechanisms in organic systems i.e., CSA, farm network, and circularity. Complementary to other tasks within FOODLEVERS project, this ABM can recognize and include the leverage points from varied contexts that would help to scale out innovative organic initiatives. Main analyses were performed for the showcase of Flanders, but also for Italy and Poland. A sensitivity analysis was performed for the main parameters in the model that could promote a scale out of more innovative and organic farms. Those parameters were the trend for innovative and organic food, the opportunity window threshold, the economic orientation, the distance to consumers, the farms links probability to build up a farm network, the number of available group consumers or public institutions, the subsidies for scaling out, and the time when the subsidies are applied. Identified leverage points to scale out innovative organic food systems are a strong innovative consumption trend for this kind of production while the opportunity window threshold is low, and engaging more public institutions (i.e., group consumers) in such collaborations. The scenario analysis in the case study of Flanders showed that a rural renaissance as well as a consumption scenario could result in enhanced scaling out of innovative organic farms, although limited in the territory and in the whole agricultural sector.

All results can be found in the Report on Agent-Based Modeling.

c) Qualitative Scenario Modeling

The qualitative scenario modeling can be viewed as an outlook of FOODLEVERS. It was carried out as participatory workshops with external experts (from agriculture, nutrition, sustainability) and stakeholders from the innovative case studies. The scenario workshop focuses on the field of deep sustainability levers in order to project the effects of these levers for the future. The intention behind it was to formulate variants of future developments based on qualitative expert opinions and scenario-based assumptions. To account for the diverse contexts and realities in our project countries, the workshops were held in the respective national/regional setting. In participatory workshops, variants for the future development of food systems were designed on the basis of expert opinions and scenario-based assumptions. The scenarios formulate future pathways to go until 2050 with regard to biodiversity, climate, consumption, boosting production through innovation and food production as a means of revitalizing rural areas. The scenarios define boundaries of development to highlight routes for the future-oriented design of food systems and therefore serve as an orientation for future policy towards sustainable food system.

All results can be found in the Report on the Qualitative Scenario Modeling.