Can living labs offer a pathway to support local agri-food sustainability transitions?

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Abstract:

Living labs are defined as both an approach and an arena for supporting experimentation in natural settings with a wide range of actors. In this article we explore the potential and limits of living labs for analysing and supporting the local transition of agri-food systems. We base on a bibliometric analysis and insights from our transdisciplinary research team's experience with agroecological transition. It appears that living labs informed mainly by strategic managerial and user-centric approaches benefiting the dissemination of (technological) innovation, require certain changes in order to address sustainable development issues. Citizen-centred living lab approaches are better suited to increase capacity building and empowerment through action, iterative learning, and capitalization of experience. Faced with the specific issues of local agri-food system transition, we propose to (re)-introduce the notion of "commons" in order to support the collective territorial management of both material resources (food, environment) and immaterial resources (values, ideas).

Keywords: living lab; sustainable transition; local agri-food system; commons; sustainability; social experiment.

Highlights :

- Few researchers have addressed living labs in the context of agri-food sustainability transitions.
- Living labs focused on product innovation with a market rationale are not conducive to support sustainability transitions.
- Citizen-centric living labs are more suitable to support sustainability transition particularly in urban context.
- The concept of commons appears relevant to guide living labs towards the transition of sustainable local agri-food systems.

1. Introduction

Throughout the world, many collaborative initiatives are attempting to address sustainability issues by promoting local, long-term transition processes involving multiple actors. These new forms of governing transitions (like transition experiments and transdisciplinary sustainability projects) are underpinned by the notion of experimentation in "real-life settings" (Nevens et al., 2013). Among these approaches, living labs are promoted as catalysts for innovation (Mulvenna et al., 2011). They are defined as "user-centred, open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real life communities and settings" (European Network of Living Labs website) and have received extensive political support, particularly as part of innovation and regional development policies (European Commission, 2006). They are also of scientific value, to foster interaction between science and society (Houllier, 2016).

This article investigates the characteristics of living lab approaches that support the development of healthier and more sustainable local agri-food systems (Lamine et al., 2012). Many studies have shown the negative environmental, social and economic consequences of the dominant agro-industrial system. They have called for more sustainable models to be invented as part of a truly inclusive societal project encompassing food and education, knowledge transmission and science, justice and social equity, health, and so on (Francis et al., 2003). Although eating constitutes a daily activity for each and every one of us (and is a strong expression of culture, health, and know-how), citizens are often cognitively, geographically and politically disconnected from the steering of agri-food systems (Colonna et al., 2011). Yet health and environmental crises, high unemployment rates in rural areas, and the difficulties experienced by new farmers to acquire agricultural land, all attest to how deeply "territorialized" this issue is. 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. It also requires that all the actors concerned by this issue (farmers, politicians, associations, etc.) adhere to the same approach. If this could be achieved, living labs would offer a promising avenue to enable local inhabitants to be involved in the production of their food.

Living labs can take on very different forms, particularly as regards goals, activities, participants, and context (Habibipour, 2018; Steen and van Bueren, 2017). They are presented not only as an approach but also as a concept, a method or a locus of experimentation (Bergval & Stahlbrost, 2009). Several reviews of the literature on living labs have been published over the past few years (Schuurman et al., 2015; Santonen, 2018; Westerlund et al., 2018; Mcloughlin et al., 2018). They have sought to better define this concept, as well as the way in which certain research communities (such as action design research and innovation management) articulate it. Yet none of them relate to the agroecological transition of agri-food systems. Thus, the research questions of this article are: how do living labs help or hinder the transition of agri-food systems in the territories? What kind of transition do they design? Are there "types" of living labs best suited to this purpose?

In order to answer these questions, we compare the existing literature on living labs with the current challenges of territorialized agri-food systems transition. To do so, we conducted an analysis of the scientific literature on living labs, based on a bibliometric analysis of the articles referenced in the Web of Science database and an analysis of the spatial representation of the terms used (bibliometric mapping approach). This is presented in the results part of this article. Then, in the current literature on agri-food system transitions, we selected key points that seemed to us to be relevant to a comparison of the results of our bibliometric analysis. The last part of this article discusses the characteristics and particularities of the development of living labs to support transitions towards healthier and more sustainable local agri-food systems.

2. Analysis method

First, we carried out a bibliometric analysis to better identify and understand the different uses of living labs, so as to ascertain their suitability for supporting agri-food system transitions. We started by compiling a corpus of scientific articles, from 1969 till 2019, by searching for all articles in the Web of Science database that mentioned the term "living lab" in their title, abstract or keywords. This corpus is comprised of articles written in English only, and excludes grey literature. We then used the Web of Science website's analytical tools to build a first representation of the landscape of the living lab concept.

Second, we extracted the text of all titles, keywords and abstracts (where available) from the corpus, so as to map all the textual occurrences using the VOS Viewer software (Van Eck and Waltman, 2007). This type of cartographic representation for bibliometric analysis (Heersmink, 2011) seeks in particular to represent the frequency of occurrences of nominal groups within a corpus and the links that connect them. We built the map by following several analytical steps (Fig. 1).

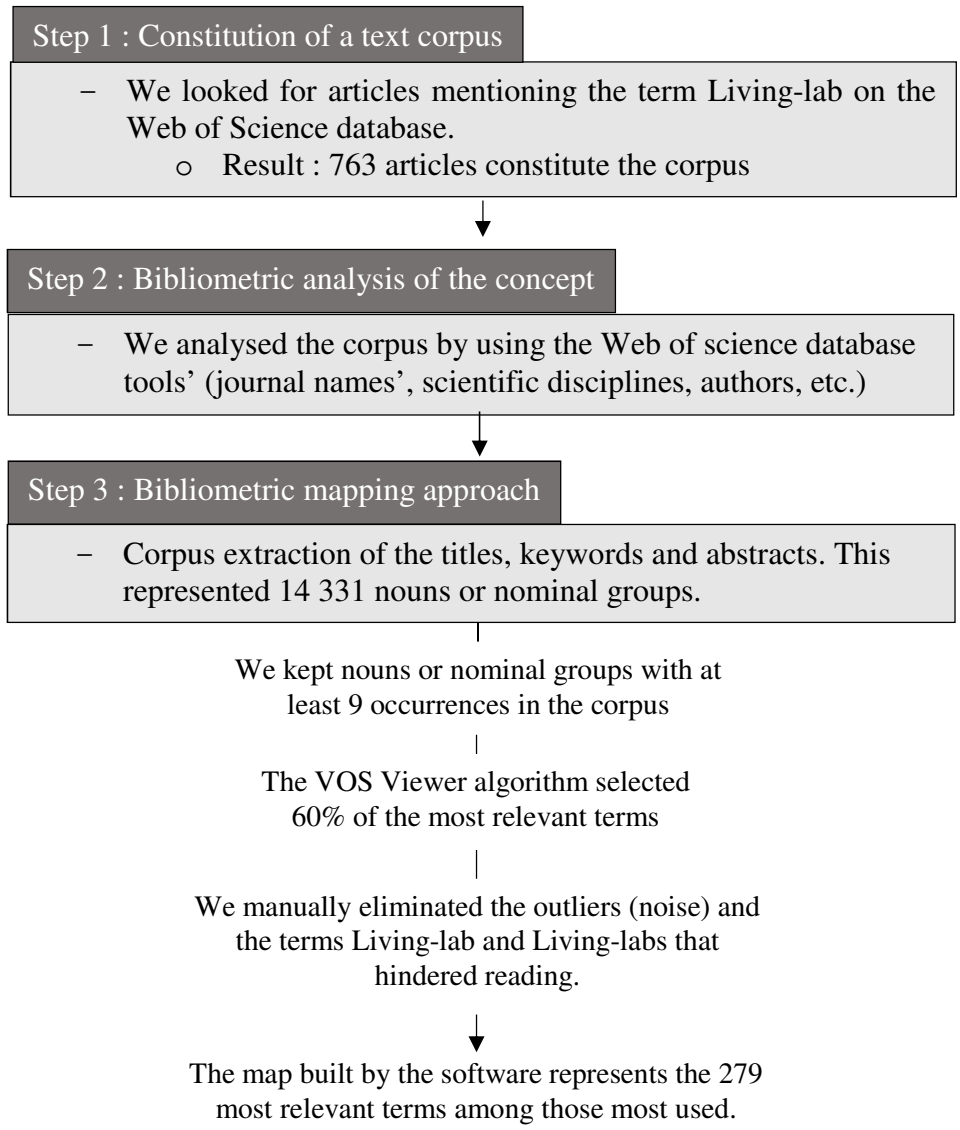


Figure 1: Schematic representation of the method used for the bibliometric analysis

In parallel with this analysis, we have highlighted those characteristics in the literature on agri-food system transitions that we think are relevant to compare with the results of the Living Lab concept analysis. In doing so, we have based our analysis on a reading of the current literature on both living labs and agri-food system transition. We have also drawn on our own experience in the field of support for in agri-food system transitions and in the construction of a living lab to support healthy and sustainable food in a rural area (Coquil & al, 2018).

3. Results of the bibliometric analysis

3.1. WoS analysis: an evolution of the use of the term

Use of the term living lab in the literature is recent (Fig. 2). It has increased significantly since 2006, when the European Network of Living Labs (ENOLL) was launched by the European Commission as part of its policy to improve competitivity. 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 today, which has most certainly impacted the number of publications. Given this historical background, the vast majority of publications on the subject are now European (Table 1).

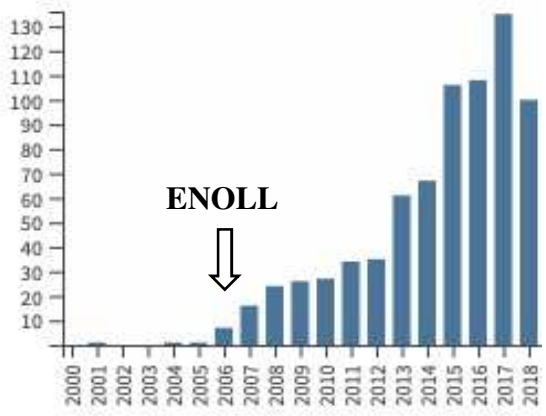


Figure 2: Evolution of the number of publications mentioning the term "living lab" over time

Table 1: Table listing the countries most represented in the publication of articles on Living labs

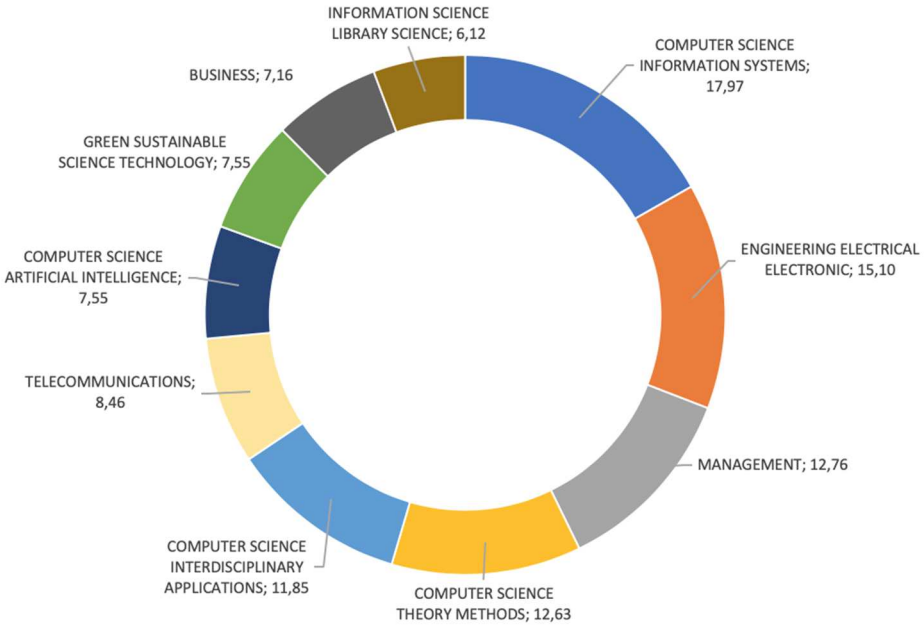
Authors' countries	Records	% of 768 papers
Italy	100	13
Netherlands	81	11
Germany	76	10
Finland	69	9
Belgium	65	8
France	59	8
Spain	59	8
USA	50	7
Sweden	49	6
England	42	5
Other countries	118	12
29 articles (3.8%) did not contain sufficient data to be categorized		

The term "living lab" is mainly used in disciplines related to computer science and new information and communication technology. The three journals that mention the term "living lab" the most are *Technology Innovation Management Review*, *Lecture Notes in Computer*

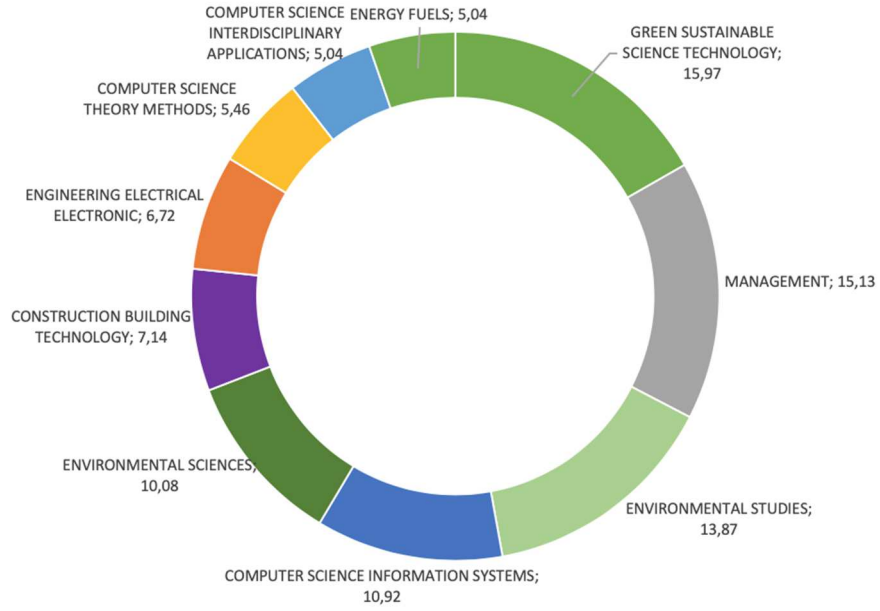
Science, and *Information and Communication Technologies and the Knowledge Economy*. The Web of Sciences categories reveal the same trend (Fig.3a). The vast majority of the articles address topics related to artificial intelligence and digital technology, such as "computer science information systems", "computer science theory methods", and "telecommunications". Less significantly, the articles also relate to topics such as "management" and "business". Environmental issues are addressed through the lens of new technology, with a category titled "green sustainable science technology".

Figure 3: (a) 10 Web of Sciences categories most represented in the corpus between 1969 and 2018 and (b) for the years 2017-2018 more specifically.

a.



b.



It is interesting to note that the themes addressed have evolved in recent years. In 2017 and 2018 (Fig. 3b), 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 living labs literature (and certainly in scientific literature more generally), with growing interest in sustainability issues.

3.2. Semantic cartographic analysis

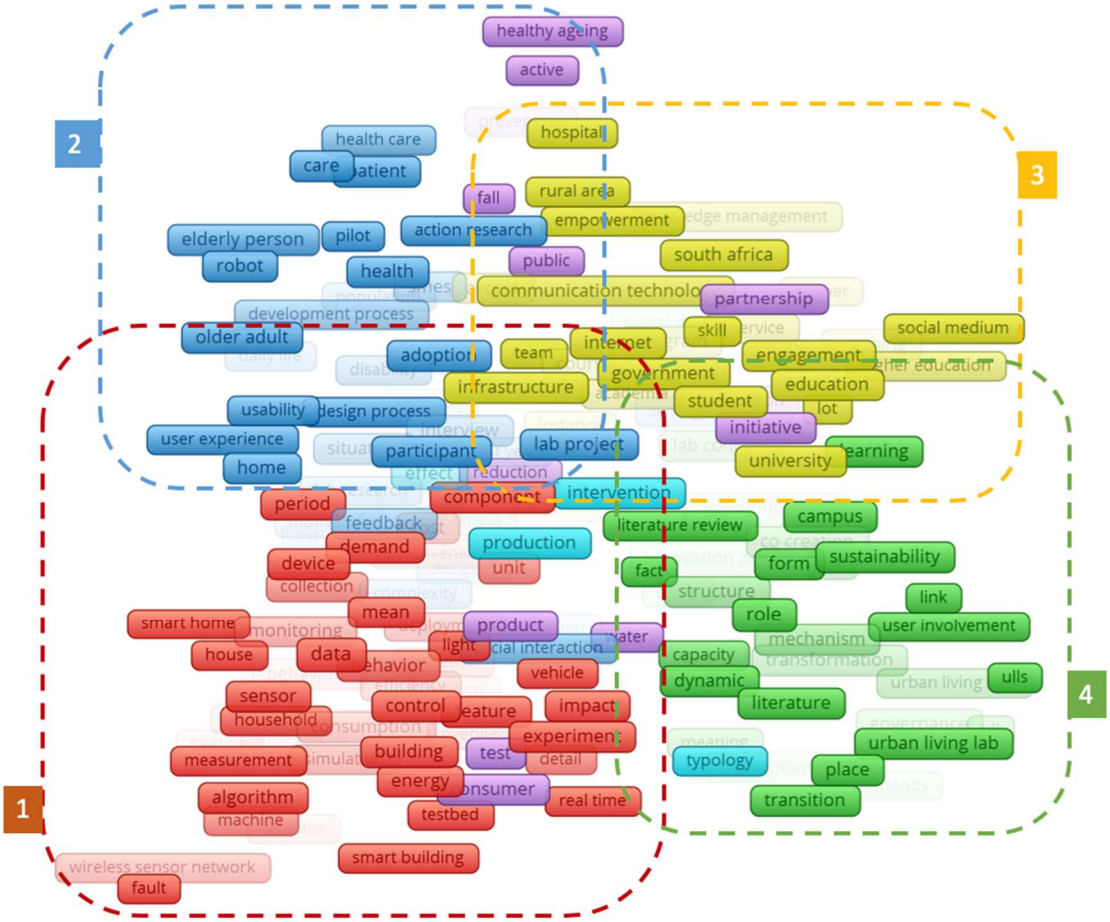


Figure 4: Mapping of the terms in the titles/keywords/abstract of articles mentioning the term "living lab" (minimum 9 occurrences)

This map (Fig.4) is based on the frequency of occurrence of the terms highlighting the main characteristics of the living lab concept. This mapping of the terms used has three dimensions:

(i) The words displayed on the map are those that stand out with the highest occurrence. A more detailed list is provided in the Appendix.

(ii) The relationship between the items is based on the number of articles in which the terms appear together. Thus, the closer two terms are spatially on the map, the more they are used together in the articles.

(iii) The colours identify clusters, that is, groups of words that tend to appear more frequently together, thus highlighting rationales in the mobilization of the notion of a living lab.

The text mapping shows five clusters (see Appendix) but four areas can be identified, delimited by dotted lines. Area 1 mainly includes terms from the field of technology. Area 2 covers themes surrounding health. Areas 3 and 4, which are more closely intertwined, encompass terms relating to education and sustainability transitions, respectively.

Approaches represented by the terms in Areas 1 and 2 seem to give particular importance to "user experience", examined primarily to study the usability of an interface. In that respect, we find terms such as "user", "control", "demand", "measurement", etc. The user experience approach involves investigating the interaction between a user and a device through an analysis of uses. Individuals are involved in the process to enhance their experience using a prototype that designers will alter, based on feedback. The distinction between designers and users therefore still applies. Hence, terms such as "acceptance" are used.

These approaches also focus on specific objects with a strong interest in "new technology" (data, algorithms, wireless sensor network, etc.) and health, particularly that of the elderly (older adults, elderly, senior citizen). Finally, the question of sustainability is addressed here through the lens of "product development" (electric vehicle, smart home, etc.). The approach targets an object or a category of users and is therefore not systemic.

With regard to "real life settings", the terms used refer to physically delimited environments. They are "ambient assisted living" devices, which mobilize data on objects ranging from vehicles to the home, and are equipped to study certain uses. Moreover, a specific segment of the population is selected to take part in the design.

This type of living lab can be linked to open innovation theories (Chersbrough, 2003), a set of theories striving to stretch the boundaries of research and development processes beyond companies, so as to enrich and improve their innovation capacity through collaboration between various stakeholders. For companies, the aim is both to benefit from knowledge, methods and resources from outside the company, and to better exploit the innovations produced. On the map, we find terms such as "customer", "consumer", "product", and the designation of certain actors, such as "industry". These living lab initiatives seem to be more geared towards the market economy and the development of product innovation, particularly related to new technology.

In the living lab landscape, it seems to us that this type of living-lab is characterized by a user-centric (Schliwa & Mc Cormick, 2016), techno-centric and market-oriented approach. The question of transitions in agri-food systems is not raised. One can however imagine that this kind of Living lab could participate in this type of approach but through a product design aspect, a technological innovation oriented towards consumer uses.

Areas 2 and 3 are associated more with a set of terms related to sustainability issues (sustainability, sustainability development, transition). User involvement is referred to with terms such as “user involvement”, “co-creation”, “creativity”, “involvement”, and “empowerment”. These terms suggest a different type of involvement from that which users usually have, one that is based more on creativity and concerned with skills development and emancipation. The term “user-driven” shows that the “user” enacts and steers the innovation process. The user is no longer simply a user but also an actor. Yet the absence of terms such as citizens or people to denote users raises questions. In reality, this is a limitation of the algorithms of the VOS Viewer software, which sorts results that exclude generic terms, “citizen” being one such term. Looking at our corpus, we can see that the term “citizen” occurred 216 times, and the term “people” 190 times.

The distinction between users, citizens or people seems blurred and interchangeable. The term “people” seems to be used either very generically (for example, “the real needs of people living in cities”) or to denote a category of individuals (for instance, “elderly people”). The term “citizen”, however, seems to refer more to the active position of inhabitants in their involvement in urban living labs. We thus find expressions such as “citizen-initiated grassroots project”, “engaging with local citizens to co-create”, and “including the citizens as active agents”.

As regards real-life environments, these approaches seem to address sustainability issues on the scale of the city (cities, smart cities). The emergence of the term “urban” living lab makes it necessary to distinguish it from the generic term. Moreover, it is important to note the presence of terms surrounding place, such as “place” or “local community”, which show the contextualization of these approaches on the scale of a territory.

There is also a wide variety of actors mentioned (government, municipality, university, company). This reflects multi-partner and transdisciplinary projects raising questions around governance, cooperation and the role of actors (“cooperation”, “governance”, “involvement”).

With regard to the approach adopted, the term “experimentation” is again used, suggesting a scientific approach aimed at “understanding”. The term “definition” suggests forms of characterization and therefore also of temporal and spatial delimitation of reality. At stake, however, are “mechanisms” of “transformation” and “dynamics” that need to be not only described, but also explored and created (“co-creation”). The development of “initiatives” that adopt a “vision” in order to change a problematic situation could serve this purpose. This directly echoes transition management theories promoting experimentation as a form of transition governance (see theoretical framework).

In relation to sustainable transition, there is a family of words surrounding university and education, particularly in Area 3. These living labs developed on university campuses offer a teaching tool to challenge and stimulate students’ creativity in finding solutions to design more sustainable lifestyles based on real cases (problem-learning and open-ended cases). Nevertheless, the absence of specific terms related to the types of knowledge (academic,

experiential, etc.) or to the modalities and processes of learning (social, collaborative, organizational learning, etc.) that support transitions (Mierlo and Beers, 2018), suggests that pioneering research must be carried out in living labs.

Areas two and three present a different involvement of actors in the design process, both in terms of the diversity of actors involved (government, citizen) and in terms of their place and role (more co-creation). The level of scale is also different since the living lab in this case can be at the level of a neighbourhood, a campus or a city.

These two living lab streams, which we can summarize according to Schliwa & McCormick's distinction (2016) between User-centred or Citizen-centred living labs, relate to very different methods, purposes and infrastructures (between a fully equipped house or a neighbourhood, for example). The first analytical results presented show that the citizen-centred trend came after the user-centred trend (Fig. 3). In our opinion, this is an evolution of the term living lab, which is intended to support cities in their capacity to innovate in order to meet the challenges of sustainability.

However, at this stage of analysis, we note an absence of concern around the issues of agri-food transition. Moreover, the concern of the Citizen-centred living-lab for cities raises questions on the place of rurality and of support for transition in these territories whose resources and constraints are very different.

4. Identifying the interfaces between living labs and agri-food transition theories

4.1. Supporting the transition of agri-food systems on a territorial scale

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). This transition requires a profound overhaul of the way we produce, process, distribute and consume on a territorial scale (Duru, 2014). To allow for such a paradigm shift, several authors highlight the need to develop systemic approaches (McCormick et al., 2013; Wittmayer et al., 2014). In the literature we identify four dimensions concerning support for the transition of territories towards healthier and more sustainable agri-food systems, which seem to us relevant to the living-lab approach. By transition towards territorialized agri-food systems, we mean a process aimed at reconnecting agriculture, food, environment and health at the scale of a territory, based on its specific resources and constraints (Lamine & al. 2012). This approach to agri-food systems is opposed to the development of the agro-industrial regime based on the intensification, specialization and massification of production, the liberalization of trade, a diffusionist knowledge regime (Aggeri and Hatchuel, 2003) and a financialization of the system (Clapp, 2014).

4.1.1. Fostering alternatives to the dominant model

The dominant agro-industrial regime steers action in a certain direction. It has the particularity of being very stable, as it is supported by a set of rules that are at once cognitive (belief systems, principles of action, objectives, etc.), regulatory (laws, regulations, etc.) and normative (values, behavioural norms) (Geels, 2004; Stassart, 2008). However, its structural stability is now being weakened by environmental and economic crises in the farming sector, as well as health scandals (Raoult-Wack, 2001; Beck, 2001). Initiatives described as "niches" are thus emerging outside this regime, under the impetus of actors who need to create alternatives to a system that no longer matches their vision of the future. The literature on transitions has produced numerous conceptual propositions on the creation and development of innovation niches (like strategic niche management and transition management), with applications at city, neighbourhood and community levels (Wittmayer et al., 2014). In the case of agri-food systems, examples of such innovation niches have spawned a corpus of research around Alternative Food Networks (AFNs). These include initiatives like the creation of informal networks of local farmers, and the development of other forms of social organization between producers and consumers (community-supported agriculture, markets, etc.) (Lamine et al., 2012)

The transition process involves complex and multidimensional interactions between the micro, meso and macro levels. Transforming the dominant regime becomes possible when the tensions and pressures between the different levels trigger the emergence of other possibilities. The development of localized agri-food systems therefore involves a confrontation/adjustment relationship between the alternative innovations that emerge at local level and the dominant global agro-industrial model, where places of production, processing and consumption are disconnected. It may be difficult, for example, to articulate short supply chains that favour direct contact between producers and consumers, and long supply chains that increase the number of intermediaries. There may also be a tension between the legitimacy of institutional actors from public policy (with its resources, constraints and ways of operating) and the legitimacy of citizens who come together to create new forms of cooperation around food. This presents two challenges for support initiatives.

First, the emergence of alternatives needs to be facilitated and the proliferation of initiatives encouraged. Some authors in the literature advocate a horizontal approach that multiplies points of contact with the dominant regime (Elzen et al., 2012; Chatterton and Pickerill, 2010) and connects locally grounded initiatives to encourage the sharing of experiences and the spread of new ideas. This approach contrasts with the vision of dissemination and generalization of the innovations produced.

Second, agri-food system transition does not take place outside the dominant system. There are many stumbling blocks between the niche and the dominant system that need to be addressed during the design process. The emergence of niches requires adaptation/adjustment by both dominant and alternative actors, and even more so in the transition of agri-food systems, which requires the involvement of a large number of very different actors (since we all eat, everyone is concerned). It is therefore relevant to equip the design process so that it

allows this relationship to become part of a reflexive process in which the stakeholders can identify the various adjustments required (Ingram, 2015).

In living-labs, there are proposals to conceptualize this link between niche and dominant regime. Initially, the triple helix model strongly mobilized in the user-centric living-lab model stemming from open innovation theories seems interesting insofar as it seeks to enrich the design process through the participation of other actors. However, in the case of agri-food systems, the difficulty of applying such a model seems to lie more in the number of actors to involve in the design process. Whether citizens, politicians, businesses or farmers, the forms of involvement can vary widely, which requires flexibility in the design process. This is a criticism that has been levelled at the "transition management" or "strategic niche management" models, frequently adopted by citizen-centred living labs. These models involve streamlined and organized transition, which is contrary to a design process based on learning and building as you go along.

4.1.2. Steering initiatives embedded in their context

The transition towards territorialized agri-food systems implies building the transition process around the creative capacity of the people living in a territory. This is a situated approach where what matters most is to create the frameworks for people to explore new paths outside the dominant system, by confronting the tangible limits of reality. It is characterized by a vision of transition involving a transformation of the relationship between people and their environment. For example, for farmers transforming their practices, this particularly means shifting from a process based on controlling living organisms through the use of inputs, to one that relies on and works with these organisms (Cayre et al., 2018; Chevassus au Louis, 2000). Embedding the transition process in a territory therefore involves enabling its actors to rebuild new meaning around the environment in which they live. “In a nutshell, place-explicit transition experiments can connect a sense of change (transformation) with a sense of place by co-creating new practices and new relations between people and place and by allowing the co-design or (re)establishment of places with symbolic meaning” (Frantzeskaki et al., 2018). Anglade et al. (2018, 2019) have thus shown the importance of grounding initiatives supporting agro-ecological transitions in the local environment so as to create situations conducive to critical thinking and sharing of experiences, to encourage the development of more autonomous systems of thought and practices. They found that providing spaces of dialogue for actors to share their respective sensorial experiences could foster genuine experience-sharing and allow these actors to overcome pre-established categories. It could thus enable them to transform the operative and epistemic premises underpinning conventional farming practices. More generally, the recent major shift towards eco-centric approaches in environmental education (Barrable, 2019) has highlighted the central role of place and outdoor teaching, with regular contact with nature, in reviving a sense of wonder and attachment in order to foster responsible behaviour.

Bergval and Stahlbrost (2009) argue that living labs can be seen as both (i) an “approach” with a certain methodology that aims to involve end-users and connect many different actors, and (ii) a “milieu” made up of an environment created or selected to place the innovation process as close as possible to real-life situations. “Lab refers to the intentional experimentation as it is done in a laboratory, while living refers to the fact that this is conducted in a real-life setting in contrast to an artificially created space” (Schliwa, 2013). Living labs are therefore presumably geographically or institutionally bounded spaces where stakeholders conduct experimentation for socio-technical innovation together”. Generally, “experiments are conducted, monitored, and conducted again with improvements from the previous round, in order to generate useful knowledge in a real-life setting” (ibid: 15).

In this sense, the living-lab approach seems interesting for integrating the design process in the territory. However, as we have seen, the notion of experimentation "in a real-life context" can involve very different realities. Frequently launched in the field of new technology, living labs allow for the design and testing of prototypes, while enriching the design process by immersing it in the daily life of communities of users (Bergvall-Kåreborn et al., 2009) By contrast, the challenge with citizen-centric living labs is to propose innovations adapted to the particularities of the area in which they are located. This notion of borders can however be called into question when looking at the transition of agri-food systems, as rethinking the organization of the agri-food system from a territory (e.g. a city) may require the involvement of actors outside the territory. Therefore, the most relevant boundary to define the living lab here may not be spatial. Defining the boundaries of the living lab by the network of actors that compose it seems more interesting to us. It would allow even more flexibility in the transition process and, from a methodological point of view, the analysis of the networks of actors can equip the actors in their action.

4.1.3. Developing a new governance of the agri-food system

In the literature on transitions, questions surrounding roles and relationships between actors have mostly been addressed by research currents working on the governance of transitions within innovation niches (Frantzeskaki et al., 2012; Grin et al., 2010; Loorbach, 2010; Meadowcroft, 2009). The development of niche innovations within the framework of agri-food systems lends particular importance to the relationship and cooperation between local actors. This has led to propositions to change agri-food governance systems, such as food policy councils, which open the gates to governance by citizens on several scales. It thus implies a new distribution of roles, and new forms of sharing and cooperation (mutual support, trust, etc.). The literature highlights the diversity of actors involved in the transition process at local level (policymakers, firms, social movements and civil society) and the diversity of roles they can take on (such as “regime actor” or “niche actor”, for example) (Wittmayer, 2016). Cross-boundary work between fields of knowledge has been identified as a key process in the transformation of relationships between actors during transitions (Ingram, 2018).

Setting a transition in motion on a local scale induces not only a new definition/distribution of roles, but also the (re)construction of their articulation (Elzen et al., 2012, Grin). It requires the involvement of multiple actors at very different levels. The establishment of reflexive governance of transition (Mardsen, 2013) has been suggested to take up these challenges.

Living-labs notably centred on sustainability offer methodological tools to think about governance, particularly in line with Transition Management theories. They are interesting insofar as they are opposed to the top-down project-based logic that is gaining prevalence in the conception of the governance of food systems (Territorialized Food Project, European Leader funding). However, the difficulty remains to envisage a form of governance that allows for the involvement of widely diverse actors at different scales and with different types of engagement, on the basis of co-creation. Keeping the design process "in touch" with the territory and its inhabitants is a real challenge if the living lab is not to be turned into a mere partnership project.

4.1.4. Supporting individual empowerment

A transition is a story that is woven over time through individuals' interactions and the complexity of their environment (Abbott, 2001). This seems important to us, as it highlights the experiential dimension of transitions. While a transition can be seen as a process with an ultimate goal (the desire for a more sustainable model, etc.), within an open-ended perspective, the forms it can take are the product of a construction process. Transition should therefore be seen as a reflexive process in which the experience of situations and the unfolding of events need to be prioritized (Elzen et al., 2012).

For the individuals who experience it, transition is similar to a destabilization of the frameworks usually mobilized by individuals to act. This constitutes a paradigm shift that requires new ways of being, thinking, and acting. Coquil (2014) formalized the transformation in terms of action, objectives, knowledge, values, professional norms and tools required by farmers engaged in an agro-ecological transition. He analysed this transition as a change of professional world (Coquil et al., 2017). He adapted the concept of step-by-step design (Coquil et al., 2014), to facilitate the acquisition of experience in transitions in the making. This concept seeks to empower individuals by allowing them to grasp the full complexity of the situation as it develops, so that they are able to make choices and reconfigure the resources of their action. In the dominant model, farmers have become largely stripped of their decision-making autonomy, with external diagnoses and ready-made solutions produced by AKIS actors (Agricultural Knowledge and Innovation System). The aim here is not to study the appropriation of an innovation designed without the users, but to allow the subject to build up the resources they need for their own action. This fundamental distinction is informed by design science theories, which have shown that innovation cannot be grasped independently of the historical and cultural context in which it is steeped (Wisner, 1985 ; Temple et al., 2011).

This developmental dimension of transition shows the extent to which transition is a knowledge-intensive process. Whether individually or collectively, the transition to healthier and more sustainable agri-food systems requires new ways to facilitate experiential learning and thus to empower subjects by restoring their ability to act on their environment.

Transition towards agri-food systems aims moreover to empower actors to transform their environment. It allows citizens to negotiate the rules of governance of their agri-food systems, and to participate in decision making on the direction to choose (El Bilali & al. 2018). Transition of agri-food systems is thus accompanied by a political issue of citizen empowerment. In this respect, the citizen-centric living-lab is an interesting tool to allow the involvement of actors who are currently not necessarily integrated into the decision-making process.

4.2. Living lab, a multifaceted and fuzzy notion

To sum up, we find concerns in the literature on transitions in agri-food systems that echo the proposals formulated in the literature on living labs and more specifically in the citizen-centred living lab stream. However, the implementation of living labs to support the transition of agri-food systems also requires adjustments in view of the divergences in the response to these issues (summarized in Table 2).

Table 2 : Analysis of the living lab concept in relation to issues surrounding support for the agri-food transition

Key characteristics	**Transition des systems agri-alimentaires**	**Comparison with the characteristics of user-centric living labs (UCLL)**	**Comparison with the characteristics of citizen-centric living labs (CCLL)**
Developing alternatives to the dominant model	The transition process = complex and multidimensional interactions; involves confrontation /adjustment between the alternative innovations at local level and the dominant global agro-industrial model; The emergence of alternatives needs to be facilitated and the proliferation of initiatives encouraged; The interactions between these levels requires adaptation/adjustments by the actors of the dominant regime as well as the alternative actors; This has to be equipped in order to make this relationship part of a reflexive process.	No relationship between scales is reported. The Triple Helix model allows the involvement of a diversity of actors and a wide diversity of actors in the case of agri-food system transitions.	- There are terms relating to a greater plurality of actors (university, policy maker, local community) - Is part of transition management theories criticized specifically for a rationalized and organized view of transition, which is in opposition to the process of design along the way.
An initiative grounded in its context	This transition involves a transformation of the relationship between people and their environment; It is necessary to encourage the development of more autonomous systems of thought and practices; A “sense of place” must be recreated.	The laboratory is spatially delimited (the house, the vehicle) and is situated on a very small scale.	- A contextualized approach in a larger space, particularly in cities (urban living labs); - An approach aimed at both product and social innovation; - The boundaries of the living lab geographically delimit the space of experimentation, which is not necessarily relevant for the transition of agri-food systems.
Supporting the transformation	Setting a transition in motion on a local scale induces not only a new definition/distribution of roles, but also the (re)construction of their articulation	A relationship between actors marked by a distinction between	- A wide variety of actors: academics,

of relationships between actors	It requires the involvement of multiple actors at very different levels and the establishment of reflexive governance of transition.	designers and users.	government actors, policy makers, students; - An experimental approach based on co-creation; - Governance and involvement of inhabitants are addressed; - Difficulties remain in conceiving of a form of governance that allows for the involvement of widely diverse actors, in different ways and on different scales, based on a principle of co-creation.
Supporting individual empowerment	Transition should therefore be seen as a reflexive process in which the experience of situations and the unfolding of events need to be prioritized; the acquisition of experience in transitions-in-the-making must be facilitated; experiential learning must be facilitated, so that subjects are empowered as their ability to act on their environment is restored; enable citizens to negotiate the rules in the governance of their agri-food systems, and to participate in decision making on its orientation.	These approaches focus on the appropriation or adoption of a technology by individuals.	- Empowerment/creativity/user involvement are a set of terms that reflect an approach aimed at empowering actors; - Learning is core cited.

5. Discussion: How could living labs sustain the transition of local agri-food systems?

5.1. A renewal of experimentation modalities

The living lab concept strongly embraces the notion of experimentation as a way to support sustainability transitions. But this notion is caught between two meanings. On the one hand, there is user-centric experimentation which, although it takes place in "real-life settings", is monitored, measured and largely controlled, just as it would be in a laboratory. It only partially challenges the diffusionist relationship between those who design to gain knowledge and those who participate in the experiment. Here, the process is enriched with users' knowledge to improve the object designed, following an iterative process.

A broader conception, on the other hand, posits the laboratory as a place to experiment and learn through an iterative and generative process of the "prob-and-learn" or "learning-by-doing" type. Ansell and Bartenberger (2016) call this generative experimentation. This second approach, more present in citizen-centric living labs, seems better suited to agri-food systems. It supports the production of contextualized, actionable knowledge to contribute to inhabitants' empowerment and the concrete transformation of territories. This means building representations of the complexity of the issues at stake through action and insightful reflexive self-evaluation by the actors leading the initiatives. Experimentation thus becomes an approach to the governance of transitions towards greater sustainability "that entails a multi-actor collaboratively and creatively trialling new ways of organizing, doing, relating and in this way, generating alternative (forms of) innovative solutions with the potential to address contemporary urban challenges" (Frantzeskaki et al., 2018, p.1045). This position, which is based on an abductive approach, is rooted in pragmatist theories (Dewey, 1910). "The notion of urban living lab in other words, offers an interpretive frame that can be used to make sense of what happens and to offer guidance for action" (Karvonen and Van Heur, 2014).

We believe that to support transitions of territories towards healthier and more sustainable agri-food systems, experimentation needs to foster the emergence and survival of breakthrough innovations vis-à-vis the dominant agro-industrial model. The living lab approach, however, does not seem to guarantee this. Some innovations, although bottom-up and striving for sustainability (for example through the use of new technology), remain essentially for-profit, prioritizing private profits for companies without really challenging the status quo and entrenched economic and social inequalities (Chatterton, 2016). Moreover, as we have shown, the living lab concept as a whole is strongly influenced by notions surrounding new ICT, management and entrepreneurship. This raises doubts as to whether such models can actually move away from the dominant agro-industrial model, towards a greater adaptability of socio-ecosystems. The field of agro-ecological transition is caught in a twofold epistemic and political tension: on the one hand there are approaches to the production of knowledge based on the capitalization and sharing of experience-based

knowledge developed through contact with the communities seeking to strengthen the capacities of farmers and other rural actors, and on the other hand there are approaches revolving around the encapsulation of knowledge in technical artefacts. This includes so-called "precision" or digital farming, the deployment of which relies on the development of smart tools, mainly by large cereal cooperatives. These decision-making tools are able to quickly generate optimized and streamlined solutions (based on which criteria?) thanks to an ever-growing data collection and processing capacity (for example adjusting nitrogen fertilization using drones). But behind the promise of humans "augmented" with forms of encapsulation of knowledge, emerges the whole question of the relationship between power and knowledge in the control of these systems. Various non-profit alternative farming networks are advocating for small-scale and autonomous farming, in opposition to the technological vision of agroecology that makes farmers captive and dependent on expensive technology and mechanisms of external appropriation of data and knowledge (Fressoli et al., 2015). In our opinion, living labs can support local communities' capacity to invent and experiment with more sustainable lifestyles, provided that the notion of commons central to experimentation is given greater importance.

5.2. Building communities, experimenting with what brings us together

According to us, supporting transitions towards healthier and more sustainable agri-food systems calls for a paradigm shift with a new focus on the territory and "caring for it". The notion of "commons", which has been the subject of a significant literature especially since Ostrom's work (Ostrom et al., 1994), seems to carry interesting conceptual and methodological tools for the development of sustainable living-labs. The idea is to think of food as a common good and not as a commodity (Vivero-Pol, 2017) For Chatterton & Pickerill (2010): "the commons (fields, village greens and forests) are geographical entities governed by those who depend on them – the commoners. However, the term refers to much more than simple bounded territories: it also encompasses physical attributes of air, water, soil and plants, as well as socially reproduced goods such as knowledge, languages, codes and information. The shared attribute is that these entities are collectively owned and managed. […] It is something that is perpetually made and remade, created, eroded and defended." In this way, is called common, what a society institutes as the result of its collective action. Commons are therefore understood as the fruit of human activity.

The commons have a social and political dimension in the sense that they allow collective action to be rethought. Citizens become legitimate actors in the governance of common resources. The cultivation of shared gardens, the introduction of a local currency carried by citizens or the creation of a 'Zone to be protected', all exemplified collective actions, management and sharing of what belongs to all. This collective approach to transition highlights the transformative capacity of local communities coming together around material and immaterial elements to experiment together with concrete responses to the problems they identify. Ezio Manzini (2005) refers to these as creative communities, groups of people who "cooperate to invent, improve and manage innovative solutions to develop new lifestyles" that are more sustainable (Jégou and Manzini, 2008). Through action on and the transformation of

their territory, these communities participate in the (re)construction of a "consciousness of place" (Magnaghi, 2017). Territory finds meaning through the practices that develop therein.

In terms of regional planning, this promotes shared governance involving inhabitants in the broad sense of the term (citizens, local officials, civil society organizations, etc.), to create design arenas allowing local communities to experiment with more sustainable lifestyles, drawing on the resources that their territory has to offer. This calls for a new division of roles between the actors. As we have seen, citizen-centric living labs are characterized by cross-organizational collaboration where actors from society, academia, industry and politics meet. These new forms of transdisciplinary experimentation transform the traditional relationships between knowledge and power. It is no longer possible to distinguish the designer from the user, and different forms of knowledge co-exist. Each actor provides the community with their own skills and particularities. But this is not straightforward and requires specific project management tools.

To achieve this, the continuous development of common values within a living lab project is important, so as to ensure consistency across all parties' actions and the evolution of their representations and knowledge. We distinguish here between two principles of action. Based on common values and a common will, the aim is to gain momentum to leave a situation that has become uncomfortable, but concrete implementation remains to be enacted through collective action, shaped by the unexpected developments of the project and the particularities of the environment. This proposition is based on the assumption that it is in change and tooling of change that the purposes and common objects are defined and redefined. This approach differs from more traditional and institutional teleological project management, which seeks first to establish desired outcomes, based on a diagnosis striving for objectivity, and then to determine the scope and to programme the modalities, places, and timeframes of action, before transforming reality.

We argue that, on the contrary, confrontation with reality is a source of learning which fosters the production of actionable knowledge in an environment, and requires open, step-by-step project management (Coquil, 2014). This approach revolves around knowledge acquisition by the actors involved, which determines and (re)orients the project's progress along the way. Step-by-step design also strives for collective learning and the collective transformation of frames of reference, norms and values, by opening spaces for the actors to express themselves and share their experiences. The aim, with shared governance of transitions, is to leverage intersubjectivity to create shared meaning. Each person's role develops, becomes distinctive from that of the others, becomes more specific, and evolves. Such organizational and collaborative learning allows each person to act, taking into account the actions of others (what they bring to the project, what skills and values they have, etc.) (Béguin, 2010). Despite the collective's heterogeneity and variability (with different investments), step-by-step design allows the actors to work together. The knowledge produced during the design process is therefore situated (each actor develops his perception of the environment and the issues at stake, based on his investment in the project) and grounded in an environment. This type of open-ended approach raises the question of the role of public policy in these projects, as well

as its modes of funding and its evaluation methodologies and human (and not object) centered criteria.

5.3. Experimenting following a contextualized approach designed to empower

The living lab approach allows citizens to (re)build their relationship with their environment and its significant to themselves by being centred on the commons, and by enabling each actor concerned to act at their own level. This notion of contextualization features in citizen-centric living labs especially through the empowerment of citizens. However, this concept can refer to very different realities. The concept of empowerment often suffers from a managerial influence by trying to apply managerial principles to it (Paturel, 2012). Based on this rationale, empowerment would thus consist in developing the resources of an abstract individual in order to apply management frameworks to the initiative and allow for the development of a programmatic approach. According to this definition, the participation of individuals is reduced in the expression of their needs that are only a reflection of the domination mechanisms of the dominant regime. Users can only marginally change the solutions proposed by the designers.

However, this desire for empowerment is still interesting if it aims to enable citizens to develop a critical awareness and a capacity to transform their environment (Le Bossé, 2003). Thus, we believe that one of the priorities for living labs seeking to support transitions of agri-food systems should be to foster autonomous thinking, so as to enable them to act in complex and uncertain environments. It should also be to support transformative learning (Dirkx, 1998), to move towards a more democratic society and allow for individual self-actualization. Ultimately, the goal should be to enable inhabitants of a territory to build their own understanding of agri-food issues and to influence the future of their territory. To aim for empowerment, the living-lab can not be confined to the involvement of people in the action but it must also support the acquisition of experience, by taking distance and reflection on the action taken, as a meaning-making process. Living labs therefore need to build knowledge that is actionable by and for citizens, to allow them to experience their territory through action, and to develop an "awareness of place" so that commons can be built around farming and food.

5.4. The utopia of horizontal project development

Any alternative initiative is immersed in the dominant regime (Pickerill & Chatterton, 2006). There is always a relationship materially or immaterially (institutional organizations, etc.), between these two scales, which is complex and makes radical changes difficult. In this way, we can doubt about the real capacity of local alternatives to challenge the model in place. This is a legitimate fear, given how strongly new technology, management or business, for instance, are endorsed by living labs, even those striving for more sustainable lifestyles.

Yet, while most living labs rather align with a reformist vision of change, commons-based approaches are closer to utopia as understood by Thomas Moore (Chatterton, 2016; Dahle,

2007; Wright, 2010). They aim to create examples of possible futures based on new forms of cooperation and governance of a territory's resources. Thus, developing an approach articulated around the notion of commons offers new forms of powerful and democratic confrontation by granting real importance to restoring inhabitants' control over the transformation of their territories. On the one hand, by placing "doing" at the core of experimentation, theses common-based living-lab open up the possibilities to envision other futures. As Carolan wrote (2015 ; p.13), "*to know something differently and see things in a new light we have to do something different*". On the other hand, they foster the involvement of new citizens, making cooperation not exclusive. Citizens should be able to invest themselves according to different forms (e.g. in "doing", in "creating", in "carrying projects", or in the "emergence of ideas") and be able to move from one posture to another according to their possibilities of involvement.

Moreover, the challenge for living labs endeavouring to transition territories towards healthier and more sustainable agri-food systems is thus to foster the emergence and networking of such "utopias". Whereas some living labs are calling for up-scaling niche innovations, it seems to us that commons-based living labs offer another perspective, endeavouring to connect different initiatives united by a common goal. This allows for the sharing of resources, knowledge, know-how and experience, gradually strengthening the dynamics. This more horizontal approach fits with an effort to multiply connections with the dominant regime in order to influence it (Elzen et al., 2012) – an idea that seems to be echoed in Paul Chatterton and Pickerill's words about the LILAC living lab (2010): "Drawing on the language of the multi-level perspective (MLP), the Lilac case points towards a transition process less interested in breakthrough, but more in break-out. Daily practices and discourses at Lilac are not simply about scaling-up to influence the mainstream; there is a desire to work beyond niche and mainstream". These initiatives thus make it possible to concretely transform living practices and ways of inhabiting the Earth, through their creative approaches to solidarity, sharing, the use of resources, and so on.

5. Conclusion: A call for common living labs

In view of the political and scientific enthusiasm for the living lab concept, the bibliometric analysis afforded a more precise view of the dimensions it encompasses. Like Schliwa and McCormick (2016), we found a clear distinction between user-centred and citizen-centred living labs. It seems to us that the latter approach is better suited to supporting territories' transitions towards localized agri-food systems. In particular, it allows for using experimentation as a form of governing transitions, grounding the latter in co-creation between diverse actors. However, the grip of technology and management (which also impacts the political sphere) on this concept casts doubt on its ability to influence the dominant agro-industrial model. This is why we propose an approach centred on the construction, management and sharing of commons, which we call CLL: Common Living Lab. This non-profit approach promotes experimentation where the production of knowledge is grounded in an environment and supports the acquisition of experience and individual empowerment to act on the future of a territory.

This commons of transitions towards greater sustainability is not only about creating new forms of social organization, but also about building new relationships with the environment that are more responsible and respectful.

In order to achieve a harmonious and sustainable co-evolution of socio-ecosystems, the challenge is to include non-humans – land, water, plants, animals – as subjects in their own right and no longer as mere objects of shared experimentation/experience. Thus the polysemy of the term "living" will take on its full meaning, evoking both not only places of living but also life more directly, that which lives, that which is alive.

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Appendix:

Details of the clusters (20 most frequently cited terms) shown on the map.

Cluster 1	
Terms	Occurrences
Data	187
Experiment	125
Building	121
Sensor	82
Impact	67
Performance	65

Device	60
Algorithm	48
Energy	45
Component	44
Demand	44
Behavior	43
Monitoring	43
Control	40
Consumption	39
Feature	39
Behaviour	34
Pattern	33
Mean	32
Unit	32

Cluster 2	
Terms	Occurrences
Role	145
Sustainability	86
Place	79
Literature	77
Learning	70
Co Creation	60
Experimentation	59
Form	59
Campus	58
Innovation Process	53
Structure	47
Understanding	43
Transition	41
Mechanism	40
Dynamic	39
Implication	36
Transformation	36
Cooperation	34
Urban Living Lab	32
Definition	31

Cluster 3	
Terms	Occurrences
Participant	79
Home	75
Health	52
Interview	48
Adoption	47
Robot	45
Acceptance	39
Feedback	39
Task	38
Older Adult	36
Care	35
Research Project	32
Response	32
Situation	31
Elderly Person	30
Smes	30
Lab Project	28
Professional	28
Complexity	27
Motivation	25

Cluster 4	
Terms	Occurrences
University	135
Student	96
Infrastructure	83
Education	70
Government	57
Internet	52
Program	46
Engagement	45
Teaching	38
Communication Technology	36
Gap	34
South Africa	33

Cost	32
Entreprise	32
School	32
Web	31
Access	30
Course	30
Intervention	28
Skill	26

Cluster 5	
Terms	Occurrences
Product	100
Initiative	88
Partnership	54
Effect	50
Consumer	40
Patient	35
Test	33
Production	32
Subject	31
Difference	28
Vision	25
Site	24
Innovative solution	18
Respect	15
Reduction	14
Risk	14
Cluster	13
Independent living	13
Policy maker	13
Prevention	13