



PRIMA
PARTNERSHIP FOR RESEARCH AND INNOVATION
IN THE MEDITERRANEAN AREA



TECHONEY

Development of a **blockchain-based ecosystem** that allows an **improved positioning of small producers of honey** on local and international markets

WP1: HONEY INNOVATION AND LEARNING COMMUNITY LAB (HILE)

D1.1: REPORT ON THE LITERATURE REVIEW

CHARTER

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PROJECT ABSTRACT

TECHONEY project's main objective is to identify strategies and establish lines of resilience to the new challenges determined by the COVID-19 pandemic for beekeepers in the Mediterranean (Med) agricultural systems through the implementation, definition, enhancement and transfer of competitive, profitable, efficient and trustful honey supply-chain alternatives that address beekeepers' capacities and attractiveness to fulfil consumer needs on unexpected food market changes.

TECHONEY project proposes the development of a **traceability system to guarantee the quality and safety of honey within the supply chain** for more effective communication to consumers and to strengthen access to different markets (e-commerce, direct sales, etc.). This approach will be unfolded by the joint creation of two levels of interaction: **[1]** physical: characterization of honey; **[2]** "living laboratory": creation of a *Honey Community Living Lab (HCLL)* and a *Honey Innovation and Learning Ecosystem (HILE)* that will be the arena to collect information from beekeepers, stakeholders, and consumers to transfer and apply the new optimized models.

TECHONEY is structured in 4 main technological pillars: **[1]** creation of a consortium IoT blockchain platform that involves various actors in the honey supply chain to ensure transparency and traceability, in addition to reducing costs and ensure the traceability in the honey supply chain; **[2]** creation of a transformative learning community to ensure a smart-short-resilient shared supply chain; **[3]** characterization of the quality of honey to guarantee its traceability within the blockchain directly by consumers; **[4]** develop ICT tools for honey supply chain participants and consumers.

TECHONEY will be committed not only to promote the continuation of the direct sales of honey from producers to consumers even after the COVID crisis but also develop a common methodology and clear new optimized resilience protocol to be used by small-scale farmers, beekeepers, smallholders as a new business model with a more efficient added-value chain, sustainable with fair profit, accepted by final consumers, which will be replicable to other food products and supply chains. **TECHONEY** will help beekeepers to: **[1]** generate a traceability mechanism for honey produced in the Med. Area; **[2]** diversify markets and distribution channels offers business flexibility and freedom from dependence on a single market, which will reduce risk in the event of a crisis; **[3]** cooperate and pool resources among themselves (pooling of the workforce, etc.) for logistical flexibility and solidarity in the supply chain, which will also reduce the risks in the event of a crisis.

TECHONEY proposes to design and develop a multidimensional framework to analyse 6 full honey supply chains (farm to table) that will integrate economic, social and environmental indicators and a traceability system, with a bottom-up approach considering the stakeholders' perspectives. A consortium Blockchain, coupled with IoT (Internet of Things), system will be created to offer real-time tracking and complete traceability of honey along the supply chain from the characterization of honey in a certified laboratory, the retailer, until the end consumer.

The characterization of the quality and safety aspects of local honey through local certified laboratories jointly with the use of e-commerce and quality labelling schemes will increase the opportunity for beekeepers to be identified locally and allow them to gain access to new markets (foreign markets). The implementation of e-commerce with the mobile application



will enable local honey to be better traced by consumers who attach more value to local food and local beekeepers. **TECHONEY** contributes to increasing farm profitability and increasing flexibility and risk mitigation capabilities. A shared, short and circular supply chain will allow actors in the honey supply chain to access markets and have higher incomes, share resources and skills and save money by reducing costs (economies of scale), and increase the efficiency, sustainability and flexibility of processes to strengthen resilience and flexibility to face crises and lower risks. The learning community lab and the use of the blockchain network will secure the storing of records, will strengthen intellectual property rights, as well as bring transparency throughout the supply chain; it will reduce frauds, enhance food safety, and improve the communication between retailers and beekeepers. The traceability system offered will also allow consumers to give direct feedback to beekeepers. **TECHONEY** commits not only to promote a continuation of direct sales, but also develop a common methodology and clear new optimized resilience protocol to be used by small-scale farmers and smallholders as a new business model with a more efficient added-value chain, sustainable with fair profit, accepted by final consumers and replicable to other food products and supply chains.

Moreover, a **TECHONEY** web ICT tool consumer/farmer-centred will be developed, by testing and evaluating several machine and deep learning algorithms, providing small-scale beekeepers with key information on new markets and opportunities, contributing to a better decision making and to ensure the traceability of their product. Consumers will have exhaustive knowledge of the different honeys of the Med. area, knowing their traceability from the initial producer, guaranteeing the quality and safety of each product.

TECHONEY is a project coordinated by CITA (Spain) and funded through the PRIMA Section 2 Multitopic 2021 - Thematic Area 3-Agrofood chain - Topic 2.3.1 Increasing the resilience of small-scale farms to global challenges and COVID-like crisis by using adapted technologies, smart agri-food supply chain and crisis management tools. (RIA*[5]) " under the funding scheme of "Collaborative Project" and type of Action "Research and Innovation Actions (RIA)."



EXECUTIVE SUMMARY

- This report provides a theoretical framework and methodological structure for the Techoney project. Particularly a deep literature search carried out and more than 1000 research articles and papers have been screened.
- A short market overview in figure 1 with production values of honey in the case study countries follows the deep literature review carried out with articles on existing beekeepers learning experience and communities.
- Extension to learning communities and multi stakeholder platforms MSPs in agriculture as well as pointing out the importance of living labs with an explanation of what they are, how they work and where the important key factors are necessary to consider and to apply for the project. The review indicates the success factors of multi stakeholder platforms as well as the living lab approach.
- Essential aspects for a co-innovation, design and knowledge creation of the honey innovation and learning community lab (HILE) are explained. Besides that, the quadruple helix is explained in detail, and the screened literature most useful for the project presented in Table 3.
- The review is divided in a first theoretical drawing of apiculture, aspects of MSPs and Living Labs LLs accompanied with the methodological structure, concluding with results and recommendations for the Techoney project. Stakeholder analysis is explained in detail and case studies are mentioned.
- It is important to include the framework of MSPs and Living Labs LLs described into the Techoney project.
- Connecting communities and pollinators



1. Introduction

The report and deep literature review aim to provide a selection of articles and reviewed literature useful for the Techoney project. The deep literature review (DLR) should bring a comprehensive, coherent and critical synthesis for the Techoney project. It provides evidence of reflection for a critical thinking together with the project and fostering an apiculture innovation ecosystem dedicated to sustainability and success.

The review as indicated in the proposal and project description of WP1 *“existing experience dealing with the creation of learning communities and stakeholders’ platform of small beekeepers”* has been extended to general agricultural smallholders and agriculture. Apiculture as an intersection production between animal kingdoms (bees) and plants species in agriculture is, besides technical articles in terms of bee health and pollination services less represented in scientific literature so far.

On part of work package one (WP1) and in detail task 1.1 (T1.1) besides a deeper description and a systematic selected literature collection of multi-stakeholder platforms (MSPs) and living labs (LLs) the review covers a compact overview of the honey market itself and apiculture sector of the Mediterranean area. The classical Stakeholder analysis (SA) will be described in an overview - as T 1.2 *“Mapping and selection criteria of stakeholders”* explain it in detail in the report *“Stakeholder Mapping and In-Depth Interview”*. Additionally, studies related to the consumer side are not included at this stage as WP3 (CITA) deals with consumer behaviour, willingness to adopt/pay and technology acceptance.

1.1 OVERVIEW GLOBAL AND MEDITERRANEAN COUNTRIES HONEY MARKET

The apiculture sector is - compared to other agricultural sectors as small as it can appear but plays a very important role to almost all agricultural sectors: next to providing honey and other bee products (beeswax, propolis, pollen etc.), honeybees and apiculture contribute to a vast amount of pollination of crops, fruits,



vegetables and wild plants (European Commission, 2019). Honeybees, mainly *Apis mellifera* are one of the most important pollinators in agricultural crops and monocultures worldwide (Klein et al., 2007). They are essential and dominant pollinators to more than half of animal-pollinated crops.

However, the honey export market is, compared to other agri-food supply chain products e.g. in value traded and consumed, a niche market within most food systems. It accounts of less than 1% of total agri-food exports with an estimated value of 2.2 billion US Dollars in 2016 (Pippinato, Blanc, Mancuso, & Brun, 2020). Nevertheless, it is of high importance in all countries involved in the project and a well-known product. It also witnessed constant growth on the global market in the last decades around the world (García, 2018; Pippinato et al., 2020). Figure 1 shows the current situation in the Mediterranean countries involved in the Techoney project’s case studies:

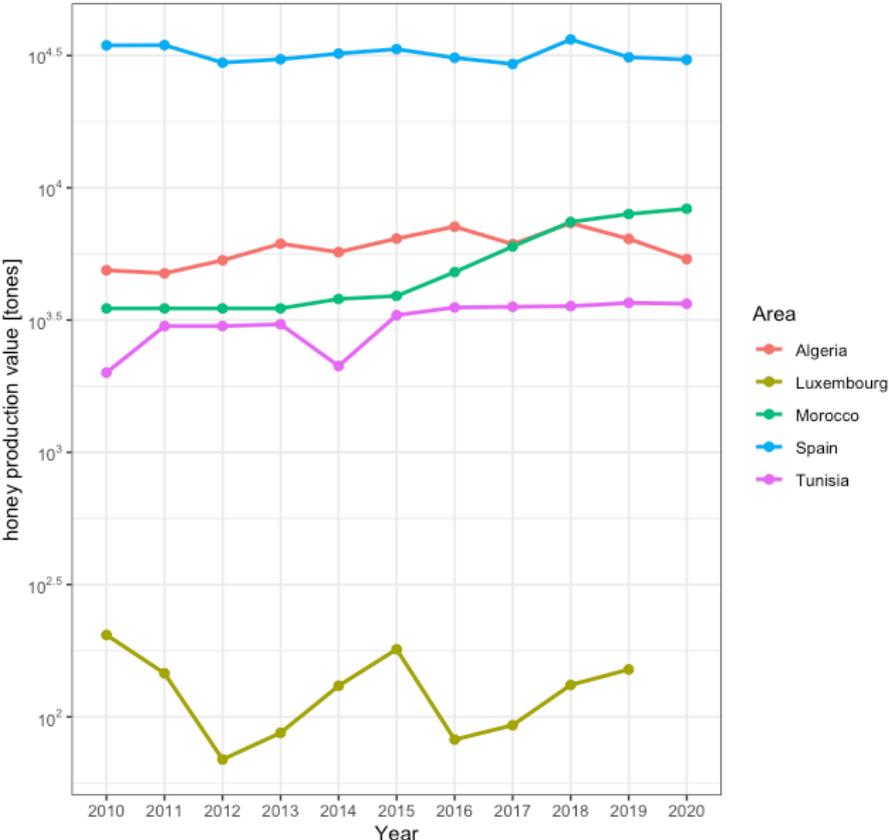


Figure 1: Honey production value of the five case study countries from 2010 - 2020. Own representation, Data source: FAOstat



1.1.1 FRAUD, AUTHENTICITY VS ADULTERATED HONEY

Although honey is part of the international food codex of the Food and Agricultural Organization (FAO) as well as World Health Organization (WHO) “*Codex Alimentarius*” founded in 1963 (Commission, 2019) fraud and alteration threatens the quality and origin of honey. Food fraud and often scaled up to food crime is rampant in honey production and has devastating consequences for honey producers. Honey is the third-most adulterated product in the world, in order to lower their costs and make more profit. It might have an influence on trust over the consumers in the product itself as well (Bicudo de Almeida-Muradian et al., 2020). Techoney combats food fraud, and it supports consumers’ transparency into making informed and sustainable food purchases.

1.1.2 APICULTURE AND AGRICULTURE

Apiculture as part of Agriculture in general has many similarities but also advantages in terms of own land needed for production. Only a small area of land is needed for keeping bees and work as a beekeeper. The beekeeping and honey production as a unique interaction between plant and animal kingdom create this complex and healthy product honey (García, 2018). There is general agreement from all academic disciplines and sites that without bees, human food security is in jeopardy where agriculture is compromised, and the environment and crop growth suffer. An investment in bees is also an investment in people, the prosperity and push of local communities and even earth as a whole. (Gring-Pemble & Perilla, 2021). It is of high importance to connect communities and pollinators for our food systems.

From a social perspective, bee farmers are not seen to be set as “common” farmers; with the main reason that bee farmers or apiculturists have often different backgrounds and as mentioned no access to land or keeping bees and producing honey as another mainstay. Also, economically there are some differences to agriculture- the bound capital is many times less than for e.g. crop production or



livestock production. Therefore, barriers to start as a beekeeper from an economic perspective are times smaller.

From a socio-economic perspective it is important to mention that in general social system factors dominate besides ecological factors and interact across scale. System analysis of honey bees and beekeeping requires thus a social innovation enhancing stakeholders' navigation in social systems and support countries in the Techoney project (Fedoriak et al., 2021).

1.2 EXISTING BEEKEEPERS' LEARNING COMMUNITY AND STAKEHOLDERS' PLATFORM EXPERIENCE

Being specific on the existing beekeepers learning community and stakeholders' platform experience thereof, so far little is reported in literature dealing explicit with beekeepers learning communities. Pointing out an article mentioned from Sustainability Journal from Vapa-Tankosić et al. titled "*Investment in Research and Development and New Technological Adoption for the Sustainable Beekeeping Sector*" here is "to understand how members of beekeeping associations, with long-standing sustainable traditions and products with registered geographical origins, perceive the investments in research and development (R&D) and new technological adoptions" (Vapa-Tankosić, Miler-Jerković, Jeremić, Stanojević, & Radović, 2020). It might have to do on one side with the niche market within the agricultural food supply chain and sector as well as on the other side with the integration of social sciences research and socio-economic aspects to this specific group. There is conducting research seen together with beekeepers and their learning community in the global south, e.g. Tutuba et al. reports on a business model innovation for sustainable beekeeping in Tanzania with a content analysis approach or Warui et al. reports on existing value addition initiatives enhancing recognition of territorial traits of three Kenyan honey (Warui, Mburu, Kironchi, & Gikungu, 2020). However, taking only technical articles into account e.g. research on bee health, colony collapse disorder (CCD), infestation of varroa destructor or



chemical analysis of pesticidal and antibiotic residues in honey and beeswax a separated review could be created with many literature and scientific effort on that side.

While the Techoney projects aim and approach is to define an efficient and trustful honey supply chain alternative; co-creation and adoption, creation of a honey innovation and learning community lab as a living lab, multi-stakeholder analysis, mapping and platforms as well as finding answers on the digital maturity and technological acceptance, identify key factors of small-holders' platform for a successful honey food supply chain and analyzations of honey consumers.

At this stage of the project (M6) it is of high importance to describe multi stakeholder platforms and living labs in detail, its methodological process and extract main recommendations.

1.3 MULTI-STAKEHOLDER PLATFORMS (MSPS)-MULTI ACTORS PLATFORM

RURAL ACTORS ARE AT CORE OF THE METHODOLOGICAL PROCESS

Multi Stakeholder Platforms (MSPs) have progressively established and are an increasing popular approach to create innovation, co-creation and collaboration within research. Due to the rapid rise of MSPs many terms are created to describe MSPs; innovation platforms, learning alliances, multi-stakeholder partnerships, alliances or partnerships to name a few (Barzola Iza et al., 2020). Attention was also set in the agricultural sector in the last two decades (Barzola Iza et al., 2020; Schut et al., 2019; van Ewijk & Ros-Tonen, 2021). Governments, agencies and many more actors involved in agricultural supply chains using the framework of MSPs in achieving innovations and scaling-up their performance (Sartas et al., 2018). The mechanism addresses the agri-food system main challenges and range from local to regional up to national and international scale.

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. It is a way of creating knowledge in regard of its development, exchange, and dissemination among stakeholders (Barzola Iza et al., 2020). It also considers innovation as a driver of rural development (Pérez Perdomo, Farrow, Trienekens, & Omta, 2016). Concluding the list of key elements, sustainability is the backbone of many MSPs, including all three dimensions: ecological responsibility, social equity and economic performance (Gurzawska, 2020; van Ewijk & Ros-Tonen, 2021).

In a nutshell MSPs are meant to facilitate the development, proclamation and exchanges of knowledge, services and resources in agricultural innovation systems (Klerkx et al., 2012). Actors are typically researchers to analyse their fundamentals, to scale processes and outcomes. Furthermore, governments, consultancies, agencies and civil society channels are involved with the aim to improve agri-food value chains in a common space along all participants. MSPs in the agri-food sector engages producers, traders, processors, distributors, public institutions, semi-public institutions, agencies as non-profit or non-governmental organizations (NGO or NPO), consultancies, civil organizations, processors, retailer and consumers. In a nutshell, all stakeholders which are involved in a certain food supply chain manifest to be part of a multi-stakeholder platform.

However, finding an adequate definition or integrative framework for the multi-stakeholder platform and explain it by a straight terminology is not expedient as it gets studied from multiple angles and disciplines with their own perspective and variety of actors involved.

Summarising, MSPs refer to both innovation platforms (Sartas et al., 2018; Schut et al., 2019) and multi-actor alliances, arrangements or partnerships. This leads us to differentiate the platforms based on immediate objectives: between a research-led and a market-lead approach in MSPs constitution or between learning-oriented (Lacombe, Couix, & Hazard, 2018); focused on innovation assimilation; and development-oriented; focused on local economic development, as Nederlof et al.



reports in her book *“Putting Heads Together: Agricultural Innovation Platforms in Practice”*.

From another perspective Thiele et al. 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 (Thiele et al., 2011).

Since the last decade, this growing scientific interest has resulted in the publication of several case studies and literature reviews. For example, (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. Schut et al. undertake a meta-analysis on innovation platforms and analysed eight case studies (Schut, Cadilhon, Misiko, & Dror, 2018). Finally Vermeulen et al. together with FAO published an extended guide to multi-stakeholder processes for linking small-scale producers to modern markets (Vermeulen, Woodhill, Proctor, & Delnoye, 2008). While it has still to be clarified of how analysing different stakeholders to create such MSPs which will be explained in the following chapter.

1.3.1 METHODS TO MSPS ANALYSIS AND EVALUATION

There are different methodologies adopted by researchers. Both quantitative and qualitative approaches have been applied to investigate key MSPs features. On a qualitative basis questionnaire are a widely used source of information. Sartas et al. use descriptive models to investigate stakeholder’s participation as a channel for MSPs contribution to the performance of research for development interventions (R4D) (Sartas et al., 2018). A project in northern Ghana investigated in factors influencing stakeholders’ willingness to participate in MSPs by a Probit model as well as a Kendall’s coefficient of concordance for testing the agreement between ranked constraints to participation (Martey, Etwire, Wiredu, & Dogbe, 2014).



Stakeholder workshops are also a useful option to extract qualitative data. Bampa et al. conducted 32 workshops in 5 European countries to detect farmers' knowledge needs on soil management in the framework of the LANDMARK research project (Bampa et al., 2019). The projects' stakeholder highly appreciated the participatory research as a means to address problems and solutions. Face-to-face engagement resulted in a sense of ownership, trust and reciprocity towards the results of the study. Other approaches follow several data sources (surveys, in-depth interviews, and focus groups) finding incentives and motivation to the participation in MSPs.

1.3.2 PLATFORM GOVERNANCE AND PARTICIPATION ISSUES

The creation of a platform made up of different stakeholders with the plurality of visions and ideas, interests, needs and styles that everyone involved joins, requires an establishment of collaborative governance mechanisms. Important to note that governance encompasses both the platform management processes as decision making, responsibility, accountability and the platform members' relationship (Nederlof, Wongtschowski, & Lee, 2011). Dentoni et al. explore in *"Harnessing Wicked Problems in Multi-stakeholder Partnerships"* the major governance issues which might arise in MSPs on a basis of three key governance processes (Dentoni, Bitzer, & Schouten, 2018):

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

Subsequently three major wicked problems are identified.

- i) first, the lack of complete information on the problems and its causes, as well as the set of possible solutions, referred as knowledge uncertainty.



- ii) second, the different affection of these problems, assumptions of its causes and interests covered by the possible solutions could lead in value conflicts.
- iii) third, wicked problems are characterised by a dynamic complexity that makes it almost impossible to stop exploring and tackling them. For operationalise the response to these problems they suggest the use of key performance indicators (KPI) described in their study and framework

Clarified MSPs' governance mechanisms, the focus has to be on participation as the key element of the platform's success. However, it is especially in Techoney important to identify stakeholders who are willing to participate over the whole project period for the establishment of the honey innovation and learning community lab. Therefore, task 1.2 of mapping the stakeholders and analyse best ways of creating a platform might be an inevitable process.

1.3.4 OUTPUT AND PERFORMANCE

The impact of MSPs on agri-food stakeholder's performance and output was discussed on the designing of effective multi-stakeholder collaborative platforms: "*Learning from the Experience of the UN Global Compact LEAD Initiative*" reported by Gitsham & Page (2014): arguing that the success of MSP depends also on:

- i) 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.
- ii) 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.



- iii) 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 to provide more efficiency. Transparency and responsiveness in the decision-making process are key indicators.

Nederlof et al. identify three main factors that lead to the disintegration of the established MSP after reviewing 12 African MPSs (Nederlof et al., 2011):

- i) Lack of funding or creation of revenue: resource mobilisation is crucial for the platform's long-term sustainability.
- ii) Irreconcilable conflicts between partners, such as those related to expected benefits share, resources access and process control/monitoring.
- iii) Unfavourable changes (instabilities) in the institutional and political context.

MSPs' outcomes should be separately considered for two levels of beneficiaries: the platform members as direct beneficiaries and the target population as indirect beneficiaries 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, exchange of ideas and the developing of new projects.

Also worth noting the intangible outcomes that MSPs may provide to the platform members, emphasizing communication. Achieving a common language to discuss strategic issues and results of cooperation outcomes; the recognition of joint work as the most effective solution to a problem.

However, tangible results are the outcomes for which the literature has provided the most evidence from 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 the global south (Pamuk, Bulte, & Adekunle, 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 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). Actions that target the whole production-distribution-retail chain are needed.

1.4 STAKEHOLDER ANALYSIS

The Stakeholder analysis (SA) is a core form for two-way exchanges of ideas which will be of high importance especially in Task 1.2 on the mapping and selection criteria of stakeholder. See also internal document of CREDA on *“Stakeholder Mapping and Semi-structured deep interview protocol for TECHONEY”*.

Stakeholder Analysis (SA) is a widely used decision-support tool (Barquet, Segnestam, & Dickin, 2022; Bendtsen, Clausen, & Hansen, 2021) which start by a clear definition to what “stakeholders” (hereafter, SH) means and which guidelines follow to perform the analysis, including identification, determination of interests, power, influence and how to document and report findings (Bendtsen et al., 2021). In the SA, individuals or groups of individuals who are directly or indirectly affected by a project or organization, have interest in or can affect a decision, are identified and their roles, relations and/or interests are systematically analysed. In this context, the first step in the SA is the needs to clearly define what the term “stakeholder” includes.

The Stakeholder Theory (ST) stress the interconnected relationships between an organization or projects, and its customers, suppliers, employees, investors, communities, social entities and other agents who have a stake in the organization or projects (Jones et al., 2017). Accordingly, organizations or projects deal with a multitude of constituent groups and a deep analysis of what these relationships mean is needed. Freeman (1984) developed a comprehensive and integrated



understanding of the stakeholder concept. More in detail, as for the stakeholder definition he/she is who has specific knowledge or direct or indirect relation about the studied idea, project or initiative. The stakeholders have a relation and are motivated by the specific project or initiative aiming at influencing on its implementation. The stakeholder approach seeks to broaden management's vision beyond profit maximization. Particularly, ST deals with the nature of the relationships between the organization and its various stakeholders especially in terms of the processes and outcomes for the organization/project and the stakeholders.

1.5 LIVING LABS

The concept of Living Labs (LLs) became first a popular boost in 2006 where the European Network of Living Labs (ENoLL) was founded and the Commission declared its support by stimulating project under the Finnish Presidency of the Council of The European Union (EU). It is clearly seen in the evolution of the number of publications mentioning the term "living lab" over time, with a strong increase from 2006 onwards (Gamache et al., 2020).

Living labs are at the cross section of open innovation which can be understood as a paradigm for using not only internal but also external ideas and user innovation. Which refers to "intermediate information" e.g. in a food supply chain intermediate user or also consumer users instead of producers. In short a living lab as a distributed innovation process is a potential bridge between open innovation and user innovation (Schuurman et al., 2013).

The aim of the network is to offer a gradually growing set of network services to support the "*Innovation Lifecycle*" for all actors in the system: beekeepers, end-users, small and medium-sized enterprises (SMEs), corporations, the public sector and academia (Bergvall-Kåreborn, Ihlström, Ståhlbröst, & Svensson, 2009). The methodology provides several merits and therefore an understanding is highly relevant that all agents involved in innovation must select the requisite



methodologies to appropriately address their respective challenges (Almirall, Lee, & Wareham, 2012).

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 & Leminen, 2011). LLs user 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. They can simply contribute to the LL methodology by expressing their needs and desires or directly shape innovation by acting as testers or co-producers.

Several literature reviews on living labs have been published over the past few years e.g.: (Habibipour, 2018; Schuurman, De Marez, & Ballon, 2015; Westerlund, Leminen, & Rajahonka, 2018) including McPhee et al. on *“Defining the characteristics of agroecology living labs”* (McPhee et al., 2021).

Almost every day a new study emerges providing evidence on negative environmental, soil, insects, social, and economic consequences of the current agro-industrial system; these paths might be a reason as well that the European Commission launched its *“Farm to Fork”* (F2F) strategy as the foundation of the European Green Deal. With its aim reaching the goal of creating a more sustainable European food system. The green deal / F2F action plan as the name might reveal encompasses all stages from production to consumption, envisioning equitable livelihoods for smaller primary producers, a transition towards sustainable and pesticide free farming practices, as well as promoting healthy and sustainable soils and 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 as seen in McPhee et al., 2021. It also



requires that all actors concerned by this issue (farmers, food industry, companies, retailers, researchers, students, non-governmental organizations, communities, governmental institutions, financial institutions, small and medium-sized enterprises, consumers, advisory services and other members of the of the European 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, innovation and knowledge creation throughout the value chain, because of their user-centric approach to develop and co-create innovative solutions in partnership with stakeholders.*** With its main promise to implementing it and tested in the user's real-life context.

1.5.1 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-Kåreborn et al., 2009). They are conceived as a harbour 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, a user-centred approach, creative space (Zavratnik, Superina, & Duh, 2019), or as in Techoney project a honey innovation and learning community lab (HILE).

1.5.2 QUADRUPLE HELIX INNOVATION SYSTEM APPROACH

The quadruple helix model (QHM) is an extension of the created triple helix model and emerged out of the business and management field. Regional innovation systems (RISs) have been widely imposed as the intertwining of several helices (Carayannis, Grigoroudis, Campbell, Meissner, & Stamati, 2018). Among them, the



Triple Helix Model (THM) as a well-established model of innovation, which encourages interaction among academia, industry and government (Etzkowitz & Leydesdorff, 2000). The QHM initially suggested by (Carayannis & Campbell, 2009) introduces a fourth helix: Civil Society/Citizens (

Figure). QHM's considers citizens as key actors with not only involvement in product development and testing, rather they actively participate in developments by suggesting new innovations, co-create ideas and actively involving in the process for connecting users to stakeholders (Compagnucci, Spigarelli, Coelho, & Duarte, 2021) However, despite the undeniable contribution of the QHM, there is a methodology challenge on the way of the citizens introduce their public perspective e.g. how the different actors define their functional role of the society as a fourth pillar in collaboration with the innovative processes (Taratori et al., 2021). Considering these premises, the LL was proposed as a possible platform for quadruple helix innovation, as the European Union is effective on producing knowledge, but not as effective when it seeks to transfer it to market. However, the creation of LLs is just one of the responses of the EU, introduced in the context of the QHM, to invest in economic competitiveness and society for increasing sustainability challenges.

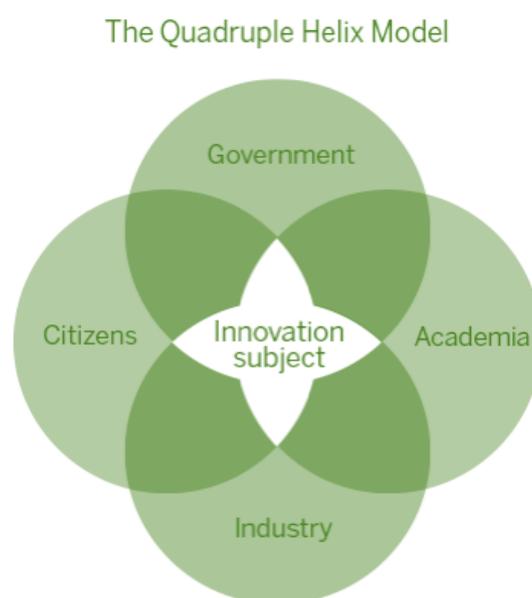


Figure 2. Visualisation of a Quadruple Helix Model (QHM) source: Report T1.2

1.5.4 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 and project-based risk (McPhee et al., 2013) and spread research costs (Kviselius, Andersson, Ozan, & Edenius, 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 achieving (market- and investment-focused) objectives, outputs, and outcomes that they value (Paskaleva & 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.

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. Users can be considered sources of innovation, and firms or participants can identify unique insights by joining all involved stakeholders about their needs and promises for observing them during the use of existing products and tracking their behaviour during consumption processes (Dell'Era and Landoni, 2014). Dell'Era et al., also note that all LLs involve users in the co-creation process, but in some cases the participation is 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 a



consequent marketability of the project outcome, but reduce the efficiency of the innovation project in terms of time, cost and path (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.

1.5.5 CASE STUDIES

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

It also shows that qualitative methods of data collection are the more common methods used in the evaluation of LLs. Quantitative methods appear in the literature but are more common in assessing LLs focused on technology development and technology adoption. Table 1 presents examples of Living Labs found after a literature and online search relating to agriculture, food, rural development and sustainability.

Table 1. Living Labs platforms reported examples.

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

2. Methodology

The literature review presents a systematic methodology and synthesis of the characteristics and findings using Scopus and Web of Science (WoS) as well as papers out of previous random search activities on snowball search fulfilling the project scope. Furthermore, papers found within the search scope linking with the topic via a citation screening have been also added. In total the deep literature review covers publications from 2007 to 2022 (till September). Out of 1227 articles (often articles appear in different searches and on both search platforms) and papers screened 42 were shortlisted from reports and peer-reviewed articles in scientific journals based on this conducted analysis. In detail, with the subject of the review, we follow the steps below to sample and select the reviewed papers:

- i) An initial secondary data collection using two online scientific citations databases - Scopus and Web of Science.
- ii) A soft screening of the results of each database (search criteria) by matching the papers' titles and abstracts with our research goal. In table 2. column R1 shows the number of search results after applying the filters allowed by each search engine and deployed the first soft screening.
- iii) A deep screening of R1 results through a paper's content analysis. The selected articles meet one of the following conditions: i) analyse a specific topic in or case study together with apiculture, ii) address participation or governance issues, iii) carry out a literature review on overall involved



actors of the honey supply chain, and iii) show results, limitations or impacts related with the search.

Table 3 shows the final number of results after this individual filter. A supplementary excel file of further information on the presented literature as doi, country and journal published will be uploaded to the shared teams' folder of Techoney.

Table 2: Search criteria R1 and R2

SEARCH CRITERIA	R1	R2
BEEKEEPER AND STAKEHOLDER	42	5
STAKEHOLDER AND HONEY	90	4
STAKEHOLDER AND CO-CREATION AND FOOD	63	5
HONEY AND TRACEABILITY	89	6
BEEKEEPER OR HONEY AND MARKET	117	13
LIVING LAB AND FOOD OR HONEY OR BEEKEEPING	84	9
LIVING LAB AND STAKEHOLDER	386	17

Table 3: List of studies consulted in this review including apiculture: authors, title of work, search keyword, keywords of article, year published

AUTHOR	TITLE	SEARCH KEYWORDS	ARTICLE KEYWORDS	YEAR
Ameline Lehebel-Peron and Pauline Sidawy et al.	<i>Attuning local and scientific knowledge in the context of global change: The case of heather honey production in southern France</i>	beekeeper and stakeholder	Heather honey Environmental change Local ecological knowledge Community-based conservation	2016
Patel et al.	<i>Using a social-ecological system approach to enhance understanding of structural interconnectivities within the beekeeping industry for sustainable decision making</i>	beekeeper and stakeholder	local ecological knowledge; migratory beekeeping; social-ecological system; sustainability	2020
Kouchner et al.	<i>Bee farming system sustainability: An assessment framework in metropolitan France</i>	beekeeper and stakeholder	Apiculture Beekeeping Forage resource management Participatory design Multicriteria assessment	2019



Fedoriak et al.	<i>Stakeholders' views on sustaining honey bee health and beekeeping: the roles of ecological and social system drivers</i>	beekeeper and stakeholder	Social-ecological system Ecosystem services Honey bee Rural development Beekeeping practices	2021
Suryanarayana n et al.	<i>Collaboration Matters: Honey Bee Health as a Transdisciplinary Model for Understanding Real-World Complexity</i>	beekeeper and stakeholder	complex systems, interdisciplinary science, policy/ethics, stakeholders, honey bee	2018
van Ewijk et al.	<i>The fruits of knowledge co-creation in agriculture and food-related multi-stakeholder platforms in sub-Saharan Africa - A systematic literature review</i>	stakeholder and co-creation and food	Systematic review Knowledge co-creation Multi-stakeholder platforms (MSPs) Food	2021
Sagara Garcia et al.	<i>Agro-food projects: analysis of procedures within digital revolution</i>	stakeholder and co-creation and food	Critical success factors, Agile, Stakeholder collaboration, Value co-creation, Diffusion of innovation, Client satisfaction, End-user collaboration, Digital agriculture, Participatory techniques	2019
Vargas et al.	<i>Co-creation of healthier food retail environments: A systematic review to explore the type of stakeholders and their motivations and stage of engagement</i>	stakeholder and co-creation and food	co-creation, food outlets, food retail environments, participatory research	2022
Kok et al.	<i>Transforming Research and Innovation for Sustainable Food Systems—A Coupled-Systems Perspective</i>	stakeholder and co-creation and food	food systems; complexity; sustainability transitions; societal transformation; transdisciplinarity; research and innovation; boundary innovations	2019



Salvia et al.	<i>Multi-actor platform as a tool to enhance networking of sustainable socio-ecological food systems</i>	stakeholder and co-creation and food	co-creation, food system, authenticity, multi-actor platform approach, design	2019
Kleinman et al.	<i>Pollinating Collaboration: Diverse Stakeholders' Efforts to Build Experiments in the Wake of the Honey Bee Crisis</i>	stakeholder and honey	Stakeholder Collaboration, honey bee crises	2019
Lisa Gring-Pemle and German Perilla	<i>Sustainable beekeeping, community driven-development, and tri-sector solutions with impact</i>	stakeholder and honey	Sustainable development, Beekeeping, Sustainable business, Community-driven development, Honey Bee Initiative, Tri-sector solutions	2020
	<i>Report from the European Commission to the European Parliament and the council on the implementation of apiculture programmes</i>	stakeholder and honey	Apiculture Sector, national apiculture programmes, implementation, report EU	2019
Warui et al.	<i>Existing value addition initiatives enhancing recognition of territorial traits of three Kenyan honey</i>	stakeholder and honey	Baringo and Kitui Counties, geographical indications, honey, territorial traits, value addition initiatives, West Pokot	2020
Rünzel et al.	<i>Designing a Smart Honey Supply Chain for Sustainable Development</i>	Honey and traceability	smart honey supply chain food security counterfeit goods mislabelled goods product differentiation honey sector smart supply chain sustainable agriculture food safety honey fraud smart agricultural technologies data-driven honey yield prediction	2021

Balletta, A., Locher, M.V.	<i>Innovation, networks and territory. An analysis of the beekeeping system in downtown Santa Fe, Argentina</i> [Innovación, redes y territorio. Un análisis del sistema apícola del centro de Santa Fe, Argentina]	Honey and traceability	Actors' networks, innovation system, beekeeping, coordination mechanisms, territory, Santa Fe, Argentina	2022
MARCHESI et al.	<i>Automatic Generation of Ethereum-Based Smart Contracts for Agri-Food Traceability System</i>	Honey and traceability	Agri-food product traceability, honey blockchain, smart contract, supply chain	2022
Sirvastava et al.	<i>Application of blockchain technology for agri-food supply chain management: a systematic literature review on benefits and challenges</i>	Honey and traceability	Traceability, literature review, digital adoption, food supply chain	
Menozi et al.	<i>Motives towards traceable food choice: A comparison between French and Italian consumers</i>	Honey and traceability	Food traceability Theory of planned behaviour Chicken Honey Trust Habits	2012
Kehagia et al.	<i>European consumers' perceptions, definitions and expectations of traceability and the importance of labels, and the differences in these perceptions by product type</i>	Honey and traceability		2007
Pippinato et al.	<i>A Sustainable Niche Market: How Does Honey Behave?</i>	Honey and market	honey; international trade; niche market; gravity model; econometrics	2020
Lehebel-Peron et al.	<i>Attuning local and scientific knowledge in the context of global change: The case of heather honey production in southern France</i>	Honey and market	Heather honey Environmental change Local ecological knowledge Community-based conservation	2016
Norberto L. García	<i>The Current Situation on the International Honey Market</i>	Honey and market	import, export, trade data, honey	2018



Popescu et al.	<i>Bee honey production concentration in Romania in the EU-28 and global context in the period 2009-2018</i>	Honey and market	bee hives, honey production, concentration, Romania	2020
Saner et al.	<i>Alternative Marketing Strategies for Honey and other Bee Products in Turkey</i>	Honey and market and beekeeper	Beekeeping, honey, marketing, cooperatives, Turkey	2008
Bhikolimana Tutuba et al.	<i>Business Model Innovation for sustainable beekeeping in Tanzania: A content analysis approach</i>	Honey and market and beekeeper	beekeeping, commercial beekeeping, business model innovation, Tanzania	2019
Bušová et a.	<i>Comparing the quality of honey from beekeepers and honey from the market chain</i>	Honey and market and beekeeper	blossom honey; honeydew honey; adulteration; beekeeper; market chain	2018
Khaoula et al.	<i>Consumption, preferences and habits of purchasing consumers of honey in Morocco</i>	Honey and market and beekeeper	<i>Honey, Consumption, Purchase, Preferences, Behavior, Morocco</i>	2019
Šedík et al.	<i>Generation marketing in strategic marketing management: case study of honey market</i>	Honey and market and beekeeper	honey market, consumer behaviour, age cohorts	2018
Ballco et al.	<i>Investigating the price effects of honey quality attributes in a European country: Evidence from a hedonic price approach</i>	Honey and market and beekeeper	hedonic price, honey, market price effects, quality attributes, retail stores	2022
Vapa-Tankosic et al.	<i>Investment in Research and Development and NewTechnological Adoption for the Sustainable Beekeeping Sector</i>	Honey and market and beekeeper	apiculture investment; research and development; sustainability; beekeepers; honey; geographical origin; food; label	2020
Tomljanović et al.	<i>Production, practices and attitudes of beekeepers in Croatia</i>	Honey and market and beekeeper	beekeeping economics; honey production; treatment of honeybee diseases; organic beekeeping, Croatia	2020



Guiné et al.	<i>Characterization of Beekeepers and Their Activities in Seven European Countries</i>	Honey and market and beekeeper	beekeeper; bee products; beekeeping sector; Hofstede dimensions	2021
Vercelli et al.	<i>A Qualitative Analysis of Beekeepers' Perceptions and Farm Management Adaptations to the Impact of Climate Change on Honey Bees</i>	Analysis of Beekeeper	honey bee; climate change; beekeeping; focus group; SWOT analysis; bee hive management; beekeeping farm	2021
Hvitsand et al.	<i>Establishing an Agri-food living lab for sustainability transitions: Methodological insight from a case of strengthening the niche of organic vegetables in the Vestfold region in Norway</i>	living lab and food or honey or beekeeper	Action research Living lab Boundary Cross-sectorial Multi-actor Visioning	2022
Wolfert et al.	<i>Organizing information integration in agri-food—A method based on a service-oriented architecture and living lab approach</i>	living lab and food or honey or beekeeper	Information integration Service-oriented architecture (SOA) Business process management (BPM) Open innovation Interoperability Arable farming	2009
McPhee et al.	<i>The Defining Characteristics of Agroecosystem Living Labs</i>	living lab and food or honey or beekeeper	living lab; agroecosystem; agriculture; innovation; characteristics; sustainability; typologies; placed-based	2021
Rowan et al.	<i>Empower Eco multiactor HUB: A triple helix 'academia-industry authority' approach to creating and sharing potentially disruptive tools for addressing novel and emerging new Green Deal opportunities under a United Nations Sustainable Development Goals framework</i>	living lab and food or honey or beekeeper	Just transition, New Green Deal, Sustainability, Open research, Multiactor hub, Circularity, UN Sustainable Development Goals	2021



Gamache et al.	<i>Can living labs offer a pathway to support local agri-food sustainability transitions?</i>	living lab and food or honey or beekeeper	Living lab Sustainable transition Local agri-food system Commons Sustainability Social experiment	2020
Ciaccia et al.	<i>Organic Agroforestry Long-Term Field Experiment Designing Trough Actors' Knowledge towards Food System Sustainability</i>	living lab and food or honey or beekeeper	living lab; participatory action research; agroecology; organic agriculture; system re-design; long-term experiment	2021
Feche et al.	<i>Building a transformative initiative for a territorialized agri-food system: constructing a living-lab and confronting norms? A case study from Mirecourt (Vosges, France)</i>	living lab and food or honey or beekeeper	Territorialized agri-food system Living-lab approach Social innovation Normalization Mirecourt (Vosges, France) Transformative initiatives	2021

3. RESULTS

The results of the literature review and search of documents is twofold: First, the explicit task to review literature on “existing beekeepers’ learning community and stakeholders’ platform experience” turned out to be too close-meshed as in terms of enough articles and literature done in this direction. The question of adoption to digital applications, using the new waves of digitalization, and linkage with more direct and integrated food supply chains towards a real producer-consumer connection seems also not yet established in the apiculture sector as well as in the integration of the whole food supply chain. On the one hand it is of great chance to change this within the Techoney project for showing and present initiatives together with an apiculture supply chain digitalization approach. On the other hand, placing the Techoney seed and let them root requires a creative open designed user-centric and decentralized innovation process of all participants, partners and future stakeholders involved in the innovative digital approach.



Even so, the scientific literature in the reports present a valid basis for the project scope and point out challenges for the multi-stakeholder platform, their analysis and creation to subsequent mapping among these. The living labs approach is explained in detail and is a promising tool for the project. The goals for agri/api-food stakeholders will be the innovation process, linkage of user innovation as well as design the pathway for an efficient honey farm to fork strategy. Thus, the creation of MSPs/LL resulting in the HILE ***responds to these shared challenges, seeking to address key issues and meet the stakeholder's needs.***

4. APPLICATION IN TECHONEY

The review provides Techoney with an adequate theoretical framework on multi stakeholder analysis, living labs and a comprehensive review of the literature and case studies of the existing literature on apiculture with the main objective to empower the Mediterranean beekeeper's through the definition, enhancement, and transfer of competitive and efficient honey food supply chain alternatives. To fulfil this main objective, the project is committed to create a honey innovation and learning Ecosystem Living-Lab with a multi-agent approach.

Techoney promote the continuation of the direct sales of honey from producers to consumers and develop a common methodology and clear new optimized resilience protocol to be used by small-scale farmers, beekeepers, smallholders as a new business model with a more efficient added-value chain, sustainable with fair profit, accepted by final consumers, which will be replicable to other food products and supply chains. For TECHONEY, helping beekeepers to generate a traceability mechanism for honey produced in the Med. area, and to diversify markets and distribution channels offers business flexibility and freedom from dependence on a single market, which will reduce risk in the event of a crisis. In addition, helping beekeepers to cooperate and pool resources among



themselves (pooling of the workforce, etc.), offers logistical flexibility and solidarity in the supply chain, which will also reduce the risks in the event of a crisis.

KEY FACTORS FOR SUCCESS AND FAILURE OF SMALL-HOLDERS' PLATFORM FOR CO-CREATION AND ADOPTION OF INNOVATIONS

The essential participatory approach of the project is based on the creation of a Honey Innovation and Learning Ecosystem (HILE) Living-Lab (LL) that will be the arena to collect information from the honey sector and consumers and transfer and apply the new optimized models. The HILE is based in the quadruple helix innovation system approach incorporating local clusters of beekeepers, small manufacturers and distributors, public institutions, academia, research centres and consumers. The HILE will hold multiple group activity types (workshops, training activities and networking) allowing a full definition of an innovative honey supply chain alternative.

Described in the review, MSPs as well as living labs (which go hand in hand in many points) 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 involved actors, but also provide them with market information and improve market access. These are significant achievements that would probably be unattainable without the platform's action. MSPs and LLs can redefine the beekeeper's 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, intermediary reduction fraud prevention and less dependency for import honey out of China. The literature provides enough successful case studies to convince us that the use of such collaborative platforms is appropriate for the project's development. 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. Living lab and MSP drivers must take an effort to foster stakeholder participation, on the basis of trusting relationships and effective governance. 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 Techoney project will be.

5. MAIN RECOMMENDATIONS FOR THE TECHONEY PROJECT.

The review of existing experience dealing with the creation of a honey innovation and learning community lab through an multi stakeholder platforms' approach as well as living lab ecosystem creation presents these essential concepts in detail. It is recommended to build a shared vision among all stakeholders, co-create through communication and concept presentation to improve also local knowledge production and innovation, design local set-up and bridge the gap between thinking and knowing and doing.

The involvement in innovation and knowledge production process will be key to success of the project. With characterizing the expected role of participants as providers of knowledge and targets for learning and co-innovation will lead to success. A living lab as a core forum for two and multi way exchange of ideas for co-learning, creation finest and knowledge sharing among the wide variety and involved stakeholder. Rethinking the development of healthier and more sustainable agri-food systems requires us to build new ways for "people to organize themselves in space and time in order to obtain and consume their food" (Malassis, 1994).

Concluding this report with the words:

Connecting Communities and Pollinators!



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