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D1.1 Literature Review

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Abstract
The literature review provided in this document constitutes the theoretical framework for the LAB4SUPPLY project. The review firstly discusses the definition and explores the experiences of agri-food Multi Stakeholder Platforms in the literature and secondly presents the Living Lab as a methodology for stakeholder engagement and collaboration.

Keywords
Multi Stakeholder Platform, Innovation Platform, Agri-food supply chain, Living Lab

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Contents

Executive Summary

This report aims to provide a theoretical and methodological corpus for the **LAB4SUPPLY** project. In this regard, we carry out a deep literature review of existing cases of study dealing with the creation of stakeholder platforms. This theoretical approach should serve to facilitate collaboration between stakeholders in the discussion and co-creation of agri-food value chain innovative solutions. Thus, this review is focused on the different forms of stakeholder collaboration and the related methodologies, as well as the factors that determine their success and their limitations. The results should become a guideline for the development of LAB4SUPPLY.

This review is divided into two chapters, each analysing a key driver of stakeholder collaboration. First, we conduct a literature review on **Multi Stakeholder Platforms**, where we discuss its definition and analyse the reported outcomes and limitations reported by the literature. The review also includes the methodologies in which the authors have approached the case studies, as well as useful guidelines for the design and management of a platform. In this sense, we identify the key elements that can lead to its success, such as the mapping of stakeholders, their willingness to participate and their potential role to be played.

In the second chapter, we explore the use of the **Living Lab** as a methodology for engaging stakeholders in research and development projects as both co-creators and testers of the aimed innovative solutions. Thus, we carry out a literature review to establish a definition of this approach, as well as to contextualise its development. In this regard, we expose the Quadruple Helix Model and show the role of European Network of Living Labs as a European Commission strategy within its policy to improve competitiveness. Then, we discuss the reported benefits of LLs for stakeholders, as well as the limitations of this approach. Finally, we outline different LLs cases of study, analysing their geographical and sectoral distribution.

1 Literature Review on Agri-food Multi Stakeholder Platforms

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1.1 Introduction

The establishment of **Multi Stakeholder Platforms** (MSP) is an increasingly used mechanism to address the agri-food system's main challenges in a wide range of projects, programs and interventions ranging from the local to the international scale. In parallel, there is a growing interest from both 1) researchers, who seek to analyse their fundamentals, processes and outcomes, and 2) agencies, governments and civil society entities, who aim to improve agri-food value chains.

Agri-food MSPs engage producers, distributors, public institutions, civil organizations, development agencies and other actors involved in the agricultural value chain in a common space (Schut et al., 2019) or forum (Mulema & Mazur, 2016). Thus, what appears to define an MSP is that it brings together stakeholders of different kinds, unlike other stakeholder arrangements such as producer cooperatives (Thiele et al., 2011). However, as we shall see in this review, it is not easy to provide a more specific definition of MSPs due to the plurality of phenomena that can be identified under this category.

MSPs are developing all over the world, involving diverse actors, exploring multiple forms of organisation, and pursuing different objectives. The published literature has highlighted several key elements that may constitute the main axis on which MSPs are built. Some emphasise **knowledge** in regard of its development, exchange, and dissemination among stakeholders (Barzola Iza et al., 2020), or consider **innovation** as a driver of rural development (Pérez Perdomo et al., 2015). **Market information and access** (Martey et al., 2014) and **linkage to value chains** (Thiele et al., 2011; Cavatassi et al., 2011) are also potential issues that MSPs address. Others point out **governance** as the core element of its definition, focusing on institutional arrangements, decision-making processes and common management of specific pools of resources (Dentoni et al., 2018). **Sustainability** is, to conclude the list of key elements, the backbone of other reported MSPs, including all three dimensions: economic, environmental and social sustainability (Gurzawska, 2020; Dias Santos et al., 2019).

Summarising, MSPs refer to both **innovation platforms** (Schut et al., 2019; Makate & Mango, 2017; Mulema & Mazur, 2016 ; Nederlof et al., 2011) and **multi-actor alliances, arrangements or partnerships** (Nesheim et al., 2021; Dias Santos et al., 2019; Dentoni et al., 2018; Ragasa et al., 2016). This leads us to differentiate the platforms based on immediate objectives: between a research-led and a market-lead approach in MSPs constitution (Mulema & Mazur, 2016); or between learning-oriented –focused on innovation assimilation– and development-oriented –focused on local economic development (Nederlof et al., 2011), as well as between strategic and operational platforms (Adekunle & Fatunbi, 2012). In a different vein, Thiele et al. (2011) distinguishes between platforms that foster the creation of new market opportunities via commercial, institutional, and technological innovation, and platforms that seek to empower farmers by addressing market governance problems.

In the last decade, this growing scientific interest has resulted in the publication of several Case Studies or **Systematic Literature Reviews**. Regarding the latter, Barzola Iza et al. (2020) carry out a systemic literature review on the relevance of the development of MSP on farmers' adoption of both product and management innovation. In turn, Dentoni and Ross (2013) analyse how MSP manage wicked problems, whereas Dentoni et al. (2018) focus on governance processes that harness these wicked problems. Other reviews explore their outcomes (Schut et al., 2018; 2019). The exploration of indicators related to the social dimension in agri-food collaborative actions is held in Dias Santos et al. (2019). Finally, other literature provides advice and guidelines on MSP implementation, management and facilitation (Vermeulen et al., 2008).

The main objective of this review is to elucidate the major problems and achievements of the MSPs reported in the published literature. To this end, the following section provides a methodological note on the selection of articles for our Systematic Literature Review. This is followed by a section with the main results of the review, arranged as follows: 1) the methodological approaches used to analyse MSPs, 2) the guidelines for platform design and stakeholders' mapping, 3) governance issues and stakeholder participation, and 4) notable results and impacts as well as significant limitations. Finally, the main findings and their application for the LAB4SUPPLY project are discussed.

1.2 Methodology

This paper draws on a Systematic Literature Review (SLR) to synthesise the state of the art on the employment of MSPs in research, development and cooperation projects. As mentioned in the introduction, MSPs are gaining attention from both development agencies and research centres, which contribute to the discussion of their adequacy, performance, benefits and limitations. Thus, taking MSPs as the subject of our review, we follow the steps below to sample and select the reviewed papers:

1) An **initial secondary data collection** using three online scientific citations databases –Google Scholar, Scopus and Microsoft Academic. The term "Multi Stakeholder Platform(s)" is complemented with analogous terms such as "Innovation Platform(s)" and "Multi Stakeholder Partnership(s)". Later, a second search is made with the term "Multi Agent Platform(s)" to identify case studies located in Europe with this nomenclature, adding 4 papers to this review.
2) A **soft screening** of the results of each database by matching the papers' titles and abstracts with our research goal. In Table 1, column R1 shows the number of search results after applying the filters allowed by each search engine and deployed the first soft screening.
3) A deep screening of R1 results through a paper's **content analysis**. The selected articles meet one of the following conditions: 1) analyse a specific MSP case study, 2) address participation or governance issues, 3) carry out a literature review on MSPs, and 4) show results, limitations or impacts related with MSP approach. In Table 1, R2 shows the final number of results after this individual filter.

Table 1. Table showing search criteria and results obtained by search engine.

Database	Search criteria	R1	R2
1. Google scholar	"*Agrifood multi stakeholder*". Including: "*platform*", or "*initiatives*", "*farmer*", "*agri-food*". Excluding: "*city*", "*mining*", "*industrial*". Time span: 2011-2022.	140	22
2. Scopus	"*Multi-stakeholder platforms*" (in titles and abstracts). Excluding the fields of medicine, engineering or biotechnology.	65	15
3. Microsoft academic	"*multi stakeholder platforms*" Containing: "*agrifood*"	51	10

4) A final scrutiny to remove repeated references and out-of-scope papers. Table 2 shows the 36 selected articles for this SRL, including the key words and main themes of interest for each input.

Table 2. MSP case studies consulted in this review

Article	Title	Main theme and key words
Adekunle & Fatunbi (2012)	*Approaches for Setting-up Multi-Stakeholder Platforms for Agricultural Research and Development*	Innovation system approach, IAR4D, MSPs, Agricultural development
Ayanwale, et al. (2013)	*Economic Impacts of Integrated Agricultural Research for Development (IAR4D) in the Sudan Savanna of Nigeria*	MSP, IAR4D, impact, Nigeria, maize, millet, sorghum
Barzola Iza, et al. (2020)	*The influence of Multi-Stakeholder Platforms on farmers' innovation and rural development in emerging economies: A systematic literature review*	MSP, Farmers' innovation, Rural development, Impact pathways, Emerging economies, Systematic Literature Review
Bampa, et al. (2019).	*Harvesting European knowledge on soil functions and land management using multi-criteria decision analysis.*	EX model, farmers & multi-stakeholders, locally relevant advice, participatory research, soil quality, European Union, LANDMARK
Cavatassi, et al. (2011)	*Linking smallholders to the new agricultural economy: the case of the plataformas de Concertación in Ecuador*	MSP, high-value chain, FORTIPAPA program, *Plataformas de Concertación*, Peru
D'Agostino, et al. (2020)	*Multi-stakeholder analysis to improve agricultural water management policy and practice in Malta*	Climate change, Groundwater, Irrigation, Risk, Water resources, Delphi analysis, Malta
Dentoni & Peterson (2011)	*Multi-Stakeholder Sustainability Alliances in Agri-Food Chains: A Framework for Multi-Disciplinary Research*	MSP, food and beverage multinational corporations, agribusiness management, Systematic Literature Review
Dentoni & Veldhuizen (2012)	*Building Capabilities for Multi-Stakeholder Interactions at Global and Local Levels*	MSP, Unilever, multinational sustainability strategy
Dentoni, et al. (2018)	*Harnessing Wicked Problems in Multi-stakeholder Partnerships*	MSP, governance, cross-sector partnership, governance processes, wicked problems, Malaysia, Palm Oil
Dias Santos, et al. (2019)	*The Social Dimension and Indicators of Sustainability in Agrifood Supply Chains*	Agrifood supply chains, Sustainable Supply Chain Management, Social Indicators, Sustainability, Ghana, Rice
Gitsham & Page (2014)	*Designing Effective Multi-Stakeholder Collaborative Platforms: Learning from the Experience of the UN Global Compact LEAD Initiative*	MSP, UN Global Compact, trusting relationships, legitimacy, effective governance and accountability, UN Global Compact LEAD Initiative
Gurzawska (2020)	*Towards Responsible and Sustainable Supply Chains – Innovation, Multi-stakeholder Approach and Governance*	Global supply chain management (SCM), Multi-stakeholder approach, Governance models, Sedex, SATORI program
Hermans, et al. (2017)	*Social network analysis of multi-stakeholder platforms in agricultural research for development: Opportunities and constraints for innovation and scaling*	MSPs, knowledge sharing, collaboration, interaction among stakeholders, Social Network Analysis, CGIAR (Humidtropics), Burundi, DRC and Rwanda
Koopmans, et al. (2018)	*The role of multi-actor governance in aligning farm modernization and sustainable rural development*	Multi-actor governance, Sustainable rural development, Agriculture, CAP, RETHINK research project
Kulak, et al. (2016)	*Eco-efficiency improvement by using integrative design and life cycle assessment. The case study of alternative bread supply chains in France*	Integrative design, Life cycle assessment, Eco-design, Longitudinal LCA, Alternative food supply chains, France, Bread supply chains
Klerkx, et al. (2011)	*The role of innovation brokers in agricultural innovations systems.*	MSP, Innovation Brokers
Makate & Mango (2017)	*Diversity amongst farm households and achievements from multi-stakeholder innovation platform approach: lessons from Balaka Malawi*	Innovation platform, Smallholder farming, Heterogeneity, Multivariate analysis, IAR4D, CGIAR (Humidtropics), Malawi
Marsden, et al. (2000)	*Food Supply Chain Approaches: Exploring their Role in Rural Development*	Short food supply chains, Rural development
Martey, et al. (2014)	*Factors influencing willingness to participate in multi-stakeholder platform by smallholder farmers in Northern Ghana: implication for research and development*	MSP, willingness to participate, Probit, Kendalls coefficient of concordance, Northern Ghana, rice
Molinari(2011)	*Living Labs as Multi-Stakeholder Platforms for the eGovernance of Innovation*	MSP, Living Labs, innovation policy

Mulema & Mazur (2016)	*Motivation and participation in multi-stakeholder innovation platforms in the Great Lakes Region of Africa*	MSP, A4D, stakeholders participation, (Uganda, Rwanda, Sorghum, potato, maize
Nederlof, et al. (2011)	*Putting Heads Together: Agricultural Innovation Platforms in Practice*	MSP case of study, East and Central Africa
Nesheim, et al. (2021)	*Multi-Actor Platforms in the Water–Agriculture Nexus: Synergies and Long-Term Meaningful Engagement*	water governance; agriculture; multi-actor approach; engagement; participation; trust; social networks, Europe
Pamuk, et al. (2014)	*Do decentralized innovation systems promote agricultural technology adoption? Experimental evidence from Africa*	MSP, Innovation systems, Impact assessment, Participatory development, Sub Sahara African Challenge Program
Pérez Perdomo, et al. (2015)	*Stakeholder roles for fostering ambidexterity in Sub-Saharan African agricultural netchains for the emergence of multi-stakeholder cooperatives*	MSP, collective action, management challenges, innovation networks, , R&D interventions, Uganda, Rwanda and DRC
Ragasa, et al. (2016)	*Effectiveness and challenges of participatory governance: the case of agricultural and rural management councils in the Western Democratic Republic of the Congo*	MSP, Participatory governance, , Agricultural extension service, Agricultural and Rural Management Councils (CARGs), DRC
Sartas (2018)	*Do multi-stakeholder platforms work?: contributions of multi-stakeholder platforms to the performance of research for development interventions*	MSP, R4D programs, LESARD method, CGIAR (Humidtropics), East and Central Africa
Sartas, et al. (2019)	*Factors influencing participation dynamics in research for development interventions with multi-stakeholder platforms: A metric approach to studying stakeholder participation*	MSP, quantitative methodology, CGIAR (Humidtropics), Uganda
Schut, et al. (2018)	*Do mature innovation platforms make a difference in agricultural research for development? a meta-analysis of case studies*	MSP, AR4D, Meta-analysis
Schut, et al. (2019)	*Innovation platforms in agricultural research for development*	MSP, Decision making tool to create MSPs within R4D
Thiele, et al. (2011)	*Multi-stakeholder platforms for linking small farmers to value chains: evidence from the Andes*	MSP, innovation, Value chains, Native potatoes, Papa Andina Partnership Program (CIP), Bolivia, Ecuador, Peru
Thorpe, et al. (2021)	*Are multi-stakeholder platforms effective approaches to agri-food sustainability? Towards better assessment*	MSP, effectiveness, theory-based assessment, network governance, agri-food system
van Paassen et al. (2014)	*Agricultural innovation platforms in Africa: How does strategic institutional entrepreneurship unfold in different value chain contexts?*	MSP, institutional entrepreneurship, strategic choice, Sub-Saharan Africa
Vellema, et al. (2013)	*Value chains, partnerships and development: using case studies to refine programme theories*	MSP, Partnerships between companies and non-governmental organizations, Uganda Oilseed Subsector Platform (OSSUP)
Vermeulen, et al. (2008)	*Chain-wide learning for inclusive agrifood market development : a guide to multi-stakeholder processes for linking small-scale producers to modern markets*	Small-scale producers, multi-stakeholder value chain
Warner (2006)	*More Sustainable Participation? Multi-Stakeholder Platforms for Integrated Catchment Management*	MSP, Water resources management

Almost half of the reported case studies are located in Sub-Saharan Africa (16), to which should be added a few references to South America (2) and Southeast Asia (1). This shows that MSPs are a tool closely related to economic development and linked to developing countries. The analysis is complemented by 5 articles that analyse European case studies, which provide an insight into stakeholder engagement in developed countries. In any case, the greater weight of the cases in developing countries may be a limitation to setting a theoretical framework in a Mediterranean scenario, so the context in which each case study has been developed must be considered.

Most of the MSPs reported are engaged in agri-food activities, although they differ on their degree of product specialisation. Some of the products on which the platforms are

concentrated include cereals (maize, millet, sorghum, soybean, and rice), potatoes, legumes, oilseed and palm oil, fruit trees such as mango, poultry, and beef farming, etc. On the other hand, the nature of the involved actors is also highly diverse depending on the case study, as we will see below: some platforms are formed by smallholders, others include rather conventional actors, or involve specific farming activities, such as organic farming. This gives an idea of the diversity and versatility of value chains that can be organised under MSPs.

1.3 Results

The scientific literature shows a certain consensus on the challenges and main goals faced by agri-food stakeholders, mostly related to poverty reduction and climate change adaptation. In developing countries, some shortages are determined as the main structural challenges, such as lack of knowledge and managerial skills, as well as lack of information on market demand and prices (Pérez Perdomo et al., 2015). In other cases, including those in Europe, the challenges faced by the platforms are the pooling of resources, the promotion of innovations or eco-efficiency. Thus, the creation of MSPs responds to these shared challenges, seeking to address key issues and meet the stakeholder's needs. In this sense, MSPs are action oriented. In this section, we consider how platforms address these issues, discussing the platforms' design guidelines, governance processes, capacity of engagement and reported impacts.

1.3.1 Methodological approach to MSP analysis and evaluation

Before discussing the results of this review, a note on the different methodologies adopted by researchers is in order. Both quantitative and qualitative approaches have been applied to investigate key MSP features. Regarding the former, questionnaires are a widely used source of information. Sartas et al. (2019) use **descriptive statistics** including ARIMA models to investigate stakeholder's participation as a channel for MSPS' contribution to the performance of research for development interventions (R4D). Factors influencing stakeholders' willingness to participate in MSP are tested by a Probit model in Martey et al. (2014), as well as a Kendall's coefficient of concordance to test the agreement between ranked constraints to participation.

Qualitative approaches are based on **case studies**, testing the theoretical findings on how supply chains can be managed with responsibility and sustainability. –i.e. incorporating obligations and motivations towards society and environment in the supra-agent governance– (Gurzawska, 2020), tracking the role played by stakeholders through interviews and focus groups (Pérez Perdomo et al., 2015) or identifying the key constraints on water management through Delphi analysis (D'Agostino, et al., 2020).

Stakeholder workshops are also a useful option to extract qualitative data. Bampa et al. (2019), in the framework of the LANDMARK research project, conducted 32 workshops in 5 European countries to detect the farmers' knowledge needs on soil management. It is worth noting that stakeholders highly appreciated the participatory research as a means to address problems and solutions, as the face-to-face engagement resulted in a sense of ownership, trust and reciprocity towards the results of the study. In the same vein, Nemecek, et al. (2016) reported the organisation of collaborative design workshops with stakeholders to improve the eco-efficiency of two alternative bread supply chains in France.

Other studies triangulate several data sources (surveys, in-depth interviews, and focus groups) to find the incentives and motivation to the participation in MSPs (Mulema & Mazur, 2016). More precisely, Sartas (2018) develops the **Learning System for Agricultural Research for Development** (LESARD) to stress out the process outputs and drivers of change in MSPs (Figure 1). With this method, research and intervention agents are able to report periodically MSP design, implementation, and evaluation through the embedded chart of indicators.

In addition, Hermans et al. (2017) apply **Social Network Analysis** to investigate how knowledge is exchanged and which role do collaboration and influence play in Burundi, Democratic Republic of Congo, and Rwanda cases of study. Observing MSPs as empirical networks, the authors use the **Exponential Random Graph Modelling** (ERGM) to identify the ties between nodes, i.e., the interaction among stakeholders.

Finally, it is necessary to mention the use of the **Living Lab** in projects that link stakeholders within the same value chain, as LAB4SUPPLY aims to do. The Living Lab is an open innovation ecosystem where stakeholders not only act as a source of information –as in focus groups and other participatory approaches–, but also co-create and test the innovative solutions in a real-life context. Thus, the Living Lab is a tool to be considered in user-centred open innovation stakeholder platforms (Molinari, 2011). This methodology will be discussed in depth in the second chapter of this review.

Figure 1. List of LESARD indicators (Sartas, 2018).

Context	Contextual factors	Location in urban–rural gradient Population size
Actor typology	Participating actors and other stakeholders	• Sex • Age • Civil status • Value chain position • Scales engaged in professional activity • Education level • Education compatibility • Expertise subject compatibility • Centrality in collaboration network • Betweenness in collaboration networks • Organizational position • Organizational objectives
Process drivers	Processes contributing to the generation of process outcomes	• Average number of participants attending intervention events • Sex ratio of attending participants • Age composition of attending participants • Civil status composition of attending participants • Total number of different value chain actors participating in the intervention events • Ratio of end users among the participants • Ratio of next users among the participants • Number of professions represented in the intervention • Number of expertise subjects represented in the intervention • Number of key words in the discourse of the participants • Awareness level of the targeted stakeholders on intervention activities • Co-funding by participants • Quality of the interaction facilitation in the intervention perceived by the stakeholders • Average number of participants to the events • Engagement level with the intervention • Per capita number of objectives of the participants of the intervention events • Per capita number of innovations participants of the intervention events wants to work on • Average awareness intervention stakeholders about the concepts targeted by capacity development activities of the intervention • Average awareness intervention stakeholders of the relations targeted by capacity development activities of the intervention
Process outputs	Changes in the configuration of distinct functions of innovation networks	• Average degree of knowledge exchange network • Average degree of influence networks • Average degree of fund flow networks • Average degree of social interaction network • Average degree of commodity exchange networks • Average degree of information exchange networks • Average degree of visioning networks

Context	Contextual factors	Location in urban–rural gradient Population size
Event typology	Events organized by the intervention	• Time of the event • Location of the event • Type of the event • Ratio of field events • Number of different event types per month • Number of events per month • Number of different event locations
Livelihood outcome	Outcomes that lead to realization of livelihood impact	Related Sustainable Development Goal indicators
Livelihood impact	Ultimate objective of the interventions	Related Sustainable Development Goals
Scales	Scale of the activities and outcomes	• Administrative scales intervention targets • Multi-scale index • Scale range of intervention outputs • Scales considered as relevant by the intervention stakeholders
Intervention Modalities	Specific components of the intervention	• Targeted ToC • Amount of investments per targeted stakeholders • Amount of investments per influenced stakeholder • Number of innovation champions • Number of intervention champions • Number of monitors • Number of organization and logistics support staff • Number of facilitators • Management approach • Manager background • Delegation of responsibilities • Fund disposal speed • Fund disposal flexibility
System mindset	Perspectives of managers and implementers	• Existence of organized innovation system boundary identification activity • Existence of organized innovation system elements identification activity • Mentioned interactions among stakeholders about SDGs • Number of recognized limitations and infeasible options • Ratio of the livelihood outcome and impact objectives mentioned by the stakeholders • Existence of a prioritization mechanism for identifying focus element of the intervention • Number of synergies and trade-offs articulated in the intervention strategies and implementation • Number of mentioned benefits/loss due to the interrelatedness of system elements

1.3.2 Design, driving agents and stakeholders mapping

A primary aspect of analysing MSPs is to identify their driving agent(s). Most platforms are promoted by public agencies or research institutions, if not an alliance of both. And in turn some MSPs are promoted by agri-food sector multinational companies, which aim to implement sustainability actions and improvement (Dentoni & Peterson, 2011; Dentoni & Veldhuizen, 2012). In other cases, companies are reported to arrange "Value Chain Partnerships" with small farmers and NGOs to enhance competitiveness and equity within a domestic food market (Vellema et al., 2013). By involving businesses in the achievement of inclusive sustainable development, MSPs appear to be the key to scale up the contribution of the private sector to address the most pressing global challenges (Gitsham & Page, 2014). Thus, we can affirm that MSPs are born out of the impulse of various research and development actors, whether public or private, as well as resulting from public-private partnerships.

All in all, research and development seems to be the great catalyst for stakeholder collaboration. In many of the reviewed cases, MSPs serve as a vehicle for increasing and sustaining the impact of agricultural innovations programs through **Agricultural Research for Development** (R4D) interventions (Hermans et al., 2017), which means to drive changes in a multi-stakeholder system by triggering collaboration and knowledge exchange (Sartas, 2018). R4D encompasses the set of programmes, projects and policies that, with research at their core, carry out a set of activities to prioritize, generate, disseminate and increase the use of agricultural innovations in a targeted area (Sartas, 2018).

Lately, the R4D approach have shifted from a linear transfer of knowledge to farmers via extension agents, to a dynamic innovation system approach, where the focus is "innovation" rather than "technology" (Nederlof et al., 2011). This shift of focus adds organisational and institutional elements to the technical core of agricultural research framework, includes the demand side to involve all stakeholders in the value chain, and introduces a social and ecological perspective. Accordingly, some authors stress that innovation developed by research institutions has been transferred inappropriately to end users such as farmers, especially in developing countries –a scenario that stagnates rural poverty (Adekunle & Fatunbi, 2012). Therefore, the argue that R4D is rather a linear and non-participatory technology transfer has led to the introduction of the **Integrated Agricultural Research for Development** (IAR4D) as a more participatory and interdisciplinary approach (Makate & Mango, 2017; Pérez Perdomo et al., 2015).

Considering this, it is challenging to translate the research-based approaches into effective policy strategies. Based upon eleven European case studies from the RETHINK project, Koopmans et al. (2018) identified six conditions to support the shift towards multi-actor governance in rural areas: 1) informal networks, 2) adequate coordination and communication mechanisms, 3) polycentric decision-making, 4) bottom-up learning, 5) agency and 6) trust and transparency. All these elements are vital to ensure legitimacy and the balance of power in smallholder collaboration, as we will see below. In this context, MSPs are potential tools to facilitate the fulfilment of all these conditions.

However, it is not compulsory for every research and development project to automatically adopt the MSP as a vehicle of stakeholder engagement. In other words, research and development promoters should not consider MSPs the panacea of every agri-food value chain issue (Sartas, 2018). As we discuss below in this section, a broad range of factors decide whether a MSP is successful or not, and henceforth they have to be taken into account when building stakeholder cooperation. Namely, factors regarding available resources, trust and expectations may influence the impact and outcomes of the MSP.

To facilitate the decision of launching an MSP in the context of an R4D project, Schut et al. (2019) provide a decision-making tool for research, development and funding agencies (Figure 2). The provided scheme bases the decision on the objectives of the project, identifying four main possible purposes to set the innovation platform (MSP):

1) Developing and testing new technological or institutional innovations.
2) Tailoring such innovations to the specific stakeholder and end-user's needs.
3) Outscaling the existing innovations for the benefit of end-users.
4) Outscaling these innovations to influence policy and business sectors.

Taking these objectives into account, the adoption of the MSP as the best option will depend on the availability of project's assets –sufficient human and financial resources, institutional support, flexibility, etc.–, as well as the perceived willingness to participate from key stakeholders. The factors and constraints that push or deter stakeholders to participate are discussed below.

Figure 2. Decision making tool (flow diagram) for research, development and funding agencies to create MSPs within R4D projects (Schut, et al., 2019).

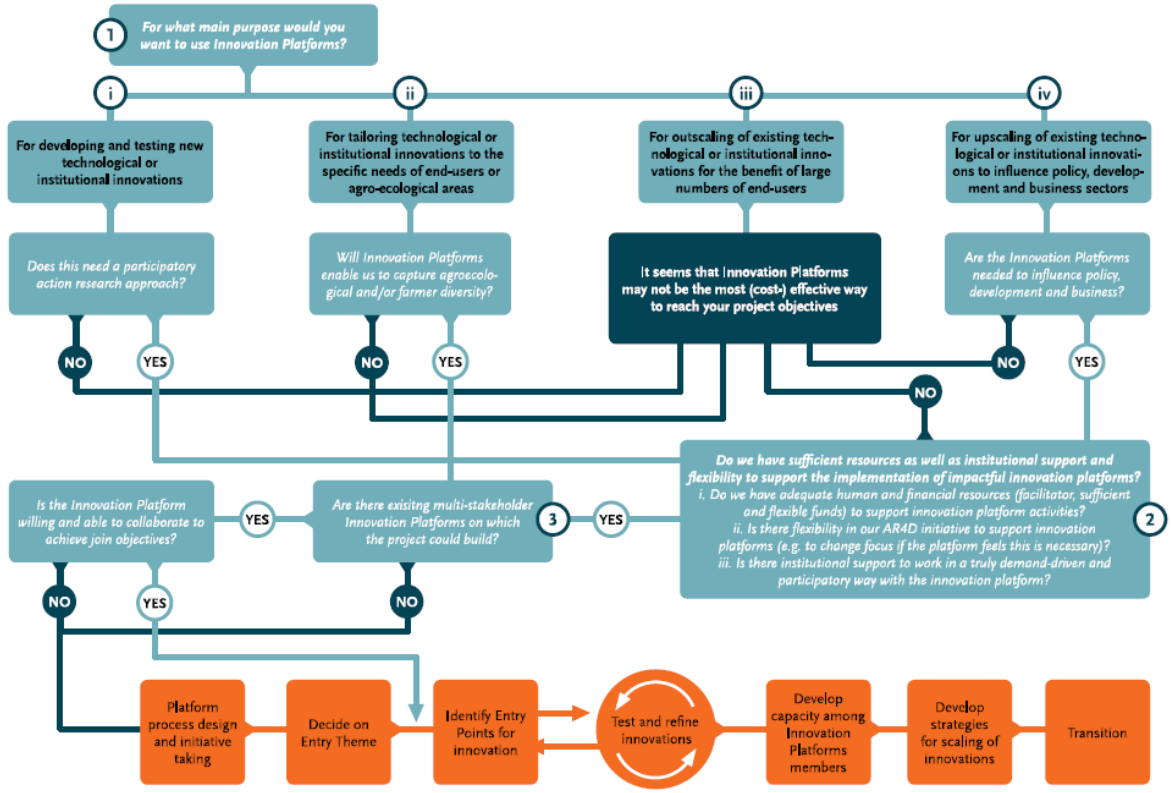

Figure 1. Flow diagram to support decision-making on whether or not innovation platforms are the most appropriate vehicle for reaching a desired research or development outcome. The innovation platform phases (orange boxes) are derived from Homann-Kee Tui *et al.* (2013).

Once the MSP is considered as a desirable and feasible tool for the research and development project, the main question is how to initiate the platform in a certain value chain. The actors, steps, formality, and other features of this initiating progress are linked to the nature of the problem to be addressed, as well as to the approach to be taken – market-lead, research-lead, development-lead, etc. A broad characterisation of the initiation process is portrayed in Nederlof et al. (2011), where three common steps are identified in almost all analysed MSPs:

1) **Scoping**. A wide understanding of the topic and the context where the platform is to be created, provided by expert committees or previous exploratory and diagnostic studies.
2) **Analysis**. An initial stakeholders mapping and selection to involve key actors and engage them in the participatory process and division of tasks. This information may be achieved through studies and consultation, meetings, networking activities and workshops. Just as important is the identification of promising action entry-points.
3) **Planning**. The definition of a clear strategy for action, through meetings and workshops.

Delving deeper into the initial agri-food stakeholder-mapping and selection, the literature aims to categorise the stakeholders and to determine their potential roles. Generally speaking, these stakeholders are expected to come from five groups (Nederlof et al., 2011): 1) smallholder farmers and other input dealers, 2) agri-food processors and traders, 3) research and managerial service providers and extension agents from private or public institutions, 4) financial services and 5) regulatory bodies. Among these stakeholders, MSPs drivers should identify the champion actors that will pull in the same direction. In line with this key actors, Klerkx & Gildemacher (2011) define the innovation broker as the person or organization, relatively impartial, that catalyses innovation through the recruitment of new stakeholders and the facilitation of their interaction.

Regarding the stakeholders' involvement, Thiele et al. (2011) identify their different potential roles within the platform once it is set out:

1) Platform **members**: the key actors that make up the platform.
2) Platform **partners**: those who interact with the platform, contribute to defining its objectives, and share information and other resources.
3) Platform's **clients and providers**: external actors that may receive or provide goods and services to the platform on a commercial basis.

1.3.3 Platform governance and participation issues

The creation of a platform made up of different stakeholders –with the plurality of visions, interests, and styles that this entails– requires the establishment of **collaborative governance** mechanisms. It is worth saying that governance encompasses both the platform management processes –decision making, responsibility and accountability– and the platform members' relationship (Nederlof et al., 2011). Dentoni et al. (2018) explore the major governance issues in MSPs on a basis of three key governance processes:

1) **Deliberation**: those processes prior to a joint decision such as information and knowledge sharing and option discussing.
2) **Decision making**: taking a joint decision among the available options.
3) **Enforcement**: the process of implementing and monitoring the decided actions.

Then, three major wicked problems are identified. First, the lack of complete information on the problems and its causes, as well as the set of possible solutions, referred as **knowledge uncertainty**. Secondly, the different affection of these problems, assumptions of its causes and interests covered by the possible solutions may arise **value conflicts**. Thirdly and finally, wicked problems are characterised by a **dynamic complexity** that makes almost impossible to stop exploring and tackling them. To operationalise the response to these problems, Dentoni et al. (2018) suggest the use of the following Key Performance Indicators framework reproduced below (Table 3).

Table 3. KPI harnessing governance wicked problems in MSPs (Dentoni et al., 2018).

Deliberation	Decision-making	Enforcement
Knowledge uncertainty		
Knowledge and information from diverse MSP members and external stakeholders are continuously acquired, discussed and evaluated Different types and sources of knowledge are collectively discussed and interpreted Different approaches to knowledge presentation and analysis (e.g., language and style) are accepted and encouraged Knowledge and data limitations on causes, symptoms and consequences of problems are acknowledged by MSP members	Items and choices for decision-making arise from the deliberation processes Decision-making is based on diverse types and sources of knowledge, including objective and subjective knowledge Decision-making explicitly acknowledges knowledge and data limitations, including remaining uncertainties, ambiguities, and possible future developments Decision-making processes are flexible to deal with new insights whenever they emerge	Implementation and monitoring plans are based on diverse types and sources of knowledge Implementation and monitoring plans are flexible to deal with knowledge and data limitations, and new insights whenever they emerge Impact of MSP actions is measured using transdisciplinary and interdisciplinary knowledge, and applying different methods and perspectives in data collection and analysis
Value conflict		
Frequent and intense interactions and negotiation among stakeholders are encouraged and facilitated Deliberation is shaped by open and fair exchange of arguments, balanced representation of stakeholders, and formalized endeavours to include marginalized stakeholders Conflicts between stakeholders are not suppressed but purposely brought to the table and dealt with through skilled facilitation Divergent values, objectives and interests of stakeholders are carefully synthesized and balanced to avoid trade-offs	Items and choices for decision-making arise from the deliberation processes Active involvement of stakeholders in decision-making is facilitated (e.g., through resource availability, adequate technology, translation services, etc.) Decision-making involves processes of negotiation, mediation, and dispute settlement between stakeholders with conflicting values Decision-making is based on compromise and temporal synthesis Decision-making procedures are transparent and made public	Implementation and monitoring plans are flexible to deal with stakeholder conflicts and negotiation over rights and responsibilities of stakeholders Implementation commitments of stakeholders are monitored and visible to MSP members Impact of MSP actions is measured and communicated to MSP members and external stakeholders Compliance with MSP decisions is incentivized through appropriate rewards and sanctions

Dynamic complexity		
Stakeholders can raise new issues for discussion, deliberation, and formal consideration Emerging issues are explored and framed from different perspectives, based on the input and participation of diverse stakeholders Deliberation leads to continuous knowledge co-production to facilitate adaptation to changing problem contexts Stakeholder participation is continuously re-assessed to remain responsive to emerging issues	Items and choices for decision-making arise from the deliberation processes Decision-making processes facilitate quick decisions responsive to the nature of emerging issues Decisions are taken based on broad stakeholder involvement and consensus orientation Decision-making processes include clear steps for implementation of decisions	Implementation and monitoring are facilitated through resource availability, processes, and structures Implementation and monitoring plans include rewards and sanctions to incentivize action and compliance with MSP decisions Implementation and monitoring plans are flexible and can be adapted to local circumstances Monitoring includes an important learning component to feedback new insights to the MSP

Having elucidated the MSPs' governance mechanisms, we must focus on participation as the key element of the platform's success. Starting with the demographic composition of its most common attendees, MSPs are usually membered by male-headed households. Regarding gender, women inclusiveness is rather reported as a hazard in farmer's participation in MSPs (Nederlof et al., 2011), but certain papers report women to be more active participating in MSPs (Mulema & Mazur, 2016) or willing more to participate (Martey et al., 2014).

Martey et al., 2014 also finds a positive relation between household size and income and willingness to participate, probably related with the capacity to cope with transportation costs. The referred article finds that participation may be constrained by 1) distance to the meeting place, 2) confliction of meeting days with market days, 3) poor dissemination of information regarding meeting days and 4) risk. On top of this list, we must add the requirement to have staff to take over the farm or the production in order to allow the farmer to participate to such events. In this sense, the lack of participation is strongly linked to lack of resources, resulting in less time available.

Following a similar idea, Sartas et al. (2019) show an increasing participation in three Ugandan MSPs and point out the following factors and temporal elements that may influence this participation:

1) **Location-related factors**: stakeholders' participation is higher at a local level due to local communities' interest and perception of more direct impact on their livelihoods. Thus, more participation in rural locations is expected.
2) **Intervention-related factors**: the success of platform processes and events rely on the clarity of impact pathways and theory of change, flexibility in implementation, available resources, quality of the human resources, etc. This is of particular interest to MSP organizers, decision-makers and monitors, given that more participation in events is expected when they are facilitated, organized and monitored by them.

3) **Temporal factors**: time management is also a strategic issue. The time span and time of operation of the MSP may influence stakeholders' participations, as well as considering calendar-based periods such as agricultural / crop season, market/ fair calendar, and holidays.

Now, do the case studies from Europe show similar limiting factors to those cited above? Kulak et al. (2016) show that lack of innovation, inadequate management and lack of access to reliable information discourage producers' participation in alternative bread supply chains in France. In this sense, limiting factors for farmer's willingness to adopt the MSPs innovations were personal beliefs, preconceptions and lack of trusts in the knowledge of the experts. Therefore, communication could bridge the gap between experts and farmers in order to improve the effectiveness of the development process (Kulak et al., 2016). Furthermore, the degree of engagement of the platform depends not only on the trust and alignment of stakeholders with the platform, but also on the strength of their relationships with third parties: Nesheim, et al. (2021) show how MSPs that were able to stablish networks with supplier companies, agricultural authorities and civil society organizations were likely to have long-term and more meaningful engagements.

In any case, the conclusions to be drawn from Sartas et al. (2019) results is that MSPs contribution to increasing average participation in R4D projects and events is limited and constrained to locational and temporal factors. In this regard, it is necessary to analyse the **motivations** that lead stakeholders to participate in MSPs. Focusing on farmers, anticipated economic and material livelihood benefits are the most contributing factors to the membership in MSPs and the willingness to participate in the platform's activities, due to the exchange of information and knowledge and the access to better markets, whereas developmental benefits –acquiring skills and knowledge– alone are not sufficient (Mulema & Mazur, 2016). In relation, the most frequent factor curtailing participation may be the unmet expectations of immediate material and economic benefits (Mulema & Mazur, 2016) or tangible results (Nederlof et al., 2011). Taking this into consideration, setting out realistic goals, generating short-term and tangible outputs and economic benefits and sensitizing about the long-term benefits are crucial to maintain farmers' participation (Mulema & Mazur, 2016).

On another side of the issue, some findings suggest that stakeholder representation in MSPs is not proportionally balanced. In some cases, the private sector needs appear to be the least responded –a scenario that jeopardises the appropriate innovation adoption by the business sector (Hermans *et al.*, 2017). An example of this may be found in the maize platform of Rwanda, where input dealers, traders and processors seem to be interested to participate when obtaining quick results (Nederlof et al., 2011). In this quoted case, the farmer's underrepresentation is solved in a maize-legume platform in Nigeria by electing a farmer's representative in the MSP's management committee.

1.3.4 Outputs, outcomes, performance

The final topic of this review concerns the impact of MSPs on agri-food stakeholder's performance. To this end, we summarise the factors that different authors have highlighted as decisive. On the one hand, Gitsham & Page (2014) point out that the success of MSP depends on:

1) **Trusting relationships and a Sense of Common Purpose**. Relationship building appears to be the key process to overcome hazards like unclear purposes and conflicting expectations. Participatory governance can be the way forward for this trust-building, as shown in the third point.
2) **Legitimacy**. The MSP's impact needs a critical mass of participants, as well as the inclusion of significant stakeholders, which exclusion could hinder success. Legitimacy is also bound up with the representability of participants and their diversity in terms of characteristics, interests, opinions, and influence.
3) **Effective governance and accountability**. Participatory governance has an essential role in the platform's performance, as a distributed leadership and a broad sense of ownership provide more efficiency. Thus, transparency and responsiveness in the decision-making process are key indicators.

On the other hand, Nederlof et al. (2011) identify three main factors that lead to the disintegration of several stablished MSPs, after reviewing 12 African MPSs:

1) **Lack of funding**: resource mobilisation is crucial for the platform's long-term sustainability, whereas an exclusive reliance on public funds can be a threat to such continuity.
2) **Irreconcilable conflicts between partners**, such as those related to expected benefits share, resources access and process control/monitoring. The misalignment of interests is also a issue reported by van Paassen, et al. (2014) in Benin's cotton value chain.
3) **Unfavourable changes (instabilities)** in the institutional and political context.

Moving forward in their evaluation, MSPs' outcomes should be separately considered for two levels of **beneficiaries**: the platform members as direct beneficiaries and the target population as indirect beneficiaries, the latter related with scaling processes (Schut, et al., 2019). The tangible benefits of MSP membership may be the access to information, the learning of skills, application of technologies, a better bargaining position and the developing of new projects, as the reviewed literature shown below reports. It is also worth noting the **intangible outcomes** that MSPs may provide to the platform members. Even they can be read as the main impact, as Vellema et al. (2013) find in the case study of a Ugandan oilseed platform, highlighting communication–the achievement of a common language to discuss strategic problems– and collaboration outcomes –the recognition of joint work as the most effective issue resolution.

However, **tangible results** are the outcomes for which the literature has provided the most evidence from the case studies. For example, the uptake of **crop management innovations** and the adoption of novel crop management techniques are positively correlated with the presence of MSPs in rural Sub-Sahara African (Pamuk, et al., 2014). Beyond technical innovation adoption, Thiele et al. (2011) find that smallholders increase their yields and selling price due to the MSPs task of linking farmer organizations to more added-value supply chains in Peru, Ecuador and Bolivia. In the same vein, Makate & Mango (2017) report an increase of smallholders' **market information** (as stated by 41.4% of farmers), **market access** (85.3%) and **crop yields** (16.4%), being the participation in MSP activities the driver of input and food security improvement. To name a few of these actions, the Balaka innovation platform in Malawi has promoted sustainable farming technologies, improved farmers' linkage to financial institutions, promoted local savings, etc. However, Makate & Mango (2017) demonstrate how different approaches and activities have a different impact on smallholder livelihoods depending on farmer socioeconomic characteristics. Thus, a possible learning from this experience is that MSPs should focus on specific groups when promoting certain activities.

Providing financial support to farmers is other of the quoted objectives of MSPs. In this sense, some platforms have enabled smallholders to untie themselves from a **financial dependence** on intermediaries –resulting from a practice of signing a pre-harvest contract in exchange for an initial credit, assuming a low price at the end of the deal. Vellema et al. (2013) report that the collaboration between the Rwandan maize value chain network and some micro-finance institutions permits a better access to credits, trustworthy contracts and, in the end, higher incomes for farmers.

In conclusion, the literature shows that MSPs can be successful market governance institutions when assuming contract management, quality control, and delivery tasks, providing information on prices and volumes, and linking smallholders to marketing and exporting companies (Thiele et al., 2017). Thus, MSP's impact is both focused on production and distribution improvement: some research has recognised that interventions seeking smallholders' access to high-value markets need a broader approach than standard production-focused actions –i.e. enhancing productivity. Instead, actions that target the whole **production-distribution-retail chain** are needed (Cavatassi et al., 2011): the *Plataformas de Concertación* in Peru have reduced the number of intermediaries within the value chain by linking smallholders to high-value product purchasers –restaurants, supermarkets, processors, etc. The paper shows how their participation influence positively and significantly in log of yields and gross margins, as better market linkage implies the sale of a higher percentage of the crop and at a higher price. Although this benefit is reported to be higher for medium and large farmers than smallholders, due to economies of scale.

On the other hand, some reports are more cautious about the success of the platforms and even mention a limited impact. This is the case of several Agricultural and Rural

Management Councils (CARGs) in western Democratic Republic of the Congo, local-level MSPs where Ragasa et al. (2016) report an average modest impact, beginning with the limited outreach and sensitization about the platforms among stakeholders. It is also worth noting that only a 33% perceived the platform meeting to be useful and a fewer 11% reported having benefitted or knowing someone who had benefitted from CARGs. This is even more remarkable if we take into account that the stakeholder who mostly reported these benefits –namely training and information– were extension agents (20% of them), in contrast to end-users (10% in the case of agricultural workers). Low participation rates were also a concern for some of these platforms. This brings us back to the idea that local and temporal factors are extremely important when it comes to conceiving and implementing the platform.

1.4 Discussion: applications in LAB4SUPPLY

The aim of this paper is to provide **LAB4SUPPLY** with an adequate theoretical framework and a comprehensive review of MSP case studies in the existing literature. LAB4SUPPLY´s main objective is to empower the Mediterranean agri-food smallholders through the definition, enhancement, and transfer of competitive and efficient **food supply chain alternatives**. To fulfil this main objective, the project is committed to creating an Agri-food Innovation Ecosystem Living-Lab with a multi-agent approach. In other words, the project aims to address farmer's capacity of adaptation to consumer needs and unexpected food market changes by engaging the stakeholders involved in 5 agri-food supply chain cases of study in a **Multi Stakeholder Platform** (MSP).

As we have seen in this review, MSPs are a widely used tool to drive **research and development projects** –from both research-led and market-led approaches. This means that they not only transfer technology and innovation to smallholders, but also provide them with market information and improve their market access. These are **significant achievements** that would probably be unattainable without the platform's action. In short, MSPs can redefine the smallholders' role in the value chain, giving them greater marketing capacity and bargaining power. From there, **tangible benefits** can be obtained, such as yield increasing, selling price raising, intermediaries' reduction and financial support –the literature provides enough successful case studies to convince us that the use of such collaborative platforms is appropriate for agri-food development.

However, some authors have been able to point out some limitations and critical factors that may determine the success of the platform –namely contextual factors, unclear purposes and conflicting expectations, lack of resources or funding, etc. In this respect, the design of the MSP is crucial, as well as an adequate stakeholders' mapping. In the end, **stakeholder involvement** is the most decisive factor –as well as an assessment of its legitimacy. Thus, the MSPs' drivers must make an effort to foster smallholder participation, on the basis of trusting relationships and effective governance.

Finally, it is worth noting that most papers report the capacity to reduce rural poverty and improve food security in developing countries (mainly in Sub-Saharan Africa, but also in South-East Asia and Latin America), which is why we should be cautious when extrapolating these conclusions to the **Mediterranean value chains**. In this regard, the MSPs developed within the LAB4SUPPLY must be tailored to the value chain context and stakeholders' specific needs. The more thorough the mapping of stakeholders, the more adequate the channels of communication and participation, and the greater the consensus around realistic goals, the more successful the LAB4SUPPLY project will be.

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2 Living Lab: A User-Centred approach for agri-food innovation

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Abstract

The **Living Lab** is a user-centred, open innovation ecosystem based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings. The European Union is extremely effective when producing knowledge, but not as effective when it seeks to transfer it to market, so living labs were proposed as a possible platform for **quadruple helix innovation**, that benefits the creation of products and services, and mitigates the risks associated with market commercialization. Users not only act as sources of information, but also collaborate on creating, prototyping, validating, and testing new technologies, services, products, and systems in real-life contexts. Throughout the world, many studies have shown the negative environmental, social, and economic consequences of the dominant agro-industrial system, so Living Labs appear to have the potential to accelerate co-creation and adoption throughout the value chain, because of their **user-centric approach** used to develop and **co-create innovative solutions** in partnership with stakeholders and tested in the user´s real-life context.

Keywords: Living Lab, innovation, user-centred, agriculture, sustainability

2.1 Introduction

The **Living Labs** (LLs) are an emerging and rapidly diffusing phenomenon that has been applied around the globe to generate innovation within and suited to real-life problems and contexts. They are viewed as a link between open innovation and user innovation (Schuurman et al., 2013). While the LL model was started in the late 1990s, its significant application has increased from 2006, when the European Commission launched a **European Network of Living Labs** (ENoLL) (www.enoll.org) as part of policy to improve competitiveness (Bronson et al., 2021). The aim of the network is to offer a gradually growing set of networked services to support the “Innovation Lifecycle” for all actors in

the system: end-users, small and medium-sized enterprises (SMEs), corporations, the public sector and academia (Bergvall-Kareborn and Stahlbrost, 2009). Understanding the merits of this methodology is highly relevant because agents involved in innovation must select the requisite methodologies to appropriately address their respective challenges (Almirall et al., 2012).

LLs are **physical regions** or **virtual realities** in which stakeholders form public-private-people partnerships (4Ps) to arrive at user-centric solutions and innovations and thus they could present a viable method for solving complex issues (Bronson et al., 2021). The advantages of user-centred design adoption have been demonstrated by academic studies (Bergvall-Kareborn and Stahlbrost, 2009; Dell'Era and Landoni, 2014; Dell'era et al.,2019). Users not only act as sources of information, but also collaborate on creating, prototyping, validating, and testing new technologies, services, products and systems in real-life contexts (Westerlund and Leminen, 2011). Users in LLs shape the innovation in their own real environments, whereas in traditional innovation methods, the insights of users are usually captured and interpreted by experts (Almirall et al., 2012). Thus, users can act in the LL methodology both as subject and objects of the innovation process and can simply contribute to the LL methodology by expressing their needs and desires or can directly shape innovation by acting as testers or co-producers.

Several **literature reviews** on living labs have been published over the past few years (Westerlund et al., 2018; Hossain et al., 2019). However, yet none of them relate to the agro-ecological transition of agri-food systems. Throughout the world, many studies have shown the negative environmental, social, and economic consequences of the dominant agro-industrial system, so in 2020, the **European Commission** launched its "**Farm to Fork**" strategy as the foundation of the European Green Deal to create a more sustainable European food system. This food system action plan encompasses all stages from production to consumption, envisioning equitable livelihoods for smaller primary producers, a transition towards sustainable practices, as well as promoting healthy and sustainable diets for consumers (European Commission, 2020). The challenge of healthier and more sustainable farming and food is therefore directly linked to local inhabitants' participation in choosing and building the future of their region (Gamache et al., 2020). Moreover, innovation in the agriculture and agri-food sector generally involves multi-actor approaches (McPhee et al., 2021), thus it also requires that all actors concerned by this issue (farmers, food industry, companies, retailers, researchers, students, non-governmental organizations, Indigenous communities, governmental institutions, financial institutions, small and medium-sized enterprises, consumers, advisory services and other members of the members of the national Agriculture Knowledge and Information System (AKIS) adhere to the same approach.

In such a context, LLs appear to have the potential to accelerate co-creation and adoption throughout the value chain, because of their user-centric approach used to develop and co-create innovative solutions in partnership with stakeholders and tested in the user´s real-life context (McPhee et al., 2021).

Taking into account these premises, the aim of this chapter is to do a **deep literature review of Living Labs studies** in order to identify characteristics and limiting factors of this methodology.

2.2 What is a Living Lab?

The Living Lab is an **innovation approach** that benefits the creation of products and services, and mitigates the risks associated with market commercialization. Living Labs share many characteristics with user-centred approaches such as “participatory design” and “socio-technical design” (Bergvall-Kareborn and Stahlbrost, 2009) and they are conceived as a place of creativity where collaboration between different people happens, a multi stakeholder organization, an innovation milieu, research methodology, an approach for involving users, a public private partnerships concept, an open innovation ecosystem based on open innovation, an experimentation platform, and a user-centred approach (Zavratnik et al., 2019).

The term Living Lab was introduced by Prof. William Mitchell at Massachusetts Institute of Technology, to describe a user-centric research methodology for sensing, prototyping, validating, and refining complex solutions in multiple and evolving real life contexts (Van Geenhuizen, 2019). Although the concept itself first emerged in North America in the early 2000s, it has emerged significantly since 2006, when the **European Network of Living labs** (ENoLL), an umbrella organization for LLs, was launched by the European Commission as part of its policy to improve competitiveness. ENoLL defined Living Labs as “user-centred, open innovation ecosystem based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings”. In addition, ENoLL argues that LLs act as “intermediaries between citizens, research organizations, companies, cities and regions for joint value co-creation, rapid prototyping or validation to scale up innovation and businesses”.

Although ENoLL’s definition is the most used, there is a wide range of definitions of the Living Lab and there is not one commonly accepted yet. Leminen et al. (2012) define LLs as “physical regions or virtual realities in which stakeholders from public-private-people partnerships of firms, public agencies, universities, institutes and users all collaborating for creation, prototyping, validating and testing of new technologies, services, products and systems in real-life contents”, while Dell’Era and Landoni (2014) define LL as an example of “design research methodology that is aimed at co-creating innovation through the involvement of aware users in a real-life setting”. LLs can take place both in physical spaces or virtual realities characterised by openness and user involvement (Almirall et al., 2012) and the designer does not interact directly with the users and leaves the users free to interact with the environment (Dell’Era and Landoni, 2014).

In addition to the large number of definitions and varying interpretations of the phenomena, researchers also distinguish between different types of LLs. Leminen et al. (2012) identified four distinct types of LLs characterised by open innovation. According to their study LLs can be **utiliser-driven**, **enabler-drive**, **provider-driven** or **user-driven**. Researchers also emphasise the variety of stakeholders that are involved in LLs. These include suppliers, customers, users, competitors, universities and other institutions and organisations. Furthermore, LLs can be open or closed in terms of participation. Open LLs imply that anyone can participate, while in close LLs, participating users are preselected (Dell'Era and Landoni, 2014).

Despite the differences in focuses and perspectives, all the definitions remark four characteristics: **openness**, **user-centred approach**, **innovation** and **co-creation**. Thus, Living Labs offer an interesting example of a network-based form of multi-actor collaboration (McPhee et al., 2016) as they turn users from being mere, observed subjects, into active participants, co-creators of value (McPhee et al., 2012).

2.3 European Network of Living Labs (ENoLL): their role in the establishment of Living Labs

The **European Network of Living Labs** (ENoLL) plays an important role in the establishment of Living Labs as a research method and a well-rooted business model. The foundation of the Network is interconnected with a wider EU policy, financial and research frameworks, as the creation of Living Labs is just one of the responses of the EU to tackle economic competitiveness and societal and sustainable challenges (Dutilleul et al., 2010). Awareness of a need for a "new open, user-centric and networked innovation environment" gave the initiative for the establishment of ENoLL.

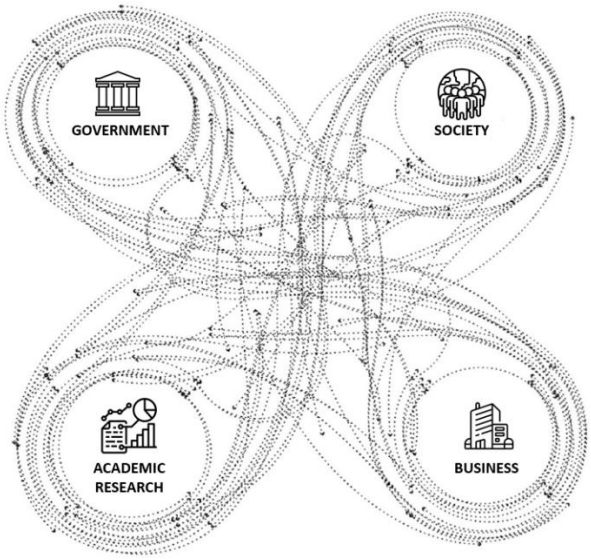
The Network is organized as a platform that gives support, enhances learning, and enables the exchange of good practices for the development of new projects. Within a few years, this network has extended through several waves of labelling initiatives across Europe, growing from 20 labelled living labs in 2007 to over 440 in 2020, which has most certainly impacted the number of publications. Most publications on the subject are now European (Gamache et al., 2020) and The Network connects, today, more than 150 affiliated members from Europe and five other continents.

2.4 Stakeholders: quadruple helix innovation system approach

Regional innovation systems (RISs) have been widely stylized as the intertwining of several helices (Carayannis et al., 2018). Among them, the **Triple Helix Model** (THM) is a well-established model of innovation, which encourages interaction among academia, industry and government (Etzkowitz and Leydesdorff, 2000). However, this model may not be enough to really address, and meet, the needs of citizens and the emerging challenges related to sustainable development. In such a way, a **Quadruple Helix Model** (QHM) configuration of the innovation ecosystem emerges, thus overcoming the THM. The QHM, which was initially suggested by Carayannis and Campbell (2009) and Yawson (2009), introduces a fourth helix: Civil Society (Figure 3). A QHM considers citizens as key actors and they are not only involved in product development and testing, rather they actively participate in developments by suggesting new innovations, thus connecting users to stakeholders (Compagnucci et al., 2021).

Nordberg (2015) defines the fourth Helix as the more "cultural" dimension and the backdrop toward the roadmap to innovation, while Ivanova (2014) discusses this topic from a more systemic view, focusing on services, arguing that the QHM not only addresses the consumer but also the communication and the media. Form the other side, Höglund and Linton (2018) argue that the fourth Helix is not a separated additional Helix, but an integrated part of the society and its significance is to reply to the citizens' requirements. Nonetheless, despite the undeniable contribution of the QHM, there is a methodology challenge on the way of the citizens introduce their public perspective and also how the different actors define their functional role of the society as a fourth pillar and in collaboration with the innovative processes (Taratori et al., 2021).

Figure 3. Representation of the Quadruple Helix Model (source Taratori et al., 2021)



Taking into account these premises, the LL was proposed as a possible platform for quadruple helix innovation, as the **European Union** is extremely effective when producing knowledge, but not as effective when it seeks to transfer it to market. Thus, the creation of LLs is just one of the responses of the EU, introduced in the context of the QHM, to tackle economic competitiveness and societal and sustainable challenges (Dutilleul et al., 2010).

2.5 Advantages and limitations of LLs

LLs are an **effective means for promoting innovation** and enables users to be involved in the development of innovations. They make it possible to cut innovation costs, to reduce market-based risk (McPhee et al., 2013) and to spread research costs (Kviselius et al., 2009).

LLs offer **multiple benefits** to businesses, societies, and users. The primary benefit claimed for using LL environment is innovation in the form of the development of knowledge, products, services and research solutions through project-based activities and processes that support users, including businesses and companies, to achieve (market- and investment-focused) objectives, outputs, and outcomes that they value (Paskaleva and Cooper, 2021). Furthermore, LLs support stakeholders by integrating policymaking and business-development issues. A wider use of LL enhances the inclusion and usefulness of their application in society. Thus, LLs are vital for transforming everyday knowledge generation into models, methods, and theories (Hossain et al., 2019). However, LLs run mainly based on national or regional funding and most funding for them is project-based. Therefore, much sustained funding is vital to keeping LLs active for a long period (Guzman et al., 2013).

LLs are by definition, user-driven, thus evaluation approaches are guided by different organizations, agencies and stakeholder groups depending on the location and specific mandate of the LL (Bronson et al., 2021). The user-centred strategy positively impacts all **innovation performance outcomes** (e.g., time, cost, quality and go to market), but only time performance shows a significant difference between non-adopters and adopters. Using this approach, users can be considered sources of innovation, and firms can identify unique insights by asking users about their needs or, even more effectively, observing them during the use of existing products and tracking their behaviour during consumption processes (Dell'Era and Landoni, 2014). Dell'Era and Landoni (2014), also note that all LLs involve are users in the co-creation process, but in some cases the participation in open to potential users, whereas in other cases the users are pre-selected. This is a critical choice, because collaborative networks differ in the degree to which "membership" is open to anyone who wants to join.

Practices such as co-design, collaboration through digital platforms and development of experience prototypes allow for the achievement of better results in terms of quality and,

consequently, marketability of the project outcome, but reduce the efficiency of the innovation project in terms of **time and cost** (Dell-era et al., 2019).

Furthermore, Bronson et al. (2021) suggested that there is a gap in practitioner and academic community knowledge surrounding how to **measure and evaluate** both the performance of LL processes and their broader impacts. It appears that this gap is even more pronounced when it comes to LLs aimed at agricultural or environmental sustainability. Ballon et al. (2018), emphasize the need to start evaluating thoroughly the effectiveness and impact of specific LL experiences.

2.6 Most represented sectors

The LLs approach has been worldwide applied to generate innovation within and suited to real-life problems and contexts.

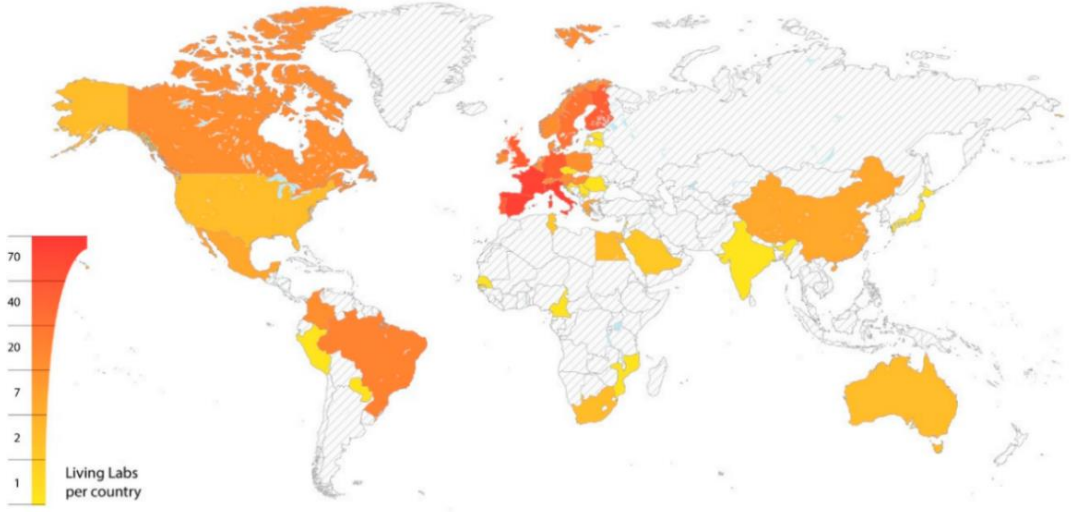
The most common way to categorize different types of LLs is by sector, thematic domain, or area of application. For example, ENoLL uses **sectors to categorize its membership**: Artificial Intelligence, Agriculture & Agri-food, Culture & Creativity, Energy, Environment, Health & Wellbeing, Social Inclusion, Social Innovation, Education, Industries & manufacturing, media and other (McPhee et al., 2021).

The LL originally focused on disciplines related to information and communication technology (ICT) and later LLs expanded to include broader social challenges in areas such as assisted living, health care, media, agriculture, mobility, urban and rural areas, smart cities and digital cities, buildings, etc. (Greve at al., 2021). In 2017 and 2018, there was a more homogeneous distribution of categories with an increase in the number of publications related to environmental issues. We thus find categories such as “green sustainable science technology”, “environmental studies” and “environmental sciences”. This seems to provide a useful marker of change in the focus in the LLs literature, with growing interest in **sustainability issues** (Gamache et al., 2020). However, there are limiting LLs studies focused on agriculture or sustainability. Sustainability is a global issue, and sustainable development is an increasingly important topic, yet many living labs do not seem to explicitly focus on them. Furthermore, Gamache et al. (2020) note an absence of concern around the issues of agri-food transition. It is obvious from the literature that **agri-ecosystem LLs** are a recent subject of attention which does connect with what is happening outside the academy. For instance, the international **Agroecosystem Living Laboratories** (ALL) working group was formed at the 2018 G20 meeting of Agricultural Chief Scientist (MACS) in Argentina, Co-chaired by Canada (Agriculture and Agri-Food Canada, AAFC) and the United States (U.S. Department of Agriculture, USDA). A major and recent initiative in Europe is **Agrilink**, which established six living laboratories (in Italy, Norway, Latvia, Spain, Romania, The Netherlands, and Belgium) supported by **Horizon 2020** research and innovation programme (Bronson et al., 2021).

2.7 Most represented countries

Although the concept of LL first emerged in North America, currently, there is a large number of actively operating LLs around the world, and specifically, there is a high **concentration in Europe** (McPhee et al., 2017) (Figure 4).

Figure 4. Map of Living Labs accredited by European Network of Living Labs (ENoLL) per country between 2006 and 2015 (source Zavratnik et al., 2019).



In fact, most of the articles are from Europe or focus on LLs based out of Europe (51%). The most comprehensive LL project is arguably **ENoLL** which has expanded across Europe, rising from 20 to over 440 LLs during the period 2007-2020, so this may explain the dominant presence of European publication (Bronson et al., 2021). Italy is the most represented country in the publication of articles in LLs, follow by The Netherlands, Germany, Finland, Belgium, France, Spain, Sweden and finally England (Table 4).

Table 4. List of the countries most represented in the publication of articles on Living labs (Source Gamache et al., 2020). n = 768 papers

Country	Records	Percentage	Country	Records	Percentage
Italy	100	13%	France	59	8%
Netherlands	81	11%	Spain	59	8%
Germany	76	10%	USA	50	7%
Finland	69	9%	Sweden	49	6%
Belgium	65	8%	England	42	5%
			Other countries	118	12%

** 29 articles (3.8%) did not contain sufficient data to be categorized*

2.8 Case studies

Case studies are essential to learning and to the production of knowledge from practice. Bronson et al. (2021) found that the most common approach to gathering data was comparative analysis case studies and, in general, the purpose of evaluation was improvement of the particular LL functioning, not its wider impacts.

Bronson et al. (2021) also shows that **qualitative methods of data collection** are more common methods used in the evaluation of LLs. This might be due to the fact that LL is considered a novel approach to innovation and qualitative methods are found to be more relevant for this kind of emergent research. **Quantitative methods** did appear in the literature but are more common in assessing LLs focused on technology development and technology adoption. Table 5 presents examples of Living Labs found after a literature and online search relating to rural development, agriculture, food and sustainability.

Table 5. Living Labs platforms reported in literature and online.

Platform Name	Link to platform
REFRESH	https://eu-refresh.org/
UNISECO	https://uniseco-project.eu/
S3P	https://s3platform.jrc.ec.europa.eu/agri-food
Circ4life	https://www.circ4life.eu/
Fit4food2030	https://fit4food2030.eu/
Labe Digital Gastronomy Lab	https://www.labe-dgl.com/es/
GREEN POINT living lab	https://itc-cluster.com/green-point/
Desira	https://desira2020.eu/
Smart sensors 4agri food	https://www.ss4af.com/
S3Food	https://s3food.eu/
Agrilink	https://www.agrilink2020.eu/
Living Laboratories Initiative	https://agriculture.canada.ca/en/agricultural-science-and-innovation/living-laboratories-initiative

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