Journal of Rural Studies 126 (2026) 104263

Contents lists available at ScienceDirect

Journal of Rural Studies

journal homepage: www.elsevier.com/locate/jrurstud

From the ambition of a living lab to a small step in participatory science: Agro-environmental living lab appropriation through the lens of Actor Network Theory (ANT)

C. Agasse [a,b,c,*], A. Nicolai [c,a], S. Chollet [a], M. Herve [c,a], H. Vaskova [d], P. Saska [d], J. Skuhrovec [d], U. Fricke [e], S. Redlich [e], H. Chole [a], J. Van Baaren [a], P. Boudes [b]

[a] University of Rennes, UMR 6553 ECOBIO, 263 Av du général Leclerc, Rennes, 35042, France
[b] Institut Agro Rennes-Angers, UMR 6590 ESO, 65, rue de Saint-Brieuc, Rennes, 35042, France
[c] Living Lab CLEF, 14 Place de la République, Plélan-Le-Grand, France
[d] Czech Agrifood Research Centre, Functional Diversity in Agro-Ecosystems, Drnovská 507, Czech Republic
[e] Julius-Maximilians-Universität, Department of Animal Ecology and Tropical Biology, Bayern, Würzburg, Germany

ARTICLE INFO

Keywords:
Living labs
ANT
Agriculture
Biodiversity
Stakeholder engagement
Research program

ABSTRACT

In the context of the current need for agricultural transition towards more sustainable systems and the general increase in participatory approaches in environmental studies, a living lab approach seems to be promising. Indeed, living laboratories are encouraged by the need for more co-constructed and transdisciplinary research involving scientists and societal stakeholders, in order to understand and implement agroecological measures in a more effective way than what could be reached by simply using experimental sites. Yet, living labs remain a broad concept with multiple understandings which may hinder their successful implementation. Via living labs developed by the research sector in five sites across Europe, our international research project investigates floral enrichment in wheat fields. We examined how different actors apprehended the living labs in an agroecological project by tracing the translation phases of the Actor Network Theory (ANT), in particular the problematization, interessement, and enrolment phases. Our results highlight the influence of research funding schemes in the use of the living lab approach and the importance of the interessement phase for both researchers' and farmers' further enrolment. Our results showcase the challenges of using this approach when actors' objectives and willingness to use participatory approaches are not sufficiently shared. We then propose four recommendations: better align research policies with the exploratory nature of living labs; define a clear, shared scope to foster a common identity among actors; treat living labs as long-term approaches that allow actors to shape and redefine shared boundaries over time to sustain their enrolment; and recognise that the geographical location of living labs influences research questions, rather than the reverse.

1. Introduction

1.1. New research paradigm for ecological and social transitions

Emerging from the industrial revolution, the predominant Fordist research regime has historically placed scientific knowledge and innovation at the service of societal development within a predominantly capitalist framework, which is itself deeply implicated in the environmental crisis (Barré and Jollivet, 2023). Since the growing awareness and recognition of environmental issues, research has increasingly aimed to support ecological and social transitions. However, environmental issues are so complex that research itself also needs to undergo transitions. Acknowledging this complexity, a new research regime based on interdisciplinarity and participatory research has emerged since the 1970s (Barré and Jollivet, 2023). This new research regime questions the disciplinary specialisation of scientific work, advocates cooperation between disciplines, and challenges the monopoly on knowledge production granted to the research sector.

Such a new research regime, also known as "mode 2" (Gibbons et al., 1994), is based on knowledge production practices within an applied

* Corresponding author.UMR ECOBIO, 263 Av du général Leclerc, 35042, Rennes, France.
E-mail address: clemence.agasse@univ-rennes.fr (C. Agasse).

https://doi.org/10.1016/j.jrurstud.2026.104263
Received 6 November 2025; Received in revised form 22 May 2026; Accepted 5 June 2026
Available online 11 June 2026

context,[1] *i.e.* a real-world environmental and socio-economic context (Barré, 2004). Rather than replacing peer-validated knowledge, this research regime adds robust social recognition to it by creating and testing knowledge in real-world contexts.

The advent of the mode 2 research regime implies the creation and mobilisation of innovative research mechanisms and devices, "spaces for interaction and exchange" (Lapostolle, 2021), enabling dialogue both between researchers from different disciplines and between researchers and non-academic actors including civil society. However, this research regime encounters obstacles in defending its legitimacy. Therefore, there is a need to adopt a reflexive approach to interdisciplinary and participatory approaches, as well as to the devices employed in these reconfigurations.

In this study, we examine a specific device called "Living Labs" (Dubé et al., 2014), a participatory methodological tool that aims to develop innovations in real-world conditions and with end users. Within the context of our study, the living labs created are part of an agroecology research project that focus on the effectiveness of wildflower strips in conventional agricultural plots for pollination and the control of pest organisms.

To reflect on these living labs and understand how they are adopted by the actors involved, we use the framework of Actor-Network Theory (ANT) or Sociology of translation (Akrich et al., 2006). The sociology of translation allows one to follow the evolution of human and non-human actor network configurations through the study of different phases of translation. Those translation phases highlight the issues and objectives carried by the actors, as well as the compromises and detours they negotiate through their interactions.

The ANT framework has already been used to study living labs (Fasshauer and Zadra-Veil, 2020) and, more generally, "third places" for participatory research, *i.e.* innovative spaces for experimenting with multi-stakeholder activities (Richez-Battesti et al., 2024). To our knowledge, this conceptual framework has not evolved and proves to be highly relevant for studying living labs, as it allows us to consider two major components. The first is that ANT is suitable for a processual approach: indeed, through the four phases of translation (problematization, interessement, enrolment, and mobilization), which will be developed later in this article, we can encompass the chronological and processual aspects of network creation. The second component of ANT we are interested in is to consider the actors in their diversity, whether they are academic or non-academic, professional or not, which is a key point in participative approaches.

Although the mode 2 research regime continues to face challenges in its implementation, living labs are being adopted with growing frequency. This raises the need to better understand the barriers and enabling factors shaping the uptake of this participatory research approach. In this study, we first provide an in-depth presentation of the living lab concept, the theoretical framework of translation, and the context of the project studied. Then, we present the results of the appropriation of the participatory research mechanism by the living lab participants in light of the translation phases. Finally, we discuss the factors that facilitate or constrain the appropriation of living labs and we make recommendations. We then discuss the relevance of the ANT framework for studying participatory devices.

1.2. Appropriation of the living lab approach by the research sector

The living lab concept embraces a range of definitions: "it has been defined as a methodology, an organization, a system, an arena, an environment, and/or a systemic innovation approach" (Ståhlbröst and Holst, 2012: 5). Despite this lack of consensual definition, the literature consistently mentions the transdisciplinary nature of the living lab approach, the co-design and co-development mechanism among participants, as well as their contribution to project monitoring, evaluation and applied research *in situ* (Mcphee et al., 2021). The European Network of Living Labs (ENoLL) defines them 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" (ENoLL, 2025a). Hence, living labs aim to develop new products and services through co-creation with users in real conditions. With a focus on user needs, this approach goes beyond user-centred design (UCD) by not only designing innovations that cater to users' specific characteristics, but also by involving them in the creative process (Dell'Era and Landoni, 2014). Hence, living labs, as user-led co-design approaches to innovation, offer numerous advantages such as the greater adaptation of innovation to user needs and the hypothetical better adoption of an innovation by users (Beaudoin et al., 2022).

The living lab approach is increasingly being adopted worldwide, including in Europe (Dubé et al., 2014; Fasshauer and Zadra-Veil, 2020) where their emergence took place around the 2000s (Bergvall-Kåreborn and Ståhlbröst, 2009). Since 2006 they have benefited from the support of European Union public policies (Dutilleul et al., 2010). The flexibility of their approach has resulted in their implementation in numerous domains, including health, tourism or environment, especially agriculture, which makes the approach both well established and yet still broad (Bergvall-Kåreborn and Ståhlbröst, 2009; Mcphee et al., 2021). All these statements call for a deeper analysis of living labs implementation in various contexts. In this article, we focus on research-driven mobilization of the living lab approach in a European project on the effect of floral enrichment on biodiversity in agricultural landscapes.

Non-academic stakeholder involvement and transdisciplinarity are increasingly encouraged and have become essential in research project calls for more than a decade (Vasbinder et al., 2010; Jahn et al., 2012). There are different methods to achieve this, including the use of living labs. Living labs are characterised by involving a set of various stakeholders (Schuurman et al., 2025), including citizens, industry partners, policymakers, and research institutions, reflecting their multi-actor and participatory nature. Among these actors, Fasshauer and Zadra-Veil, 2020 identified public institutions and private companies playing a central role, both in initiating and facilitating living lab activities.

Initially used as a means to foster participation and co-construction within the scientific process, the relevance and role of living labs have been regularly questioned, and they gradually became a subject of research (Dubé et al., 2014; Hossain et al., 2019). Most of the literature seeks to understand what a living lab approach is by exploring their functioning and how they promote innovation, the role of the actors involved, and the methodology they employ (Mcphee et al., 2021). Here, we propose to study the living lab itself, which we consider as an innovation in scientific research. We explored how actors (*i.e.* researchers and farmers) within a scientific research project on agricultural biodiversity enhancement appropriate the approach and how they are involved in the living labs.

Within the agricultural sector, living labs have received increasing attention and their use is growing steadily (Mcphee et al., 2021;Ali et al., 2025). Within agricultural living labs, research work is implemented in real-life conditions. These living labs share the perspective of testing an innovation as a hypothetical solution for a problematic situation in farm-based socio-economic and environmental contexts. In agriculture, innovative forms of collaboration are crucial as society faces challenges of biodiversity erosion due to highly impacting agricultural practices (Doran, 2002; Tscharntke et al., 2012; Mcphee et al., 2021). Agricultural living labs may represent such an innovative form of collaboration between the agricultural and research sectors addressing the challenge of mitigating biodiversity loss by changing agricultural practices. However, living lab initiatives in agriculture are rarely reported, as are the challenges they meet (Alhajj Ali et al., 2025). Therefore, we specifically analysed how actors appropriate the living lab approach through

[1] In contrast to "mode 1", which is the classic disciplinary organisation of research.

detecting, describing, and analysing their interest and their interactions in the living lab. To achieve this goal, we refer to the Actor-Network Theory (ANT), and specifically its focus on the translation process as defined by Callon (1984).

2. Theoretical framework and survey methodology

At this stage, we will present in detail the theoretical conceptual framework of ANT in order to allow the reader to become familiar with its concepts, then we will present the project studied and its actors, before specifying the research methodology.

2.1. Exploring living lab approach appropriation through the Actor-Network Theory

The Actor-Network Theory (ANT) is a theoretical framework, also known as sociology of translation, which was primarily developed by Madeleine Akrich, Michel Callon, Bruno Latour, and John Law.[2] This theory offers a framework for analysing the multiple reconfigurations of society, considering that "society" is an "ongoing achievement" (Callon, 2001: 62).

To do so, this theory brings together the notions of *actor* and *network*. For the founders of this theory, an *actor* – or an actant – is an entity whose existence produces an effect on the network composed of other actors.[3] From this perspective, an *actor* can be either human or non-human, in other words: "An actant can literally be anything provided it is granted to be the source of an action" (Latour, 1996: 373). A *network* can be defined as the dynamic configuration of relationships between the *actors* (human and non-human as described above), who mutually define themselves by the connections they maintain. Latour insists on the fact that the *network* is not a fixed configuration,[4] but thus, the *actor-networks* are defining themselves through the connections and imbrications that occur between them.

To understand the actor-network in the project we studied, we will go through a process of *translation* (Callon, 1984). We will study, through the key stages of translation described by Callon, the shifts and transformations that have taken place between the *actors* of the project regarding the living lab approach and the experimentation of flowering strips. The study of successive translations offers the possibility to follow the evolution of relationships between actors within a process completion, by observing "all the negotiations, intrigues, calculations, acts of persuasion and violence, thanks to which an actor or force takes, or causes to be conferred on itself, authority to speak or act on behalf of another actor or force" (Callon and Latour, 1981: 279). After identifying the "*primum movens*" of a story (Callon, 1984: 203), *i.e.* the actor(s) initiating a process, Callon (1984) proposes to decompose the translation into four stages, which are sometimes synchronous and which we will use for our analysis: problematization, interessement, enrolment and mobilization.

The *problematization* refers to the first stage where some actors, *i.e.*, the *primum movens*, define the issues at stake and position themselves as indispensable to others, thereby framing the network's initial configuration. They define a high-stake framework within which the research objective appears essential and become the "*obligatory passage point*" (here after "OPP", Callon, 1984: 205) around which alliances will be created.

The second stage is the *interessement* which is the phase during which the *primum movens* at the origin of the project, is trying to have the OPP recognized and stabilized. The *primum movens* aims to convince, through multiple means, the actors targeted in the problematization to address the research objective by participating in the experience.

If the interessement succeeded, it is followed by the enrolment phase to "define and coordinate the roles" (Callon, 1984: 211). *Enrolment* is a negotiation phase during which the actors will accept or question their role and that of others in the project, in relation to what was defined in the problematization. It is during this step that the actors will start to enact their role within the network.

The *mobilization* phase aims to amplify and disseminate the actions carried out at a local and experimental levels, so that they can be implemented on a larger scale. This occurs by *spokesmen,* who translate the interest of the actors involved in the project to the rest of the world. In our case, this phase could not be addressed because our study was done at an early stage of the project.

Sociology of translation allows to follow the evolution of relationships between actors within a process: it enables to analyse the negotiations around the evolving roles of the actors involved in a project and their interactions, taking into account these elements as being dynamic over time. The aim of this study is to examine how the living lab approach is appropriated by the different actors involved in the living labs developed within a research project, following the Callon, 1984 translation process. Specifically, we intend to understand if, how, why and when the living lab implementation deviates from the theoretical conception of the living labs, by identifying the *primum movens* ambitions and the convergence towards an OPP, as well as by determining the level of its recognition by the other actors involved. To do so, we adapted the four original stages of translation to our study context, which included distinguishing two phases of interessement and removing the mobilization phase. We also discuss the relevance of the resulting transformed living lab approach.

2.2. Studied project and population

The studied research project lasts from March 2023 to December 2026 and is intended to address sustainability in agriculture and biodiversity conservation through the implementation of flowering strips in combination with hedges in conventional farms, while adopting a living lab approach in five sites in Europe (Fig. 1). This geographical configuration intended to cover a climatic gradient of winter harshness from western to central Europe as a proxy of climate change.

The living labs in each study site were coordinated by local research teams and were intended to ensure local research in farm-based contexts with the farmers (Leminen et al., 2012). Local research teams followed identical general guidelines to ensure that the living labs were organized in the same way. The implementation of the living labs was mostly driven by collective events that allow actors to meet, discuss findings and observations related to the flowering strips experimentation and progressively appropriate of the living lab approach. Those guidelines left room for adaptation to local conditions as discussed during the consortium meetings.

These events are described in the project proposal (i.e. document produced to apply for funding) and consisted in "Bioblitzes" and workshops (Fig. 2). The workshops had different objectives throughout time (Fig. 2). They aimed to be collective time of work for the living labs stakeholders and combined different formats (*e.g.*, in-room or in-field meeting, world-café). Bioblitzes, for their part, are citizen science events of biodiversity sampling in a short period (*e.g.*, 24h) on a delimited area (Meeus et al., 2023). Bioblitzes are thus arenas for social cohesion between science and the general public, and to build working partnerships in the scope of biodiversity conservation (Parker et al., 2018). In the case of the described project, two Bioblitz events were set up in each study region (Fig. 2). The first ones occurred at the beginning of the research project and were supposed to occur in conventional agricultural fields, bringing together agricultural stakeholders and researchers as a launching event of the living labs. The second one

[2] The foundational texts are collected in the following book: Akrich et al. (2006).

[3] "something that acts or to which activity is granted by others" (Latour, 1996: 373).

[4] "network is not a thing [such as an engineering network for example], but the recorded movement of a thing" (Latour, 1996: 378).

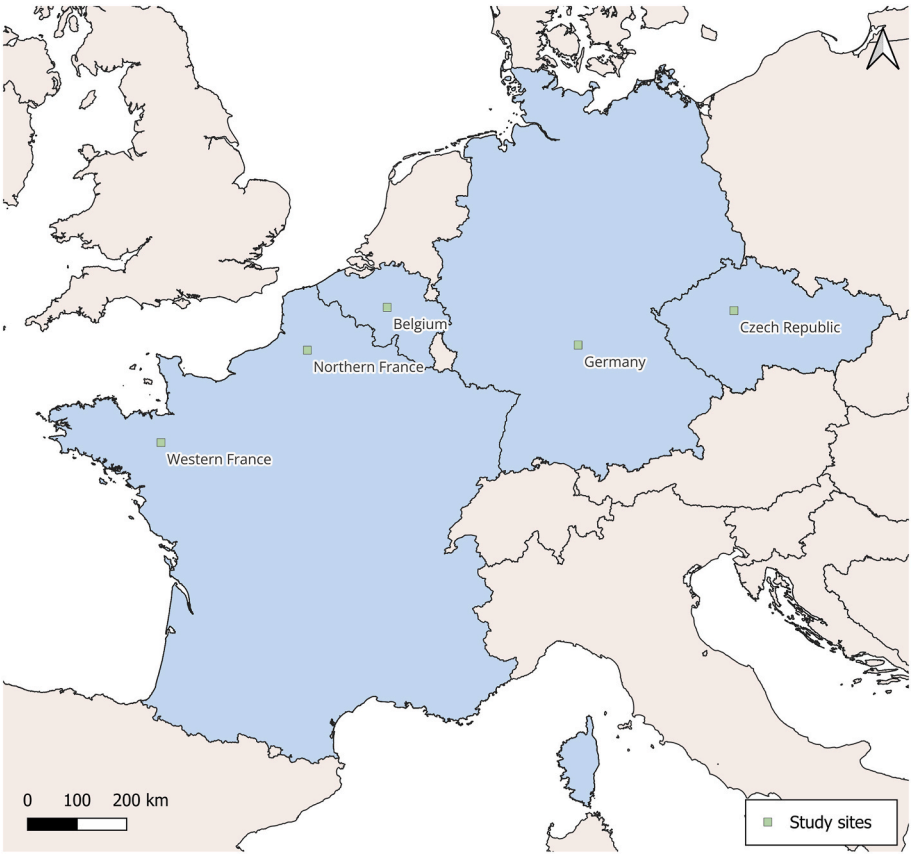

Fig. 1. Location of the five sites in four countries across Europe where living labs have been implemented during the studied project.

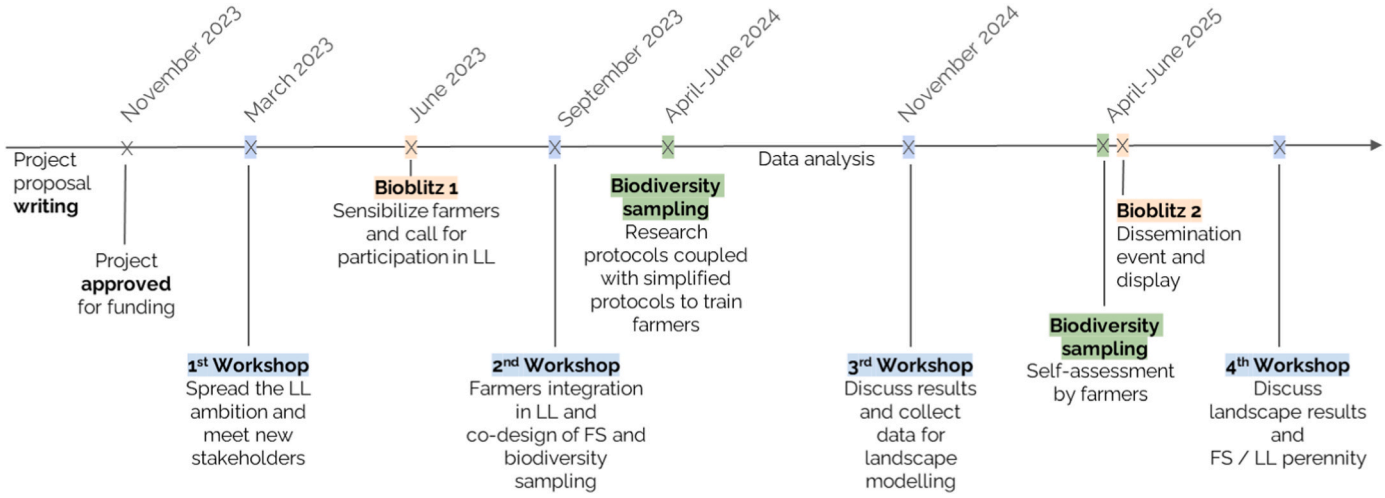

Fig. 2. Theoretical steps of the LL implementation in the five study sites during the lifetime of the research project. For readability the monthly consortium meetings are not indicated. Blue: actions related to meetings between all LL actors. Green: actions related to FS field-sampling. Orange: Citizen science events. LL – living lab, FS – flowering strip. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

was conducted later in the project (*i.e.*, after the living labs' work on flowering strips had started) and was made to reinforce the actor networks and disseminate the first ecological results of the research project.

Regarding the plurality of actors involved in the studied project, we choose to consider (Callon, 1984 actor typology[5] and focus on principal actors.

- The *initiators* of the living lab approach in the research project: ecology and participatory research researchers, who introduced the living lab methodology in this project. They represent what Callon name the *primum movens*, *i.e.* those through whom change is initiated and announced to other actors.
- The *researchers:* other researchers in ecology including professors, lecturers, teacher-researchers, technicians, PhD students, post-docs and interns. In Callon's words (*ib.*: 205), they correspond to the human actors "interested in advancing the knowledge which has been proposed" (*ib.*: 205).
- The *farmers*: farm managers correspond here to the human actors with some "long term economic interests" in cereal cultivation, similar with the fishermen of Callon (*ib.*: 204).
- The *flowering strips* as a mean of floral enrichment and all the biodiversity they host and that give an aim to the other actors' actions (*i.e.* non-human actors).

2.3. Data collection and analyses

To collect data, we combined different methodologies: participatory observations, semi-structured interviews and focus groups. The mix of these methods aimed '*to follow the actors themselves'*, that is try to catch up with their often wild innovations in order to learn from them what the collective existence has become in their hands, which methods they have elaborated to make it fit together, which accounts could best define the new associations that they have been forced to establish." (Latour, 2005: 12).

Participatory observation is conducted through an active, long enough immersion into a social group where the researcher's participation allows to increase their ability to observe and to grasp specific phenomenon and situations (Nova, 2022). In this study, participatory observations were mainly conducted while participating to the monthly consortium meetings of the research project during more than two years, but also to some citizen sciences events and workshops that occurred to reunite all the living lab actors (Fig. 2). Where direct participatory observation wasn't possible, we indirectly collected feedback, photos and records of the events. Participation (including indirect observation) in these events allowed to document research and farming practices regarding *flowering strips* and to observe actors' interactions, by taking notes about local characteristics and actors reactions and reflexions.

The semi-structured interviews methodology intends to understand the similarities and differences in the apprehension of the living lab approach by actors within different research and farming contexts. The majority of identified actors were interviewed in each country, which resulted in 53 interviews in total[6] (Table 1).

The interviews of *initiators* and *researchers* took place between December 2023 and February 2024, while the *farmer* interviews occurred from June 2024 to September 2024. All the interviews of Western France researchers occurred in person while the other researchers were virtually interviewed. Regarding the farmers, all the 28 interviews have been run in person, except one in Germany and one in Czech Republic. The interviews of *initiators* and *researchers* were done in French or in English, and the farmers were interviewed in their mother tongue (French, German or Czech).[7] *Researcher* interviews lasted 53 min in average, and the *farmer* interviews lasted 72 min in average. Czech and German farmers' interviews were longer because of integrated moments of live-translation.

Interviews followed a common interview guide designed to explore the full scope of the research question and created thanks to the exploratory analysis of various working documents, such as the funding proposal, living lab guidelines, meeting presentations, and scientific literature. The interview results were interpreted through the first three translation phases of ANT. We considered that the problematization phase only concerned the *initiators* and occurred only during the proposal writing process until the identification of the project's research question. Then, this research question echoes to the OPP within the ANT framework (Table 2). The interessement phase of other actors, with here (a) the *researchers* and (b) the *farmers*, occurred one after another. We tried to uncover the reasons for their interest by addressing topics such as their personal reasons to join the project and willingness to work with the general public (for *researchers*) or the research sector (for *farmers*) (Table 2). Finally, we investigated their enrolment in the project by identifying indicators of their implication in their local living lab and their knowledge about this approach. Transcripts were thematically coded at two levels (Table 2), (1) following the translation phases (problematization, interessement, enrolment), and (2) following the interview topics (indicators) and their declination into modalities.

We also conducted five focus groups, one with each researcher team (three in-person and two virtually). The aim was to understand *researchers'* vision of the setting-up of the research project (problematization and interessement phases) by identifying the opportunities and threats they perceived about the project, their expectations from the living lab approach in the project (interessement and enrolment phases) and their vision of their own participation at different steps (enrolment phase). We also recoded their answers according to each indicator.

Interviews and focus group discussions were recorded and transcribed with the oral consent of the participant. To ensure anonymity, participants were given an anonymity code, data were stocked separately, and well-anonymised citations were used where needed. We then analysed all the data to characterise each translation phase and the overall deviation between the theoretical and the actual implemented living lab approach in the project. We explored the relative importance of modalities within each indicator to compare the different studied sites.

3. Results

The ANT framework applied in our study revealed one problematization phase in which we determined one single OPP followed by two distinctive interessement phases, first one for *researchers* and the following one for *farmers*, and one enrolment phase. A cross analysis of interviews and focus groups did not highlight fundamental differences in the appropriation of the living lab approach across the five sites in Europe. Hence, results are presented without distinction between the five living labs.

[5] In "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay" Callon (1984: 204) considered the *primum movens* actors are the "three researchers", other human-actors are "the fishermen of St. Brieuc Bay" and "the scientific colleagues". The non-human actors are "the scallops (*Pecten maximus*)".

[6] While the interviews with the researchers lasted from 32 to 86 min, and with the farmers from 32 to 117 min, we included in our sample two shorter interactions with research technicians that lasted 6 and 9 min. These interactions, although not considered as semi-structured interviews, allowed us to understand the relationship of those technicians to the project and the limitations of their missions regarding the participatory approach.

[7] In France, interviews were conducted in French and translated into English. In Germany they were conducted in German with partial English live-translation, and the transcriptions were translated in English. In Czech Republic they have been live-translated (English/Czech) by a Czech researcher. All the translations took into account the particularity of local idioms and technical terminology.

Table 1
Number of *initiators*, *researchers*, and *farmers* identified in the project (grey, i.e. people supposed to participate at different stages of the project) and actors actually interviewed (**bold**).

	Western France	Northern France	Belgium	Germany	Czech Republic	Total number of interviews
Initiators	3 ; **3**	0 ; **0**	0 ; **0**	0 ; **0**	0 ; **0**	**3**
Researchers	12 ; **12**	2 ; **2**	3 ;**2**	2 ; **2**	4 ;**4**	**22**
Farmers	12 ; **9**	13 ; **0**	8 ; **5**	15 ; **11**	7 ; **3**	**28**
Total number of interviews	**24**	**2**	**7**	**13**	**7**	**53**

Table 2
– Themes addressed during interviews according to translation phases and the studied actor groups.

Translation phases	Interview topics	Actors		
		Initiators	Researchers	Farmers
Problematization	History and steps in project construction	X	X	
	Motivation for the early stages of the project	X	X	
Interessement	Motivation in joining the project	X	X	X
	Past experience about working with general public	X	X	
	Past experience of collaboration with researchers			X
	Perception of the integration of the living lab approach in the project	X	X	
	Willingness to cooperate with other actors	X	X	
Enrolment	Knowledge of the living lab approach	X	X	X
	Definition of the living lab concept	X	X	
	Integration of the living lab during the project's lifetime	X	X	X
	Implication in the living lab	X	X	
	Knowledge of other project members and perception of their roles	X	X	X

3.1. A dive into the start of the project: identification of the initiators, and problematization and interessement of the actors around an OPP

Our observations of the consortium meetings, of the interactions between project members and of the implementation process of the local living labs in each site in combination with an analysis of the project proposal revealed major shortcomings in the recognition of the OPP by the actors.

3.1.1. The initiators and the problem formulation

Only a few actors of the project were involved at the beginning of the problematization phase and constituted the *initiators*. These actors included the project coordinator, a researcher in ecology, and former colleagues now working as independent researchers on interdisciplinary questions related to participatory scientific practices in ecological transition. The involvement of such a research partner from the private sector was an asset for getting funded.

The *initiators* decided on the general topic of the project: studying *flowering strips* through the living lab approach. They formulated problems and research questions that appeared essential in their domains and among their collaborator network but also responded to the funding call objectives:

> "I had the idea of doing a project […] that combined flowering strips on a [climate] gradient, and that fit well with the call for projects […] and allowed us to continue sampling (…)" (Initiator 1)

Discussions among all *initiators* and their collaborators (a subsample of *researchers*) about the project's likelihood of acceptance by funders also shaped its problematization as funding agencies orient scientific agendas towards interdisciplinarity and participatory approaches. These discussions addressed both ecological and social dimensions: ecologically, they emphasised the importance of climate change and its impacts on agriculture; socially, they considered current agricultural developments and the emergence of rural living labs to tackle local issues. In this case, the *initiators* anticipated applying for funding on biodiversity enhancement in which participatory science, including living labs, has been receiving a growing attention.

At the end of the problematization phase, the emerging project innovatively combined: (1) ecological studies of selected biological models (the influence of floral enrichment on multiple taxa); (2) investigations on these models along a climatic gradient in order to study the potential effect of climate; and (3) analyses of how participatory research practices (the living lab approach) effectively contribute to biodiversity conservation (Fig. 3 | Problematization). These three elements integrated altogether constituted the OPP.

The project proposal was submitted with an emphasis on the living lab approach (the OPP appeared to be the main research objective) and was structured into four work packages (WPs, thematical work units within a project proposal, Fig. 4). WP1 on "Living lab dynamics" encompassed the establishment of a living lab in each European study sites within which ecological studies in the two other WPs was carried out. This first WP was intended to be the key for the success of the other WPs.

After the problematization phase, we determined two sub-phases of interessement (Fig. 3 | Interessement): (1) the attempts made by the *initiators* and their collaborators to interest other researchers, and (2) the collective efforts of all *researchers* to interest *farmers*. This phase is characterized by the strategies employed to convince *farmers* that the pre-established problematization is indispensable.

3.1.2. Interessement of researchers

When asked about their motivation to participate in the project, *initiators* and *researchers* noted several drivers: interest in the ecological part of the project (n = 10), but also in the participative aspect (n = 8), the access to a new job or new tasks (n = 4), starting or continuing collaboration (n = 3), doing their habitual tasks (n = 2) and getting a budget opportunity to do research (n = 1). Some researchers joined the project to keep collaborating with one of several others (known from previous projects) (n = 8), while most researchers (n = 17) joined the project because they were asked, proposed or recruited to participate.

The *initiators* and *researchers* have very different relationships to participatory science. Some of the researchers interviewed expressed their willingness to participate to the participative aspect of this project (*i.e.* enrol themselves in the living lab approach) (n = 10), others felt uncomfortable with it (n = 9), and some were curious but pointed out that they had never engaged in such an approach before (n = 6). For most of them, this is their first experience with participatory science

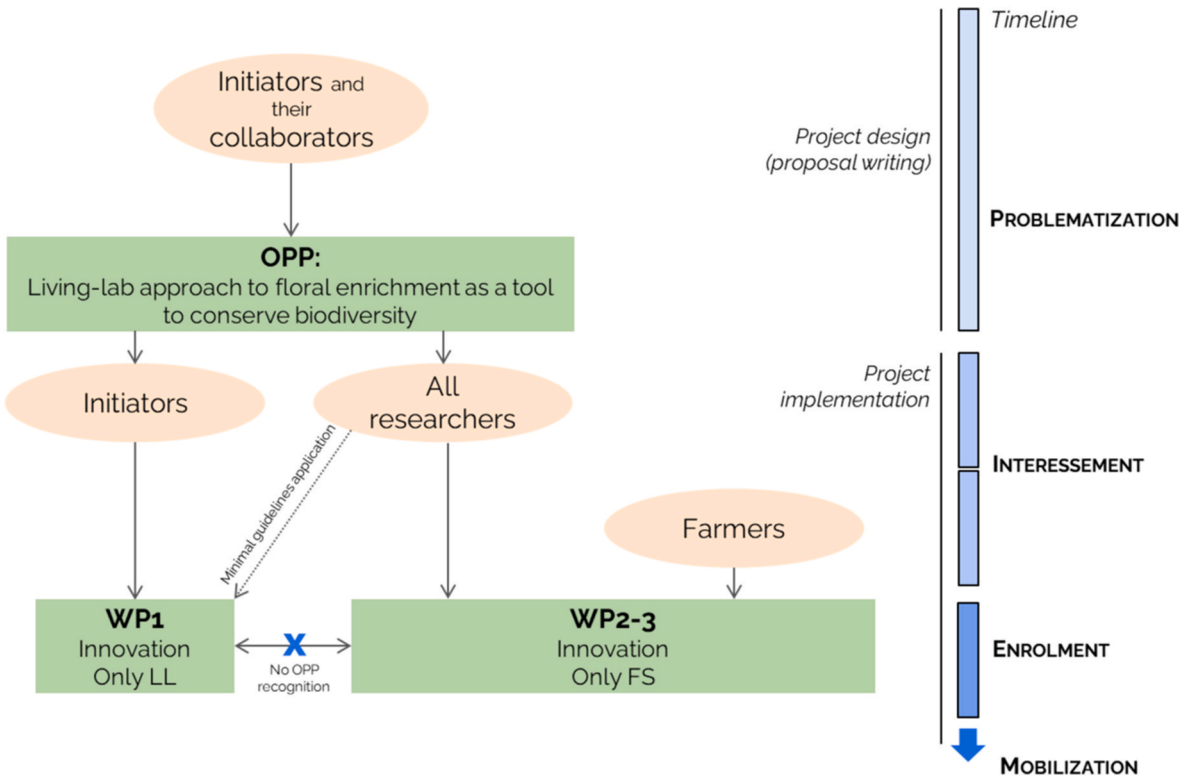

Fig. 3. – Observed structure of the phases of the ANT (Actor Network Theory) specific to the research project over its lifetime, which is divided into three phases. Phase 1 | Problematization: the *initiators* and their collaborators are at the origin of the OPP and involved in the proposal writing. Phase 2 | Interessement: researchers and farmers joined the project at different times (2 sub-phases) with divergent objectives from the OPP. Phase 3 | Enrolment: actors enrolled mainly in thematic work packages instead of working towards the OPP resolution. LL – living lab, FS – flowering strip, OPP – Obligatory Passage Point, WP – work package (thematical work units within a project proposal).

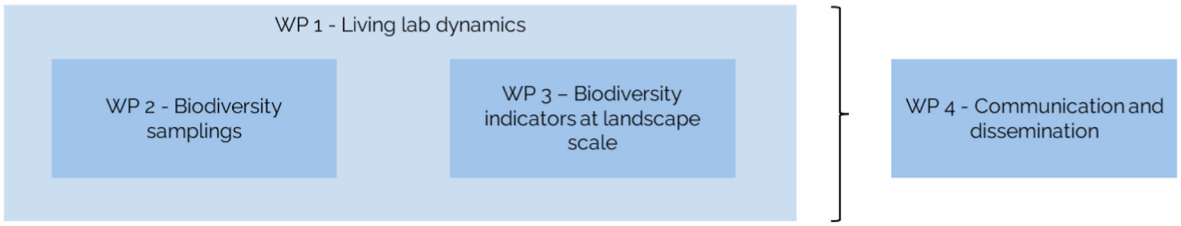

Fig. 4. Organisation of work packages (WP) in the studied project as suggested in the project proposal.

(n = 15). Although 18 researchers had already conducted research through which they interacted with farmers, this relationship usually consisted of sampling on experimental fields provided by farmers to scientific projects, as one of the researchers explains:

> "In previous projects (…) we worked with farmers, but it was mainly to ask them if they would allow us to work in their fields, and then we gave them a brief summary of the results." (Researcher 1)

During focus groups, the *initiators* and *researchers* mentioned more negative perceived aspects of this project than positive ones (84 against 74). Out of those 158 mentioned elements related to their visions of the project, 37 have a link with the living lab aspect (14 considering it negatively and 23 positively), while 121 mentioned elements that are not linked to the living lab approach but to other aspects of the project (70 negative elements *versus* 51 positive elements). In general, positive aspects of the project were mainly seen in its scope and diversity of the ecological study. They also include the participative nature of the project without necessarily linking it to the living lab approach. The negative aspects were funding constraints, unexpected environmental conditions, and a decrease in the engagement of *researchers* and *farmers* over the lifetime of the project. This resulted in increased workload for the remaining *researchers* to keep up with the project's implementation needs, and distrust towards the consortium came up among *researchers* and *farmers*.

By the end of the first stage of interessement, the *researchers* seemed to have reached a theoretical consensus to work directly under real-life conditions with the *farmers* (Fig. 3 | Interessement). However, it appeared that *researchers* made a distinction between aspects related to the participatory approach and the ecology analyses of *flowering strips*.

3.1.3. *Interessement of farmers*

The interessement of *farmers* (Fig. 3 | Interessement) refers to the set of actions through which the researchers strive to make farmers participate in the living labs once the project had officially started. During the interessement phase, *farmers* joined the project mainly through three channels: (1) intermediaries designated by researchers (elected representatives, NGOs), (2) direct recruitment by researchers relying on previous networks, and (3) direct canvassing (phone calls, door-to-door visits, snowball sampling). Contrary to what had been planned in the project proposal, the launching Bioblitz event (Fig. 2)

generated almost no recruitment of farmers despite its participative nature.

Regarding their motivations, the interessement of *farmers* did not relate to the project's innovative living lab approach with its promises of co-construction. Instead, their engagement was motivated by questions directly linked to *flowering strips* and their expected benefits for biodiversity protection or biological control (n = 13), by past participation in research (n = 15) and by the intention to help the researcher who invited them to join the project (n = 5). Some farmers also mentioned the need to improve the reputation of agriculture through *flowering strips* (n = 3).

The analysis of these two interessement subphases shows that the recruitment of local research teams before the recruitment of the *farmers* allowed for little to no co-design of the field experimentation. Experimentation of *flowering strips* focused essentially on ecological questions that were defined in the proposal and that were perceived highly binding by *researchers* once the project was accepted for funding (contrary to the living lab approach). Consequently, *researchers* decided on experimental criteria filtering out potentially highly interested farmers and accepting large distances between fields to comply with experimental requirements. In some cases, interested farmers who had initially agreed to participate in the living lab and work on *flowering strips* did not meet the criteria defined by the ecological research protocols and were not further involved. Consequently, financial compensation has been proposed as an incentive for other farmers to join the project in some sites. As such, the recruitment of the farmers in all sites targeted only the contribution of experimental fields to the project, thereby disconnecting field experiments from the living lab approach. This has led to variable *farmers* commitment.

3.2. The missed meeting of an OPP recognized by all the actors – a tense enrolment

In the studied project, enrolment corresponds to the process through which *researchers* and *farmers* either accepted or refused the roles assigned to them by the living lab approach *i.e.* to co-construct an experimental design, to contribute to data collection, to engage in knowledge co-production. In other words, this means how they deal, by their actions, with the OPP. Overall, the analysis of the enrolment phase reveals a missed encounter between actors — the failure to align around a single OPP. Although the ecological work packages were formally embedded within WP1, they were conceived and managed independently, reinforcing the fragmentation initiated by the proposal's thematic structure (Fig. 3 | Enrolment). As a result, the living lab and the *flowering strip* experiments evolved as separate trajectories.

3.2.1. Enrolment of researchers

The enrolment of the *researchers* (Fig. 3 | Enrolment) was facilitated by consortium meetings introducing and familiarizing them with participatory science and democratic research practices, and particularly with the definition and implications of the living lab approach. These meetings took place mainly through video conferences and relied on a set of interconnected presentation materials made available on the project's shared digital workspace. They combined both a theoretical framework on living labs and practical step-by-step guidelines to be followed in order to establish functional living labs across the project's five sites. The intentions and objectives for the living lab approach were clearly set: (1) to engage with stakeholders through the organization of workshops and citizen science events, here a Bioblitz, as means to establish living labs, (2) to build a community of members interested in participating in a project on floral enrichment across Europe, and (3) to act as closely as possible to local needs and contexts.

Over half of the *researchers* (n = 14) did not mention spontaneously the living lab aspect of the project during their interviews. When asked to define what a living lab is, most participants found it difficult to provide a clear definition. Some of them concluded that this part is only relevant for the researchers in charge of the living lab work package (WP1), but not for those involved in other WPs (WP2 and WP3). Thirteen researchers considered that the project's WPs are dependent from each other, and that the living lab and ecological analysis of *flowering strips* are inter-related. A minority of researchers expressed distrust or reluctance toward participatory science produced data in general, as one of them explains:

> « Actually, I don't really trust [people's] diligence. I mean, how do people actually do it?» (Researcher 2)

Contrary to what the WP1 leaders had planned, researchers involved in WP2 & 3, most of them being trained in ecology, enrolled themselves in creating research protocols focused on their respective study objects. Given the large size of the *researcher* group, the range of study topics is wide, multiplying factors to consider in sampling. Guided by the principles of replicability and the idea of an ideal field site, there was little room for the unknowns and uncertainties of the fields and the farmers they would encounter. Biodiversity sampling protocols designed by the ecology researchers were scheduled at specific times and criteria: flowering strip size, shape, composition, and localisation in the field, as well as crops and farming practices were determined without any interaction with *farmers*. Moreover, *farmers* self-assessment (Fig. 2) was ultimately not supported by *researchers* and was omitted from the project agenda. Nevertheless, some adjustments were made following the 1st and 2nd workshop (Fig. 2) in which some farmers in the five study sites expressed their thoughts. Technical aspects of sowing and additional taxa to study were discussed. WP1 leaders regretted that researchers in WP2 & 3 did not acknowledge the participatory approach that requires to step back from usual research practices:

> « the living lab approach, within which we actually allow ourselves more freedom than what is usually expected in research, is not understood at all, or is not accepted, or is very frightening. In any case, we have not detected that this could be a sticking point now and that for some people […] if the conditions are not met in order to process the data, obtain such data, process it in such a way and obtain results with such robustness, the project has no scientific interest or is not worth investing a lot of time and energy in on a personal level. » (Initiator 2)

One of the *initiators* (WP1 co-leader) mentioned that they reiterated actions to provide opportunities for ecological researchers to enrol into the participatory dimension at different moments of the project, such as inviting farmers into the field to make them discover the protocols and at the same time to learn about the farmers' interests, as well as to discuss technical issues or benefits of flowering strips. Finally, such interactions hardly took place, or only marginally. Biodiversity sampling phases unfolded like a conventional research setting, where time spent on sampling plots was optimized. *Farmers* and *researchers* confirmed that even though some conversations occurred at the edge of fields, they rarely led to questioning the research design or to genuine co-construction as promoted by the living lab approach.

Finally, the *researchers'* enrolment produced tensions and raised questions. For example, 10 researchers considered the project as failing at least in the participative aspect. The living lab approach enacted through sets of citizen science events and workshops, initially intended for co-design and co-production of knowledge, had evolved into spaces for presenting preliminary biodiversity results. *Farmers* highly valued such scientific outreach in the interviews. However, organizing these events placed a heavy burden on *researchers*, while *farmers'* attendance remained limited. Nevertheless, some *researchers* adopted a reflexive stance, viewing the use of a living lab approach as an experiment in itself, from which valuable lessons could still be learnt.

3.2.2. Enrolment of farmers

A great majority of interviewed farmers (20 out of 28) did not know about the living lab aspect of the project (even under another appellation). They described the project objective only orientated towards

flowering strips and biodiversity protection. Most of them only knew the person they had been in contact with: often the researcher in charge of their "recruitment" or some farmers previously met in other networks.

Farmers were enrolled with the obligation to plant a flowering strip with low flexibility regarding the size, timing, or precise location of planting. The strict requirements for the flowering strip implantation quickly led to tensions between research protocols and farm realities as specific tools were needed that were not available on all farms. As a result, the process involved numerous negotiations and questionings about how to effectively set up the strips among farmers. Some *farmers* had to cope with that issue and felt "to be let alone" and regretted certain aspects of the research protocols such as the seed size and composition as well as the period of seeding, as two of them explain it:

> « To be honest, I dug out the old tools to do my work. I have a cousin right next door who has a small 35 horsepower tractor with a small 2.5 m harrow. I asked him to come and do it for me. » (Farmer 1)

> « Well, regarding the planting method, there are periods when you must be careful. When you're doing research, you can't sow just at any time. There are sowing periods (…), we sowed late. » (Farmer 2)

Further difficulties arose from the mismatch between research schedules, the timing of agricultural work and the risk acceptance. Certain research protocols, such as pitfall traps and pollinator observations, interfered with farming operations like soil preparation or pesticide application and the flowering strip management when weeds appeared. Because these situations had not been openly discussed with farmers and they had to wait a lot for instructions, analyses and results, it led to tensions or farmers' disengagement in some cases.

> « We haven't had much interaction with you. We've never had any connections, practices, or work together. But that's just how it is. (…) I'm not going to bother them either, they're doing their job, doing things their way. » (Farmer 3)

Throughout the project, one persistent challenge linked to the geographical distance and the schedules that were not aligned between members of the living labs was mentioned by farmers when it came to meet in person. Several adaptations were implemented across study sites: in some cases, workshops were also offered virtually, and some living labs chose to set up social media discussion groups. Despite these efforts, information sharing remained limited making collaboration between *farmers* and *researchers* almost inexistant.

4. Discussion

In this study, we analysed the implementation of agroecological living labs across four different countries in five different sites within one research project, therefore following the same general guidelines in each site. Our analysis showed no local differences between the living labs but rather revealed one homogenous picture of decisive turning points linked to the research project within the European research landscape. In the following paragraphs, we present four main recommendations for the use of agricultural living labs to support effective appropriation by their actors, and we discuss the importance of adopting a reflexive approach about their implementation.

4.1. Living labs: from theoretical conception to empirical contexts

The living labs were initiated by researchers through a funded research project. Its construction suffered from the tight funding frame that imposed the focus, timeline and the structure in thematic work packages. Additionally, limited budget allocations decided by national funders did not allow adequate staff time allocation to all work packages, hence creating a feeling of frustration among many actors, both *farmers* and *researchers*. *Researchers* have to deal with such resource constraints which may result in what Lin-Hunter et al., 2024a-characterized as a misalignment between what participatory research leaders seek and the expectations they perceive from their working environment. Here, researchers underestimate the time to spend for participatory research regarding the fundings they received.

Furthermore, the selection process implemented by funding agencies require project proposals to use quantifiable and objectifiable indicators (Aithal and Aithal, 2023). Consequently, applicants for fundings collectively decide research questions and methods able to fulfil those requirements which ultimately undermines a co-design process with non-academic actors. Indicators are based on predefined actions, tasks and expected results with few flexibilities in methods and deliverables. The current challenge is to pass from such a top-down approach to a bottom-up approach within the existing funding schemes for research. Similar conclusion has been stated by Slingerland and Overdiek, 2023:(35) in their work using Balestrini et al. (2017) model of city commons to design what they call a *Biodiversity Urban Living Lab* (BULL). They underline the difficulty of gathering actors around the question defined by researchers because not all those actors understand this starting point in the same way: "A challenge of applying this model in the current research is that the first step […] should be informed by what concerns [the non-academic participants] rather than what the researchers or other external organisations find important. This means that biodiversity cannot be the starting point of the BULL approach because we found that very few [non-academic participants] currently care or are aware of the issues around biodiversity." (*ib.*: 35). Slingerland and Overdiek (2023) even challenge the proposal standards within the current funding schemes. While research objectives should still address biodiversity issues in society, they think the methods should target users' and producers' values of biodiversity[8] and let these results guide what and how it should be experimented regarding the ecological question to find a solution to a problematic situation. This uncovers an important challenge in the research project we studied. The consortium was mainly composed of disciplinary researchers, some interested in participatory approaches, but generally with few or no experience in neither participative science nor living labs. Subsequently, the objective and methods were strongly orientated towards disciplinary ecological research with a limited attention to the living lab approach.

Our analysis highlights the mismatch between research policy and funding. James et al. (2025) mention that institutional factors, such as the project structure, have an impact on later actors' engagement during the project. While current research policy in Europe acknowledges non-academic stakeholder involvement, interdisciplinarity and addressing issues in ecological transition, research funding imposes its limiting frame in project design, outputs and outcomes on participatory research projects. As such, the responsibility for moving away from conventional practices relies largely on individuals themselves — on researchers (*e.g.*, Riesch and Potter, 2014) not necessarily trained in mode 2 research regime and on farmers seeking to change to alternative agricultural practices. A participatory research project addressing biodiversity issues and nature-based solutions, and consequently ecological transition in agriculture, demands both researchers and farmers to change practices which cannot be done without systemic support from both the research and the agricultural sectors. Funding and research policy should be scaled up to support such highly needed research ambitions.

Moreover, research policy is currently incoherent with knowledge co-production as network building and maintaining as well as non-academic stakeholder involvement and long-term engagement needs timeframes often beyond conventional project durations (Barré and Jollivet, 2023). There is also need for specific staff trained in

[8] From a pragmatist perspective, values are not intrinsic properties but arise from specific situations and their consequences. They take shape in moments of uncertainty that prompt individuals to adjust their habits and ways of acting (Dewey, 1939; Morgan, 2014).

interdisciplinarity and participatory approaches. Allocated staff time should be aligned with the participatory projects objectives which means that research funding needs to consider long-term positions dedicated to participatory research. Productivity in science is currently measured with indicators focusing on quantitative outputs and favouring big datasets driven publications. Given the higher budget-time allocation needed in participatory projects, research policy should be aware of lower productivity. Participatory research approaches focus on qualitative outcomes and favour, if well-constructed and co-designed, transformative changes in society *e.g.*, towards an increasing interest in biodiversity conservation (Lowe et al., 2025). Qualitative or mixed-indicators (Olson and Colston, 2024; Janssen et al., 2025; Ortega-Álvarez et al., 2025) should be ultimately favoured to evaluate an applied participatory research project success, beyond its productivity only (Gignac et al., 2021).

This study of the implementation of living labs in the context of research projects leads us to propose a first recommendation: researchers responding to calls for projects involving living labs should anticipate a risk of mismatch between the formalised requirements of the research policy and the exploratory and unpredictable nature of the results from this approach.

4.2. Triggering actors' engagement: factors prior to the research project

In the project, rather than seeking to work with volunteer farmers whose potential involvement might have been significant because it was driven by their own interests, the focus of ecological researchers shifted to finding experimental fields that met very specific criteria. There was no recognition of a common OPP that could have led to a collaborative vision and so a co-constructive approach for the future enrolment of actors. This emphasises that *researchers* underestimated the importance of *farmers*' motivations for further thorough engagement in the project. Even if some researchers expressed the will to enrol in living labs during the interessement phase, the divergent appropriation of this approach resulted in a decline in engagement levels while time and availability requirements increased over the project's lifetime. James et al. (2025) underlines that motivation prior to the project implementation may drive engagement levels in all participants. One reason for that seems to lie in the insufficient training of *researchers* by the *initiators* (especially the WP leaders for the living lab approach). As James et al. (2025) pointed out, knowledge of the project to engage in by academic and non-academic actors may explain engagement levels. The vagueness and diversity of definitions of living labs do not provide a conceptual framework that is easy for lay participants to grasp. In our study, *farmers* did not really know what participating in a living lab would imply, a consequence of the consortium researchers not knowing themselves. Although these two groups of actors often work together on projects, they are not used to collaborating within the same structure as is implied by the cooperation in a living lab. Similar dynamics have been observed in Toffolini et al. (2021) where the coexistence of heterogeneous rationales and unclear role distributions likewise constrained the reconfiguration of actor networks and innovation processes. To mitigate this effect, it has been proposed to follow common guideline across sites for the living lab creation but this resulted in a more standardized or protocol-driven application of the approach, with limited consideration for adaptation to local contexts.

Trust in each-other seems also to be an important cue for engagement in participatory-science projects, for both researchers and non-academic participants (Lapostolle et al., 2023; Lin-Hunter et al., 2024b). *Farmers* who participated in the project showed trust in *researchers* because they worked with researchers before or they wanted to help researchers that had contacted them. On the other hand, trust of *researchers* towards *farmers*' contributions was limited. A few researchers had no confidence in results that could have been obtained by participatory methods while the literature shows that data collected by non-researchers can be qualitative with only a few minor modifications to adapt the protocols (*e.g.,* Hamilton et al., 2024 on the accuracy of participative benthic macroinvertebrate identification). In order to establish an atmosphere of trust, researchers should be equipped with validated methods for dealing with participatory science data, and they should adopt research practices that foster knowledge co-production through the integration of scientific, experiential, and local forms of knowledge. Such approaches would allow different ways of thinking and would involve a wide range of actors in knowledge production (De Souza Mello Bicalho and Trippia Dos Guimaraes Peixoto, 2016) Mello Bicalho and Trippia dos Guimarães Peixoto, 2016) at long term (Smith et al., 2019). Knowledge co-production practices recognise that science does not hold the sole monopoly on relevant knowledge, hence making innovations more relevant for users and locally adapted.

We have highlighted the risks associated with the lack of clear and shared objectives, and thus the recognition of a common OPP, among the various stakeholders in living labs. To address this, we recommend precisely defining the scope of action of the living lab in question. This involves developing a common identity and explicitly formulated objectives accessible to all actors (*i.e.* not only from researcher perspectives). It is also possible to disseminate this information beyond the living lab's internal network, so that other actors can benefit from such visibility of the research progress.

4.3. Maintaining actors' engagement: factors during the project

The project included several Bioblitz events, but only a few farmers attended them. While simplified protocols were developed to allow *farmers* to participate in biodiversity sampling these were not used in the end. Robinson et al. (2024) showed that hands-on and practical activities are important for non-academic participants to increase their knowledge and interest in science. Besides, social and collaborative dimensions are important in participatory projects to create a sense of belonging and being connected to a wider scientific community (Robinson et al., 2024). The cleavage between various interests among *researchers* and *farmers* has been accentuated during the project as interactions between the actors remained rare and practical activities and roles were split between *farmers* (sowing and managing flowering strips) and *researchers* (designing, sampling and analysing).

In that sense, several challenges occurred in our study. Expectations in the three actor groups were somehow disconnected. *Initiators* focused on the living lab approach, while *researchers* aimed (i) to obtain data of high research quality to test whether *flowering strips* are a relevant tool to enhance biodiversity in agricultural areas along a climatic gradient and (ii) to broadcast their conclusions through scientific publications, which allow their work to be recognized in their professional research system. *Farmers* wished to gain knowledge *in situ* and directly useful for their farm. While these objectives might overlap at some point, the extent of the expected results differed and a common methodology was clearly missing because of the initial lack of co-design and the absence of interactions during the project. This partly resulted in a situation that was also observed in Callon (1984: 213) where "[t]ransactions with the fishermen [in our project, the farmers], […] are non-existent. They watch like amused spectators and wait for the final verdict. They are prepared simply to accept the conclusions drawn by the specialists. Their consent is obtained (in advance) without any discussion".

The promise of the living lab concept is to set a common objective and to put in place actions that keep everybody aligned on this objective (Dubé et al., 2014). However, because enrolment was based on the *flowering strips* experiment rather than on the living lab with its aim of co-constructing research questions or protocols, the actors did not follow a common OPP (Fig. 3 | Enrolment). As a result, they pursued mainly — if not only — their own interests while still participating in a project whose objectives they did not share. In their study of living labs, Forbat et al. (2025) emphasise the fact that shared goals at each step are important to ensure cooperation and minimise conflict between living lab stakeholders. Thus, we emphasise that the implementation of living

labs should emerge from a shared understanding of the problematic situation or users' needs, and that the entire network of actors should acknowledge "movements and detours that must be accepted as well as the alliances that must be forged" (Callon, 1984: 206) for their enrolment.

Therefore, another important point highlighted by our results regarding the actors' engagement concerns the temporality of living labs. Living labs, as participatory research processes, are usually long-term approaches whose establishment require time. Indeed, co-design and co-production of knowledge needs numerous negotiations, thus a lot of time. However, this is often prevented by the timeframe of research projects, which generally only last a few years (3 to 4 years) which is not adapted to the living lab dynamics. Moreover, staff employed through research projects are often post-doctoral researchers and doctoral and master students. Their positions are short-term, which limits time for sufficient training and building on historical interactions with stakeholders in the study site. Researchers should be able to commit for a long time to living labs to maintain needed interactions between all actors and provided means to do so. However, these time-consuming interactions are not valued by academic standards in the current research policy and funding bodies because they do not result in scientific publications, or not immediately.

Our third recommendation extends then the second one, emphasizing the need for a shared identity grounded in clearly defined and collectively agreed objectives, while adopting a long-term perspective. As living labs and actors concerns evolve over time, we propose the organisation of regular meetings, in a format decided by the actors, enabling them to renegotiate the nature and boundaries of their engagement. Such an approach can help prevent enrolment difficulties and the withdrawal of actors who no longer recognise their role or interest in the living lab boundaries. In this sense, we would recommend considering living labs as dynamic and evolving networks rather than a fixed and finalised optimal configuration of an actor network. Mobilising living labs as a long-term approach would ensure the creation of well-established and recognisable actor networks with their own functioning.[9]

Besides the missing engagement in the participatory dimension, the project faced some stochastic events (such as weather conditions or weed invasions) that the participants were not prepared to deal with in a collective way. These events created controversial situations that further weakened the network, which already lacked a well-established and recognized OPP. Meeting with farmers, farm visits, workshops are useful tools to maintain exchanges and have been proposed during our studied project. However, large distances between farms often prevented the participants from meeting, a problem also observed by James et al. (2025). Lequin (2021) also emphasises the role of the geographical proximity activation for the network extension (or here the enrolment of new actors). Geographical proximity could consolidate the living lab along with the recognition of a common OPP.

This leads us to our fourth recommendation, which highlights the importance of taking into account the geographical dimension of living labs. We suggest that researchers involved in their creation first position themselves within a specific local context, embracing its environmental and socio-economic conditions. This implies understanding the needs emerging from the field and only subsequently identifying how these may align with their research objectives.

[9] This stage was not reached in the project presented in this study. Had it occurred, we could have studied it through the lens of the "Mobilization" phase proposed in Callon's (1984), which corresponds to the moment when the actors are represented in a single discourse: "At the end of the process, if it succeeds, only voices speaking in unison will be heard." (*ib.*: 204).

4.4. The importance of reflexivity in living lab mobilisation and the pertinence of ANT for project lifetime analysis

We have shown that living labs are complex multi-actor networks, whose dynamics are changing according to the negotiations that take place between human and non-human actors. The studies of successive translation phases permitted by Callon's theoretical framework in the ANT turned out to be a pertinent way to observe a project in progress by focusing on its actors, their interests, and the concessions they are willing to make in a collective endeavour.

The ANT proved particularly insightful, as it lies within the field of the sociology of science and therefore offers a reflexive perspective of research processes. In the context of this project - where the mobilization phase has not been reached - we assume that feedback appears valuable. This is especially relevant because such shortcomings in participatory and more broadly in citizen science are rarely reported in scientific literature because they are usually provoking stress for researchers (Ducourneau, 2020) as it may affect their career or further funding of new projects. Although there is some co-learning observed in the studied research project, reporting failures and uncertainties that are inherent to participatory research is a right and necessary to reflect on practices and to cope with adaptations (Turcati et al., 2025). This is all the more important given that participatory research today requires recognition and evaluation as a research regime (Barré and Jollivet, 2023). Our study and recommendations support this, and we hope that actors involved in living labs will recognise and accept their specific constraints.

We also argue that, when participatory research methods are employed, the responsibility of the research sector and researchers is even greater than in mode 1 research regime. Within the framework of living labs, and more specifically agricultural living labs in our case, this can be done by early non-academic actor engagement (Paleologo et al., 2025) to align expectations of outputs/outcomes and technical language between the project's actors, or epistemological negotiations (Wyss et al., 2025) from the very beginning of the project. In this reconfiguration, the role of each actor needs to be defined and redefined. In describing their "methodological bricolage," Lapostolle et al. (2023) also investigated the role of the researcher in living labs. For them, it is not a matter of the researcher concealing their knowledge, but rather of cultivating a stance of non-domination and recognition of situated knowledge (Haraway, 2013), *i.e.* knowledge not derived from scientific objectivity. Thus, the researchers even if they are at the origins of living labs are actors like any other participant involved in a common project.

Ultimately, our study converges with Fasshauer and Zadra-Veil, 2020 and Zadra-Veil (2020) and Lapostolle et al. (2023) regarding the importance of a mobilization phase or "swarming" (*i.e.*, the diffusion and reappropriation of practices, knowledge and networks beyond the initial project framework). However, while this dissemination dynamic is often presented as a desirable outcome of participatory processes, its concrete impacts and long-term effects remain only rarely investigated in the literature.

5. Conclusion

Living labs undoubtedly are an interesting approach that could address social questions disregarded by mode 1 research policy, by focusing on end-user needs regarding an innovation. Unfortunately, the growing interest in living labs eventually led to their instrumentalisation by the academic sector. ANT has proven to be a very relevant framework for the study of the mobilisation of the living lab approach and its appropriation by the actors. ANT translation phases allowed us to fit the chronological aspect of a changing network of actors over the project's lifetime.

The analysis leads to four main recommendations. First, we call for greater anticipation of the potential mismatch between institutional research expectations and the inherently exploratory and uncertain

nature of living lab processes. We also emphasise the importance of developing a common identity supported by co-defined objectives by all the living lab actors to trigger their enrolment. Such alignment should be maintained over time through regular opportunities for dialogue and renegotiation. This recognises that living labs are dynamic and evolving networks, rather than fixed configurations, and necessitate long-term appropriation. Finally, the study highlights the need to ground living labs in their specific territorial contexts, encouraging researchers to engage with local socio-economic and environmental realities before aligning them with scientific objectives.

Together, these elements support a more reflexive, adaptive, and context-sensitive approach to living labs. Further studies should address the notion of individual engagement, among both non-academic participants and researchers, in the early stages of participatory projects by investigating personal motivations and personal backgrounds as well as risk acceptance to capture the potential for success of innovative research approaches.

CRediT authorship contribution statement

C. Agasse: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing. **A. Nicolai:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing. **S. Chollet:** Conceptualization, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing. **M. Herve:** Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing – original draft, Writing – review & editing. **H. Vaskova:** Investigation, Methodology, Writing – review & editing. **P. Saska:** Funding acquisition, Writing – review & editing. **J. Skuhrovec:** Writing – review & editing. **U. Fricke:** Writing – review & editing. **S. Redlich:** Writing – review & editing. **H. Chole:** Writing – review & editing. **J. Van Baaren:** Funding acquisition, Project administration, Writing – review & editing. **P. Boudes:** Conceptualization, Formal analysis, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing.

Declaration of interest statement

There is no conflict of interest related to this publication.

Acknowledgements

The study was implemented within the Biodiversa+ BiodivProtect ConservES project (2023-2026) and funded by ANR (project number ANR-22-EBIP-0017-03), Technological Agency of the Czech Republic (project number SS72010001), and the German Federal Ministry of Education, Research and Space (project number 03LW0322K). We are grateful to everyone who has contributed to the living labs set up for this project in the five study sites. We are particularly grateful to the colleagues who agreed to be interviewed and to have their work examined from a sociological perspective. We are also thankful to the farmers who contributed their valuable time and welcomed the researchers and talked at length about their practices and future aspirations.

Data availability

The data that has been used is confidential.

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