



**Deliverable 3.1 Report on key
challenges, stakeholders and
engagement plans**

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Executive Summary

Driven by the ambition to revolutionize soil improvement practices through the development and adoption of biowaste-derived soil improvers, the bioSOILUTIONS project aims to understand and effectively address the challenges inherent in this transformative journey. It will also take stock of the opportunities and momentum created by the European Green Deal and the Farm-to-Fork strategy to develop and test biowaste derived soil improvers in three Living Labs in Valencia (ES), Murcia (ES) and Flanders (BE) paving the way towards the widespread adoption of such products.

The primary objective of this deliverable is to highlight the critical role of stakeholder engagement in the success of the bioSOILUTIONS project. By bringing together a wide array of stakeholders, including researchers, farmers, feedstock suppliers, fertilizer producers and end-users, the project aims to forge a collaborative path towards sustainable soil management.

A central theme explored in this deliverable revolves around the multifaceted challenges hindering the development and widespread adoption of biowaste-derived soil improvers. These challenges range from concerns about safety, quality, and efficacy to the alignment with traditional farming practices and the perceived economic viability of such products. The identification of these challenges serves as a critical step in developing targeted stakeholder engagement strategies to address them effectively.

In addressing these challenges, the bioSOILUTIONS project underscores the important role of Living Labs as dynamic platforms for innovation and problem-solving. Strategically located in diverse regions, the living labs serve as real-world testbeds where biowaste-derived soil improvers can be co-developed, validated and tested by end-users. This participatory approach ensures that solutions are not only technically sound but also socially and economically viable.

1 Introduction

1.1 Setting the scene

The global agricultural landscape stands at a critical juncture, faced with a soil crisis that threatens food security and environmental sustainability. Soil, while vast and seemingly abundant, is considered a finite resource. The formation of soil is a slow and continuous process and soil degrades faster than it is formed. Soil degradation, driven by intensive agricultural practices and climate change, poses a threat to the very foundation of agricultural systems in Europe and worldwide. Conventional fertilizers, while instrumental in boosting crop yields, have inadvertently become part of the problem. Their chemical composition and application practices contribute to soil degradation, water pollution, and a reliance on non-renewable resources (Savci, 2012). As the demand for food production surges, the detrimental environmental impact of these fertilizers underscores the need for a paradigm shift in agricultural practices. In response to this crisis, the development, adoption, and application of alternative fertilizers, particularly biowaste derived soil improvers, have emerged as indispensable components of a solution-driven bioeconomy (Kacprzak, et al., 2022). Biowaste still remains largely underused around Europe but holds significant valorisation potential (EEA, 2020). This potential will be examined within the innovative bioSOILUTIONS project that will seek to develop four new valorization routes for bio-waste valorisation routes (blood hydrolysate, frass, N-struvite, K-struvite) and derive advanced bio-waste soil improvers.

The paradigm shift towards a successful development of biowaste soil improvers and their uptake and effective marketization, however, requires an inclusive engagement approach with stakeholders across the entire value chain. This multi-stakeholder engagement is essential as it ensures diverse perspectives, expertise, and insights, fostering collaborative innovation and addressing the complex challenges associated with the development, acceptance, and integration of biowaste soil improvers into mainstream agricultural practices. To develop an effective engagement strategy, it's crucial to delve into the diverse needs, motivations and limitations of stakeholders at different stages of the value chain. Challenges in the adoption and application of alternative soil improvers span various dimensions, encompassing regulatory, logistical, and public acceptance issues. Stakeholders, with their distinct roles and expertise, encounter different challenges based on their areas of work. Tailoring the engagement approach to understand and co-create solutions specific to each stakeholder group's challenges is at the heart of bioSOILUTIONS' stakeholder engagement approach. The establishment of Living Labs in Murcia (ES), Valencia (ES) and Ghent (BE) will serve as collaborative spaces for local stakeholders to validate bioSOILUTIONS' products and co-create innovative solutions around biowaste soil improvers.

The aim of this report is twofold: firstly, it seeks to present and analyse the challenges that hinder the development, adoption and commercialisation of biowaste soil improvers, with the aim of linking specific challenges to different stakeholder groups. Secondly, it aims to provide detailed insights into the tailored engagement plans formulated for the bioSOILUTIONS Living Labs. The engagement plans will outline the objectives of each Living Lab and the pathways to address and overcome local challenges.

1.2 Status Quo on integrating biowaste-derived soil improvers

While research and development of alternative solutions for soil improvers to reduce dependence on mineral fertilizers is at the top of the EU's agenda, there are still several challenges associated with the process of integrating biowaste-derived soil improvers, each with its own nuances and potential solutions. The bioSOILUTIONS project is positioned at the intersection of innovation and challenges in transforming the soil improver industry with biowaste-derived products.

Overcoming the **regulatory hurdles** is no easy task. Inconsistent definitions of terms, such as “biowaste” or “soil improvers” across different jurisdictions can add to the complexity for entrepreneurs. In addition, the constant refinement of regulations, often influenced by the latest scientific findings, makes it difficult for businesses to establish a concrete, long-term plan for their operations (EEA, 2020).

Besides that, the **technical journey** from biowaste to soil improver can be very challenging. It is vital to guarantee that the final product is free of contaminants, pathogens or harmful residues. Especially urban biowaste can typically harbour pathogens, heavy metals, and other pollutants (Ayilara et al., 2020). Developing techniques to effectively mitigate these concerns is a major technical challenge. On top of that, the quest for proper **quality** is implacable. By its very nature, biowaste has a variable composition that can lead to inconsistencies in the final product (Chojnacka et al., 2020). While mineral fertilizers provide a predictable nutrient profile, biowaste-based fertilizers are subject to variation due to the countless biochemical processes they undergo (UBA, 2018).

Establishing a foothold in the marketplace requires not only a quality product, but also effective communication and education. Raising awareness of the numerous benefits of soil improvers made from biowaste, finding the right communication channels, and ensuring that biobased products blend with traditional agricultural practices are all essential steps to gaining a **market traction**. The soil improver market is already crowded with established products, so competition is fierce. Biowaste-based products may also face resistance from industries that see them as a threat. It may be difficult to convince investors of the potential returns and to secure start-up capital, especially in a relatively new sector. An important aspect for gaining market traction, is overcoming the psychological barriers associated with biowaste products. In the digital age, where information (and misinformation) spreads rapidly, the reputation of biowaste-based soil improvers can easily be damaged. Addressing and allaying **consumer concerns** about the safety, efficacy and quality of these products is of paramount importance (Kurniawati et al., 2023). Deep-rooted beliefs, especially in traditional rural areas, can also limit the uptake of innovative soil management techniques.

Economic sustainability is the backbone of any venture. Especially in the early stages, production costs may be higher, making biowaste products less competitive. Investing in ongoing research and development not only supports product differentiation, but also helps to reduce costs in the long run. Beyond the financial aspects, the **logistics** of managing biowaste in practice pose a number of challenges. From efficient collection and sorting to processing and storage, each step presents its own difficulties. The inherent perishability of certain biowastes further complicates transport and storage logistics. In addition, **infrastructure** forms the basis for large-scale processing and distribution. In emerging markets in particular, there is an urgent need to invest in state-of-the-art processing facilities to support the developing biowaste industry. However, even with the right infrastructure and logistics in place, the **impact on the environment** cannot be ignored. It is essential to ensure that the entire lifecycle of the product, from processing to application, is environmentally sound. This includes preventing water pollution, and energy waste, and ensuring that the ecological balance is maintained (Bolan et al., 2023).

In conclusion, the integrated stakeholder engagement approach adopted by the project will aim to delve deeper into these challenges, providing a strategic framework to effectively address them.

2 Framework for stakeholder engagement in bioSOILUTIONS

As outlined in the introduction, soil degradation is a major challenge that must be addressed to avoid detrimental effects on the environment, human health and the economy. Soils have a central socio-economic and ecological role through their ability to provide food, regulate the water supply and conserve biodiversity. Due to this broad and critical spectrum of functions, multiple and diverse actors – all with different roles, perspectives, needs and challenges to the topic- are affected by and affect soils and their health. It is, therefore, clear that collaboration and communication between all relevant stakeholders is crucial to effectively address the challenge of soil degradation. bioSOILUTIONS will contribute to the improvement of EU soils by scaling up four valorisation routes for biowaste-based soil improvers by identifying and involving key stakeholders in the project’s activities.

BioSolutions applies the AA1000 Stakeholder Engagement Standard which is the pioneer international standard on stakeholder engagement. The standard defines stakeholder engagement as the process of involving individuals or groups who are affected by, or can influence the development and outcome of a project. (AccountAbility, 2015). Even though the standard focuses on the involvement of stakeholders in organizations, the process and its key principles (Figure 1) will be applied in an adapted form for the bioSOILUTIONS multi-stakeholder engagement approach.

The key principles frame the entire stakeholder engagement process starting with the involvement of relevant stakeholders in activities recognising the accountability of the project, in the case of bioSOILUTIONS, to the stakeholders. The definition of key for both stakeholders and the project is another central aspect and will be on-going throughout the project. Finally, in response to the feedback and input received from the stakeholders, the solutions developed in the project will be integrated into the development of the soil improvers.

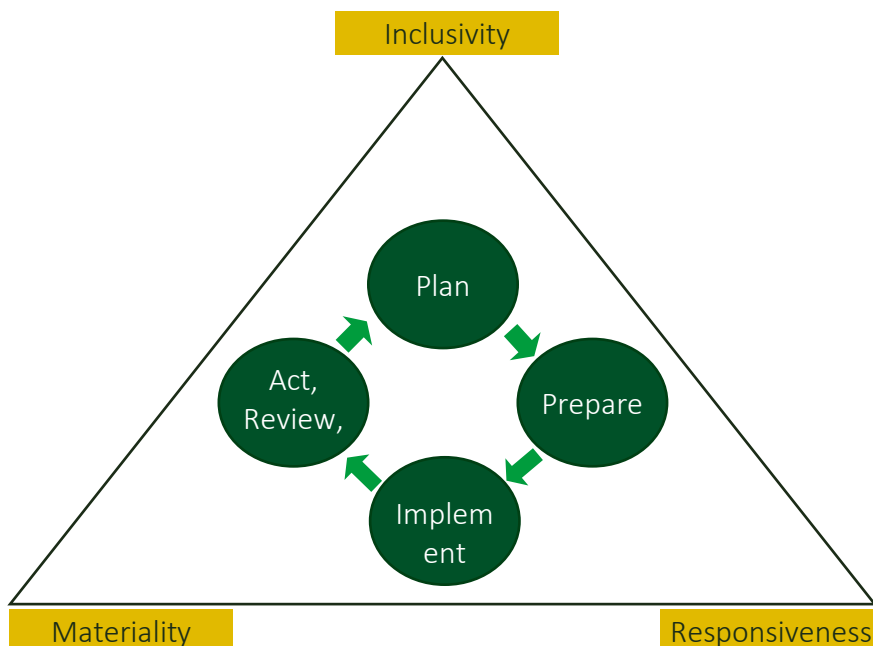


Figure 1 Stakeholder engagement process and key principles. (AccountAbility, 2015)

Following these three key principles, the first step consists of the “**plan**” phase which includes a stakeholder mapping and detailed characterization of specific engagement methods as well as the development of a preliminary engagement plan. During the “**prepare**” stage, a deeper understanding of the stakeholders to be engaged is developed and potential barriers to successful engagement are discussed and mitigated. In the third stage, “**implement**” the previously developed engagement plan is put into practice by inviting stakeholders to participate in the chosen engagement format, documenting the results of the engagement, clarifying specific action points based on the stakeholder input and communicating these to the participants. The final step “**Act, review, improve**” is to critically analyse and improve the engagement undertaken and to publicly report on the whole process and its outcomes. This process promotes dialogue and mutual trust and understanding between all stakeholders, maximizing the project’s chances of success.

In bioSOILUTIONS multi- stakeholder engagement will occur through the development and implementation of Living Labs which will be further outlined in the next section.

2.1 The bioSOILUTIONS Living Labs: a multi-stakeholder approach

Living Labs create a space for open innovation in real-world environments using iterative feedback processes throughout an innovation's lifecycle to create sustainable impact. They build on co-creation, rapid prototyping and testing, and the scaling-up of innovations and businesses, delivering (different types of) shared value to the stakeholders involved including citizens. In the bioSOILUTIONS context, Living Labs will act as intermediaries/orchestrators between farmers and farmers associations, research organisations, businesses, government agencies/levels and maybe in some cases citizens.

Living Labs can be set up in a number of different manners, depending on the intention of the organizers. Leminen & Nyström (2015) identified the following four different living lab approaches:

1. **Utilizer-driven-** companies driving the testing and validation of own products and services, creating value for the company implementing the living lab.
2. **Enabler-driven-** living labs implemented by public sector projects such as NGOs, towns, municipalities or development organizations with the goal of alleviating societal issues such as unemployment.
3. **Provider driven living labs-** such living labs target educational bodies, universities or consultancies with the larger purpose of producing new knowledge through research and the development of new theories targeting individual challenges.
4. **User-driven living labs-** these living labs are created by a group of product users with the focus on solving challenges they are facing while adhering to their values and needs.

Even though these four living labs differ in their approaches of tackling challenges faced in society, they all share specific characteristics that are outlined in Figure 2 (ENOLL, n.d.).

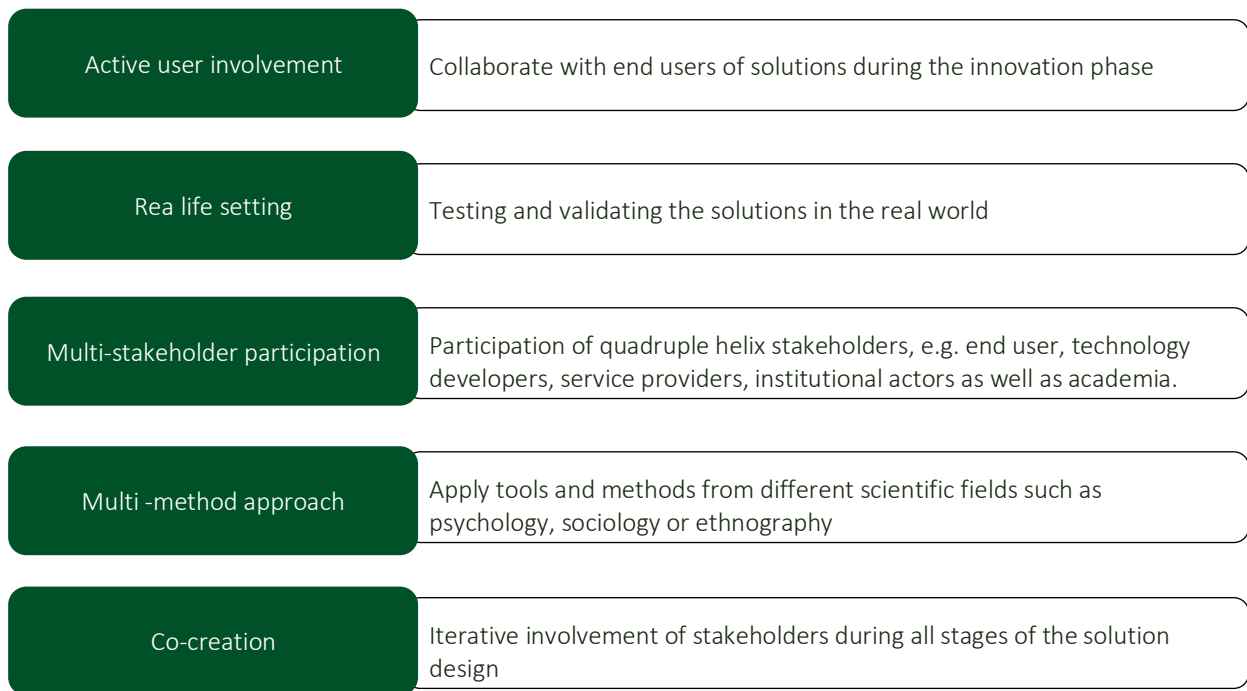


Figure 2 Five main characteristics of Living Labs (ENoLL, n.d.)

In bioSOILUTIONS user-driven Living Labs will be implemented. In total three Living Labs will be set up: in Valencia (East Spain), Murcia (South-East Spain) and Flanders (Belgium) with 2 meetings occurring per project year per living lab (6 per country/ year, 18 total during the project)

The bioSOILUTION Living Labs will serve four main purposes as shown in Figure 3. The main purpose of the living labs is to engage key stakeholders who will provide continuous feedback on the soil improvers and share their knowledge and expertise on market implementation challenges. Through the living labs the design of the four bio-waste based soil improvers will be tailored to the needs of end-users by gathering knowledge and feedback on their expectations and challenges. Validation of the soil improvers by the end-users themselves will enable the development of products that meet user and market demand. To create a broad market awareness key EU organization, soil companies, suppliers, end-users, policy makers and EU networks will be invited to participate in the Living Labs. However, the bioSOILUTIONS Living Labs will go beyond simply up-scaling bio-waste-based soil improvers and generating market awareness. Living Lab participants of the living labs will co-develop circular business models that will enable the application of more sustainable soil improver value chains and business strategies in the EU.

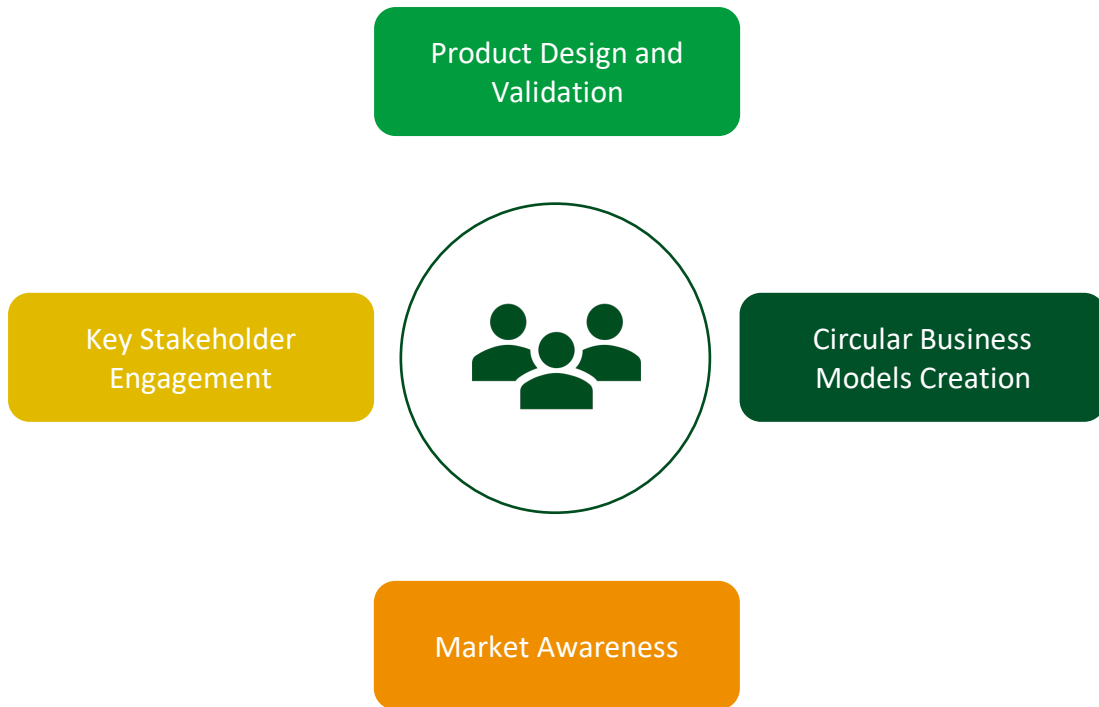


Figure 3 Purpose of the bioSOILUTION Living Labs

The following sub-section of this deliverable focuses on the first step of the stakeholder engagement process shown in Figure 1, namely the planning of the living labs in the three project locations.

2.2 The analytical tools for stakeholder engagement

2.2.1 Stakeholder mapping

In order to prepare the stakeholder engagement plans for each of the respective living labs, preparatory activities must be conducted. Each city completed a stakeholder mapping template providing general information on the stakeholders. Table 1 provides an overview of the inquired information.

Table 1 Stakeholder Mapping Questions

Category	Specific Questions
Name of the stakeholder	
Topic area/sector	What are the main areas of work?
Organisation	What types of stakeholders are members? What is the legal form? Who was the initiator? Other important remarks?

Interest to participate/likeliness to participate	How likely is their interest to participate on a scale of 1-10? How important are they for the success of the living lab on a scale of 1-10?
Important considerations	Challenges in engaging the stakeholder Opportunities & benefits they might see in bioSOILUTIONS Objections
Entry point	What is your history with the stakeholder? Do they need specific incentive to join the living lab? Will additional entry points be needed? Are you aware of specific challenges the stakeholder is facing?
Role in the Living Lab	How do you envision them in the Living Lab? Can this stakeholder be considered for the Impact Board?

Following the collection of information from Table 1 the identified stakeholders were mapped onto a matrix as shown in Figure 4. The matrix supports the prioritization of stakeholders to be engaged in the living labs, with those being placed in the top right corner having the highest priority. This exercise also indicates the appropriate level of engagement and communication required to successfully engage each stakeholder groups.

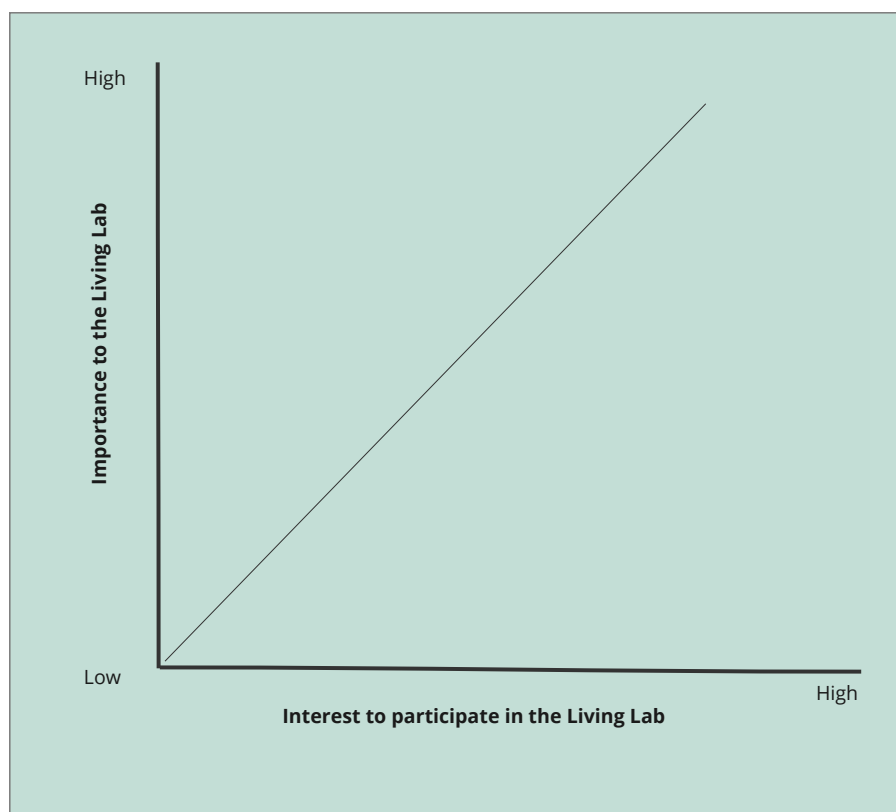


Figure 4 Stakeholder Matrix

In a final exercise, the living lab implementers were asked to reflect on any challenges they anticipate during stakeholder engagement. This will allow them to prepare in advance and tailor the engagement strategy around them, thus mitigating the challenges before they arise.

2.2.2 Validation

In addition to the stakeholder mapping, stakeholder group specific challenges were identified through desktop research (see section 1.2) and validated in a workshop with the living lab implementers and technical partners. Figure 5 provides an overview of the identified main stakeholder groups. It should be noted that these stakeholder groups are subject to change depending on the direction that each living lab takes and the technical developments during the course of the project.



Figure 5 Stakeholder groups

During the workshop the challenges identified in the desktop research were categorized according to whether the project partners considered them to be within or outside the scope of the bioSOILUTIONS project. The challenges identified as being within the scope of the project were then placed on the matrix, shown in Figure 6 according to how much effort would be required to address the challenge and how much impact it would have on the implementation and up-scaling of soil improvers in the market.

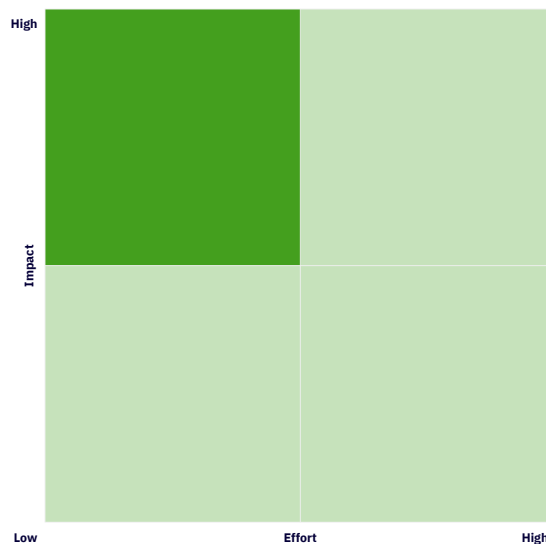


Figure 6 Challenges Matrix

The final part of the challenge identification process was to take a closer look at the challenges in the upper left quadrant, as these could be addressed primarily in the living labs. Workshop participants were asked to reflect on the following questions:

- *What might be the impact of such challenge in terms of Living Lab's objectives?*
- *Would be possible to address this challenge through the activities of the Living Labs in order to develop a common understanding and possible solutions?*

The information obtained from the stakeholder mapping and the challenge validation workshop will facilitate and guide the setting-up of the three living labs and the respective issues they will focus on i.e., an engagement plan. As Living Labs are an adaptive and flexible format, the focus and stakeholders involved can and will be adapted to the specific project needs that will evolve during the course of the project. The specifics of each Living Lab are detailed in Section 3.

3 Stakeholder engagement plans for the bioSOILUTIONS Living Labs

3.1 Valencia Living Lab

Background

The city of Valencia, which serves as the capital of the autonomous community of Comunidad Valenciana, is located on the east coast of Spain. Nestled on the Turia River, in the east of the Iberian Peninsula, Valencia is facing the Gulf of Valencia on the Mediterranean Sea. The third most populated city in Spain is situated in one of the warmest areas in Europe. Particularly notable for its climate are its hot summer months. On average, the rainfall there is 450 mm, although some places in the region have recorded up to 800 mm of rainfall. Due to these climatic conditions, the agriculture of Valencia is mainly composed of horticulture, citrus, and rice crops, which are intensively cultivated. High use of organic fertilizers, especially chicken manure, for horticulture is a key feature of agricultural practices in the region. However, these practices, together with the climatic conditions in the region, have led to a number of environmental issues. Valencia faces soil erosion, salinization, frequent forest fires and prolonged droughts. As a result, soil productivity and biodiversity deteriorate, which leads Valencia to face an increased risk of desertification. While Valencia's agricultural capabilities are undeniable, there is an urgent need to confront these environmental issues to ensure the sustainability of the land and its resources.

Las Naves, the centre of social and urban innovation of the city of Valencia, will be responsible for the implementation of the Living Lab in Valencia. As a public corporation under the Department of Innovation, Technology, Digital Agenda and Funding of the City of Valencia, Las Naves is continuously involved in the strengthening of the social and economic structures of the region, emphasizing a people-centred approach. In its position as implementer for the Valencia Living Lab, Las Naves can draw on a wide network of local stakeholders and collaborators with expertise in soil health and biowaste valorisation.

Stakeholder analysis

When conducting the stakeholder mapping exercise for the Living Lab in Valencia, the stakeholders described below emerged as key actors and the main audience for engagement.

The **Universitat Politècnica de València (UPV)** was identified as one of the key stakeholders for the bioSOILUTIONS Living Lab in the region. As a technical university, UPV offers a high level of academic expertise in the fields of agriculture, environmental sciences and engineering. Their technological and

scientific knowledge will be instrumental to the success of the project. In particular, the UPV can contribute to the process of developing innovative solutions. By providing expertise in agricultural engineering, environmental science and related fields to the Valencia Living Lab, UPV can actively facilitate the co-development of innovative soil management practices and technologies. In addition, it is also feasible to act as a demonstration site for the validation of the bioSOILUTIONS products. Different management practices and technologies could then be showcased so that stakeholders can observe and learn from practical implementation. In addition, the enhanced reputation and potential of the university's involvement opens up further funding and collaboration opportunities. However, in the context of EU-wide collaboration, data ownership issues may arise, which would need to be addressed through data sharing agreements and a robust data governance within the project. On top of that, large academic institutions like UPV typically have complex administrative processes and decision-making hierarchies, which can slow down project initiation and implementation.

Other important players in the research and development sector are the **Valencian Institute for Agricultural Research (IVIA)** and the **CIAGRO - Agrifood and Agri-environmental Research and Innovation Institute - Universidad Miguel Hernández**. These two public research institutions from Valencia focus their research around agriculture. In doing so, they frequently engage with stakeholders from the agricultural sector, aiming to increase productivity and sustainability for the benefit of farmers. Likewise, the institutes also interact with policymakers and companies for whose work IVIA's and CIAGRO's research is relevant to policies, processes and strategies. For the Living Lab in Valencia, they can be of particular relevance for soil testing and monitoring. On the one hand, IVIA can assess the effectiveness of different soil management techniques and preservation strategies. This could involve measuring soil health indicators, nutrient levels, and organic matter content. On the other hand, IVIA could support with the design, oversight and evaluation of field trials to test new agricultural products suggested by the project. Moreover, IVIA can provide input on how project findings align with existing agricultural policies and regulations in the Valencian Community, insights that will be particularly helpful for the regulatory roadmap, developed in WP4. This would ensure that the project's recommendations are aligned with regional policy objectives. On their side, CIAGRO has a large knowledge on soil health, developing important projects on management and composting of natural residues. They can have an advising role for the Spanish Living Labs, both the Valencia and the Murcia Living Lab, since they are located in Orihuela, geographically very near to Murcia, and are also close collaborators with CETENMA, coordinators of the Murcia Living Lab. They can be a connection bridge between both Living Lab.

The **Conselleria de Agricultura, Ganadería y Pesca (Agriculture, livestock, and fishery)** and the **Conselleria de Medio Ambiente, Agua, Infraestructuras y Territorio (Environment, Water, Infrastructures and Territory)** also play a crucial role for the bioSOILUTIONS Living Lab in Valencia. They are the regional government departments responsible for agriculture and rural development in Valencia, respectively. The departments working on agriculture and rural development will be of high importance for the Living Lab in Valencia. Collaboration with government departments requires a comprehensive understanding of their objectives, priorities, and decision-making processes to ensure a mutually beneficial partnership and collaboration during the project. In order to build trust, consistent and transparent communication is essential, informing the Conselleria about the milestones, hurdles and results of the project. While engaging with the Consellerias presents certain challenges, the benefits of Living Labs are manifold. By elevating public understanding of soil health, bioSOILUTIONS can amplify support for the Consellerias' conservation initiatives, bridging policy with public sentiment. The presence of government institutions like this brings valuable policy feedback that builds on the foundation of their experience in the local context. On top of that, the Consellerias can use its communication channels and influence to advocate for the importance of soil health, sustainable land management, and the benefits of the Living Lab's initiatives. This can increase public awareness and support for soil-related projects.

Furthermore, the regional farmers' cooperative **Federación de Cooperativas de Agroalimentarias de Valencia (Valencian Agrifood Cooperatives Federation)** as well as Farmers Unions "**La Unió de Llauradors i Ramaders**" and "**AVA-ASAJA**" should also be considered as a significant stakeholder group. These associations represent the interests of individual farmers in particular, but also of business people from the agricultural industry. While farmers initially struggle with the transition to new soil management practices, their participation in EU R+D+i projects (such as the [LIVESEEDING](#) project) can open the door to potential financial support and can alleviate the financial burden of adopting new methods. The involvement of local farmers in the living labs could raise awareness of soil health issues. In addition, participation in bioSOILUTIONS provides a platform for networking and collaboration with agricultural experts, fostering valuable partnerships and knowledge sharing. In particular, the use of certain soil management techniques can lead to a reduction in input costs, which can mean savings on fertilizers, pesticides and water for the members of the cooperatives or the Farmers' Unions. In addition, participation in the Living Lab can enhance the success of bioSOILUTIONS, as these organisations can provide invaluable insight by evaluating and providing feedback on the practicality and effectiveness of new agricultural technologies in real farming scenarios. In this way, they influence both policy development and technological progress. However, cooperative members and individual farmers may not be familiar with EU projects, so clear communication of the project's objectives and benefits is needed to gain their support. Coupled with this, some members may lack technical expertise in modern soil management practices, highlighting the importance of comprehensive training. Furthermore, an inherent resistance to change, especially among those who adhere to traditional methods, emphasizes the need to demonstrate the benefits and practicality of the proposed innovations.

Another group of stakeholders relevant to the bioSOILUTIONS Living Lab in Valencia are the private organic primary production companies as **Terra i Xufa and Sà i fresc**. They could add a more practical and business-oriented perspective to the LIVING LAB. However, their availability in participating may not be guaranteed due to the lack of time to participate in one more research, since they are already involved in many. Being part of the Living Lab would give them the opportunity to try out new products and to have access to high-quality inputs for their crops. At the same time, they would be at the forefront of research into innovative agriculture and thus close to sustainable solutions that can also shape regenerative agriculture. As organic primary producers they can provide valuable insights from organic farming that are useful for sustainable agriculture and soil-health. Both embody a comprehensive understanding of the agricultural landscape from different critical angles. **Terra i Xufa's** involvement is particularly significant because of its key stakeholder status, which stems from its deep integration into the Valencian local farming community. This is reflected in its presence on the Valencia agricultural council, its role in distribution, its ownership of several local stores and its participation in Mercavalencia, a major wholesale market in Valencia. In addition to that, Terra i Xufa already has a collaborative relationship with SAV, the project coordinator of bioSOILUTIONS. As a result, it can be assumed that there is a level of mutual trust, that allows for a smooth working process. **Sà i Fresc** stands out for its innovative approach. The company, which already collaborates with several universities and research institutes, is another important asset for the Living Lab.

As the stakeholder mapping exercise is an ongoing exercise, Las Naves and SAV have identified some additional stakeholders that may be of interest to the project, but it will be decided on an ad hoc basis whether to invite them to the Living Lab meetings.

Educational institutions and networks, exemplified by the **Municipal School Gardens Network**, bring an educational perspective to the Living Lab. With expertise in educational programs, this group ensures that the project integrates seamlessly with educational initiatives, fostering awareness of sustainability practices among students and the broader community, thus contributing to increasing soil literacy and awareness on the importance of soil health.

Other important stakeholders and stakeholder groups that will be important to the Valencian Living Lab are the **Parks and Garden’s autonomous body of the City Council** to explore the possibility to have some public gardens as bioSOILUTIONS test sites; the **Water Management Irrigation Communities** to bring in the perspectives of irrigators; consumers associations, and environmental associations focused on agriculture to contribute certification insights, consumer perspectives, and considerations for environmental impact; as well as fertilizer producers and commercialization companies, both small and large scale. Having these perspectives represented in the Valencian Living Lab can help with the work conducted in WP1, WP2 and WP4, bringing important contributions to the legal and environmental specifications of the bioSOILUTIONS products, as well as contributing to the development of sustainable business models.

Figure 7 shows the most important stakeholders to be engaged in the Living Lab in Valencia.

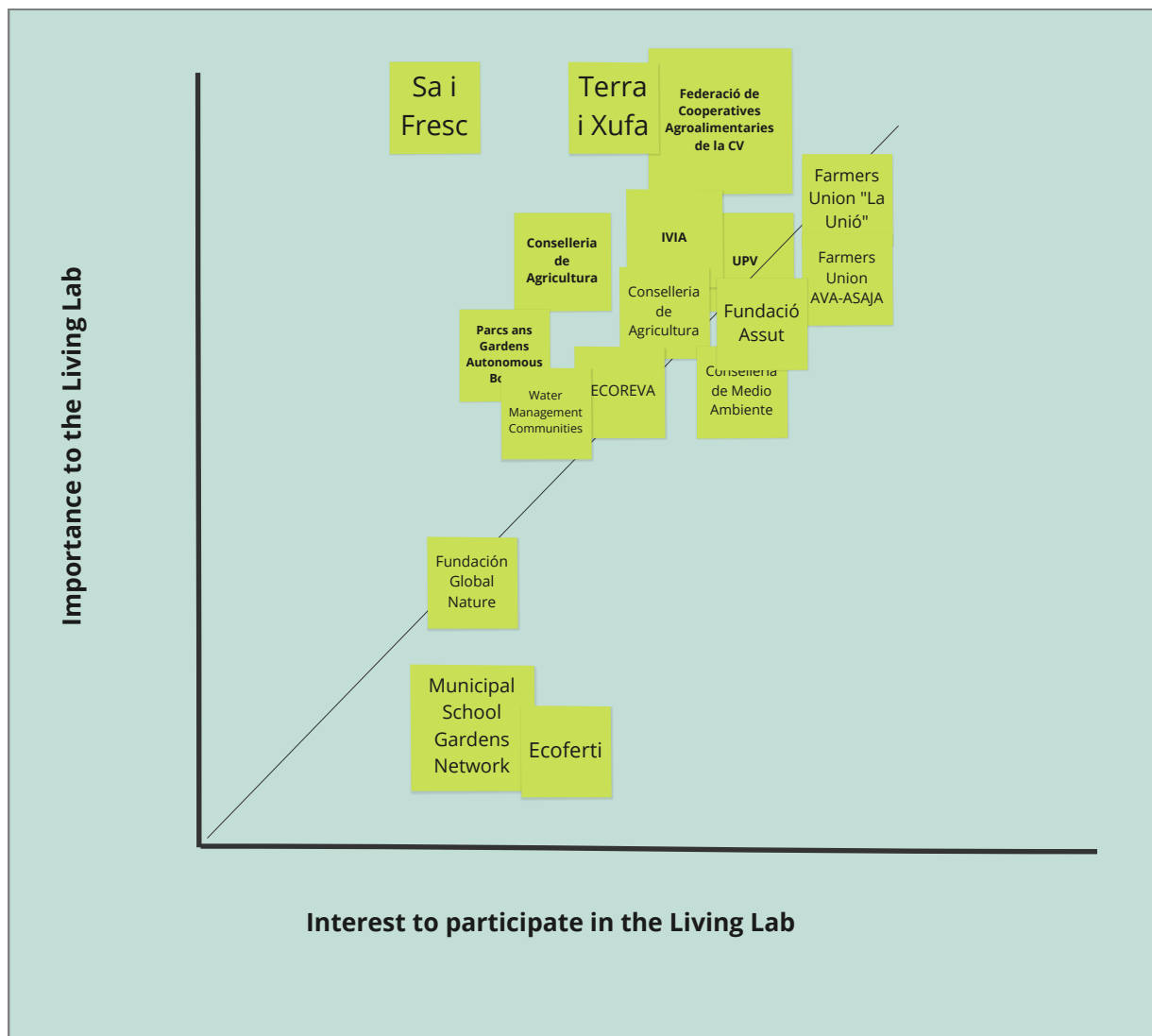


Figure 7 Valencia: Stakeholder matrix

Context-specific challenges & opportunity areas

Building on the identification of the key stakeholder groups critical to the success of the bioSOILUTIONS Living Lab in Valencia, the next phase focused on the specific challenges faced by these groups in the development and use of biowaste soil improvers. The results of the validation

workshop are summarised in Table 2. In bold are the challenges that were identified as the most pressing ones to be addressed in the Living Labs.

Table 2 Valencia: Challenges within bioSOILUTIONS scope

Stakeholders	Challenges
Business Owners	Access to start-up capital
	Determining the perceived value and pricing of biowaste products.
	Establishing long-term plans amidst changing regulations
	Changing regulations due to emerging research
	Developing a sustainable business model
	Anticipating economic fluctuations and their impact on demand
	Varying regulations across different regions
	Understanding competition
	Initial high production costs
Regulatory, compliance and quality control teams	Definitions of 'biowaste' or 'soil improvers' varying across regulations
	Ensuring consistent quality of biowaste soil improvers
	Variability in biowaste composition
	Nutrient content stability in biowaste products vs. mineral fertilizers
	Ensuring end products are free from contaminants, pathogens and pollutants
	Strict standards and guidelines in some countries
Marketing and Sales Teams	Identifying effective communication channels
	Educating consumers on product value and benefits
	The 'yuck' factor and taboos linked to certain biowaste products
	Aligning with traditional regional farming practices
	Gaining recognition against established competitors
	Countering misinformation spread online
	Overcoming resistance from consumers due to perceived risks
Farmers and consumers	Resistance to change and established practices
	Local beliefs and practices regarding soil management

	Concerns about safety, quality, and efficacy of biowaste-derived products
	Perceived belief that biowaste-derived products should be cheaper
Environmentalists	Determining the perceived value and pricing of biowaste products
	Anticipating economic fluctuations and their impact on demand
	Understanding competition with established soil improver products and potential resistance from threatened industries
Logistic planners	Navigating competition with other waste management strategies
	Efficient collection, sorting, and processing of raw materials
	Building adequate infrastructure for processing and distribution
	Building adequate infrastructure for processing and distribution
Technical research and development	Developing and scaling efficient biowaste transformation processes
	Handling region-specific technical issues
	Continuous research for product improvement and innovation
	Overcoming challenges with consistent end products due to varying biowaste composition

In the context of Valencia, the identified challenges are particularly prominent for various stakeholders, including business owners, regulatory, compliance, and quality control teams, as well as marketing and sales teams, farmers, and consumers. The prioritization of these challenges underscores the imperative to:

- **Increasing Awareness and Acceptance:** As people are often resistant to change, there is a pressing need to increase awareness about alternative of soil improvers in Valencia. Local communities, especially in rural areas, may have established beliefs and practices regarding soil management. Efforts to introduce a new concept should be directed towards enhancing acceptance among stakeholders while carefully aligning with existing farming practices as much as possible.
- **Address Production and Safety Concerns:** Due to the high variability in the composition of bio-waste and the risk of contamination, special attention must be paid to aspects related to the production of soil improvers to ensure their safety for use without compromising crops quality. This involves managing regulatory, compliance, and quality control considerations to build confidence among farmers and consumers.
- **Establish clear and transparent communication:** In the Living Lab in Valencia, it is essential to establish a communication environment that is both clear and transparent. This environment will facilitate the exchange of ideas and allows stakeholders to voice any concerns or questions they may have about the new processes and products. The emphasis on clear and transparent communication aims to encourage an open dialogue. Through transparent communication channels, the project team can effectively communicate the safety measures taken in the development and production of soil improvers. This includes information on testing procedures, quality control measures, and compliance with regulatory

Engagement plan

Given the challenges identified and their importance, the Living Lab in Valencia will centre its efforts around the topics illustrated in Figure 9.

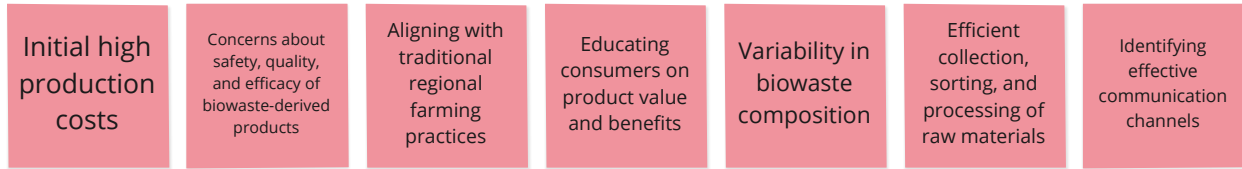


Figure 9 Valencia: Identified challenges

A key aspect of bioSOILUTIONS in Valencia is to identify and address the concerns of farmers and end-users about the use of biowaste-based soil improvers. Addressing concerns about the safety, quality and efficacy of these products is of paramount importance. The aim of bioSOILUTIONS is to produce non-toxic, high-quality products that are in line with traditional regional farming practices in Valencia. Ensuring transparent communication, rigorous testing and understanding the variability of biowaste composition are integral to achieving this.

Engagement and collaboration with stakeholders, including businesses, academia and consumers, is essential. By working together, we aim to raise consumer awareness of the value and benefits of biowaste-derived products and ensure that our quality assurance measures are both robust and reflect industry standards and scientific best practice. By addressing these challenges directly and involving end-users in a continuous feedback loop, we aim to build confidence in bioSOILUTIONS innovations and support their integration into the Valencian agricultural landscape.

In addition, the development of a market roadmap together with relevant stakeholders will help to establish a common understanding of how to successfully introduce products made from biowaste while meeting the needs of all parties. Recognizing the high initial production costs and finding effective communication channels is one of the key factors.

Table 3 presents an initial suggestion of potential topics to be addressed in the Living Lab meetings in Valencia.

Table 3 Valencia: Tentative overview of Living Lab meetings

Living Lab No.	Focus	Stakeholders to invite
1	Concerns about safety, quality, and efficacy of biowaste-derived products	Farmers' unions, associations and cooperatives, product developers, organic primary production companies, municipal bodies, water irrigation communities
2	Aligning with traditional regional farming practices	Farmers' unions, associations and cooperatives, product developers, municipal bodies, water irrigation communities
3	Public acceptance and education on biowaste derived products	Consumers associations, product developers, citizens, municipal bodies, public educational networks

4	Testing and validation of soil improvers. Iterative feedback process.	End-users, product developers, organic primary production companies, biowaste feedstock companies
5	Testing and validation of soil improvers. Iterative feedback process. Input for the co-development of the market roadmap.	End-users, product developers, organic primary production companies, biowaste feedstock companies
6	Final results and way forward	End users, municipal bodies

Las Naves and SAV are collaborating to connect with regional and local stakeholders, laying the groundwork for the upcoming bioSOILUTIONS Living Lab. The fact that Valencia is the European Green Capital in 2024 presents a valuable opportunity to highlight the significance of soil health and strategically position the Living Lab. We aim to align with other initiatives and projects during the European Green Capital events, fostering collaborations whenever possible. Additionally, active engagement of local stakeholders in EU projects like the [InBestSoil Project](#) enhances the bioSOILUTIONS Living Lab by leveraging insights and creating cross-project synergies.

3.2 Murcia Living Lab

Background

Murcia is located in south-eastern Spain and it is the capital of the vastly populated autonomous community of the Region of Murcia. It is on the Segura River, in the southeast of the Iberian Peninsula. Murcia is one of the warmest regions of Europe with a hot-semi-arid climate and a rain average of 300mm. The region has very intensive agriculture, and the main crops are fruits and vegetables. Due to the intensive agricultural practices, there is a very high usage of chemical fertilizers, resulting in several detrimental soil issues, such as salinization, low nutrient retention, high risk of desertification and eutrophication of waters. While there are several legislations in place to protect the soils and ecosystems and the awareness regarding the need for soil conservation is high for some stakeholder groups, there are difficulties to shift current agricultural practices to protect local soils, mainly due the farmers and agronomic consultancies' reluctance in assuming risks associated to new farming methods that could potentially drain the profit.

CETENMA, a Business Association dedicated to supporting research, development, and technological innovation in environment- and energy-related companies, including agricultural companies, is the Living Lab leader. Through their extensive stakeholder network, CETENMA is well-positioned to facilitate the success of the Living Lab in Murcia by leveraging their expertise and involvement in soil health and biowaste valorization projects, including but not limited to others [H2020 VALUEWASTE](#), [H2020 HOOP](#), [FER-PLAY](#).

Stakeholder analysis

Among almost 20 organisations mapped and assessed, about 10 stakeholders in and around Murcia Municipality were identified in this first stage of project development as key for bioSOILUTIONS and analysed in greater detail with regards to their main area of work, challenges, opportunities and potential relevance for the local bioSOILUTION Living Lab, based on the knowledge gathered by CETENMA. Thanks to CETENMA's action in agriculture-related projects, the list of Living Lab members is expected to double my M10 (Apr 24) and to further increase during the project lifespan, when more profiles will be included in alignment with tasks development, especially those in WP1, WP2

and WP4. Living Lab members will be recruited across the whole Region of Murcia, being the most relevant located beyond the Municipality's boundaries. This choice is also endorsed by the will to have onboard stakeholders that represent the variety of agricultural environment of the region.

The **Universidad Politécnica de Cartagena (UPCT)** was highlighted among the most important stakeholders in the region for the success of the bioSOILUTIONS Living Lab. UPCT is a technical university with agricultural and environmental departments. Its members primarily consist of students, professors, researchers, and faculty members engaged in academic pursuits related to agriculture, environmental sciences, and other technical disciplines. With technical departments in agriculture and environmental sciences, UPCT can contribute valuable academic expertise to the Living Lab. Their feedback will be key for the development of the bioSOILUTIONS products. While UPCT's focus might be more towards the research part, their contribution to the Living Lab can be developing decision support tools or models that help farmers and policymakers make informed choices related to soil management and preservation. Their participation in the Living Lab can also help them connect to other stakeholders, such as farmers, agronomers and practitioners, enabling knowledge exchange and the direct "translation" of research into on-the-ground activities. Additionally, the collaboration through the Living Lab can open new avenues for funding and resources for agricultural research.

Another important research institute for the Living Lab is the **Murcian Institute of Agricultural and Food Research and Development (IMIDA)**. IMIDA is a regional research institute focused on agriculture and food. IMIDA has extensive knowledge and experience in soil management and preservation. Similar to UPCT, IMIDA's contributions will be of paramount importance for the co-development of the bioSOILUTIONS soil improvers. As a public research institute, IMIDA might not have sufficient resources to focus on bioSOILUTIONS or they might need to prioritize other areas of work. Within the Living Lab, the engagement challenges will be leveraged by harnessing them for the advancement of research capabilities, capitalizing on networking opportunities provided by the Living Lab, fostering multi-stakeholder collaboration with experts, and utilizing Living Lab meetings and outcomes as avenues to influence and impact agricultural policies and practices.

Another important stakeholder identified is **BIOALAMO SL**, a regional SME focusing on organic agriculture and soil recovery. Their advocacy for sustainable agricultural practices positions them as valuable contributors to field validation, offering crucial insights and policy feedback that align with bioSOILUTIONS' objectives.

Interesting companies relevant to the Living Lab, are **Fyneco** and **Symborg**. Fyneco is an innovative technology-based company (EIBT) specialized in the formulation and packaging of fertilizers, nutrients, biofertilizers and phytofortifiers. Symborg is a big company (multinational) specialized in the production biostimulants, biofertilizers, biological pest control solutions. Having companies present in the Living Lab will bring an important perspective of providing market uptake and business feedback as well as contribute to feedback on current policies pertaining to the uptake of biowaste soil improvers. The presence of companies such as Fyneco and Symborg in the Living Lab is integral, offering a diverse and valuable perspective. Their participation will provide insights into market uptake, business feedback, and contribute to discussions on existing policies related to the adoption of biowaste soil improvers.

Other relevant stakeholders identified include urban kitchen gardens, such as **HuertoLabSE**, **Organic Kitchen Garden "El Verdecillo"**, farming companies as well as farmers' associations and local agricultural cooperatives representing farmers in the region, all contributing valuable perspectives to the success of the project.

Figure 10 shows which stakeholders are the most important and likely to join the Living Lab in Murcia.

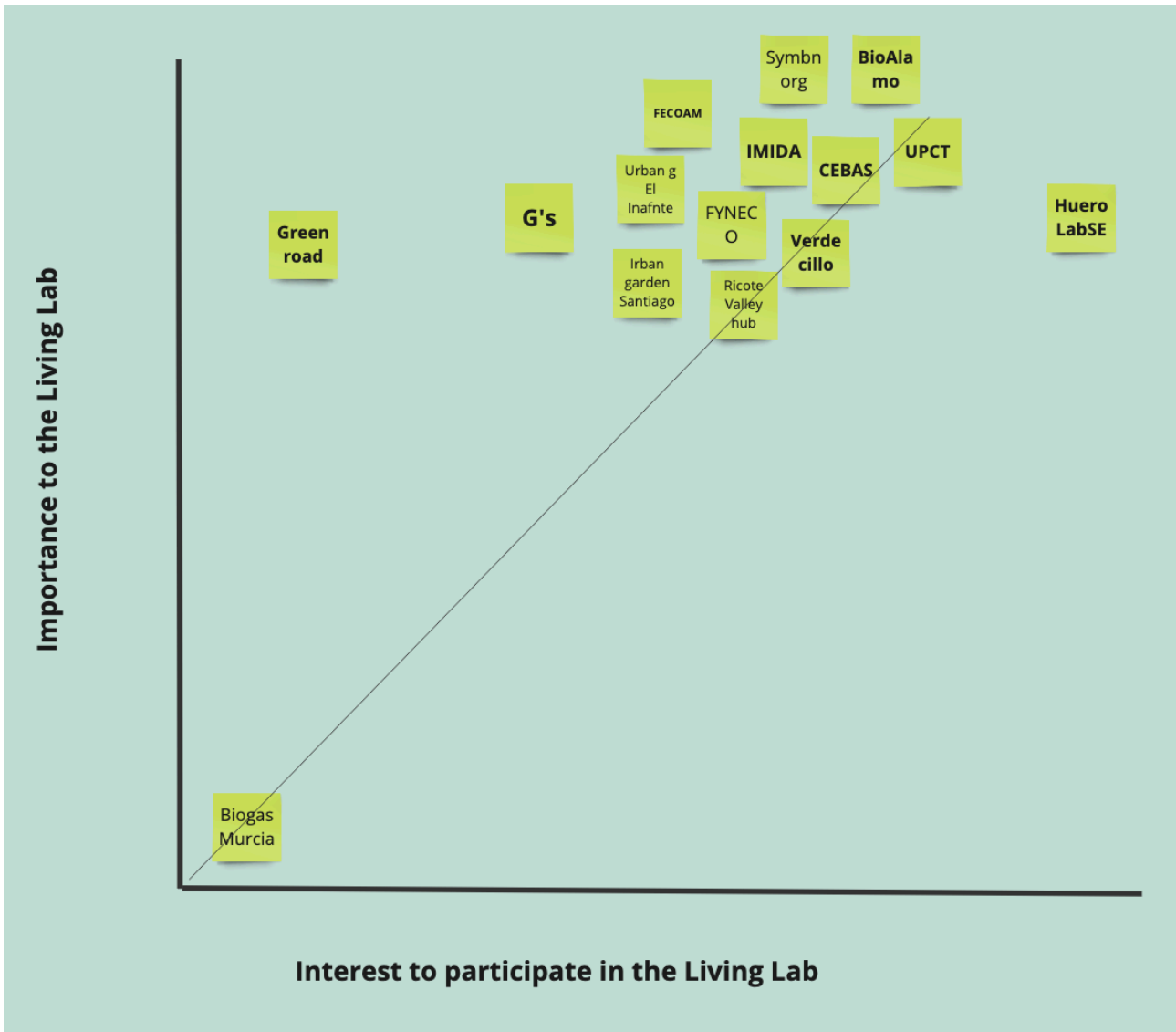


Figure 10 Murcia: Stakeholder matrix

Context-specific challenges & opportunity areas

Based on the stakeholder groups that were identified as the most important ones for the success of the bioSOILUTIONS Living Lab in Murcia, the next step was to go deeper into the specific challenges these groups face when it comes to the development and adoption of biowaste soil improvers. The results of the validation workshop are summarized Table 4.

Table 4 Murcia: Challenges within bioSOILUTIONS scope

Stakeholders	Challenges
Business Owners	Find buyers (B2B or B2C) to kick-off a pilot-scales production batches
	Determining the perceived value and pricing of biowaste products.
	Establishing long-term plans amidst changing regulations
	Changing regulations due to emerging research
	Developing a sustainable business model

	Anticipating economic fluctuations and their impact on demand
	Varying regulations across different regions
	Understanding competition
Regulatory, compliance and quality control teams	Cumbersome animal by-product regulation
	Strict standards and guidelines in some countries
	Variability in biowaste composition
	Aligning with traditional regional farming practices
	Ensuring end products are free from contaminants, pathogens and pollutants
	Reaching end-of-waste status for bioproducts (like fertilizers) coming from biowaste
Marketing and Sales Teams	Identifying effective communication channels
	Educating consumers on product value and benefits
	The 'yuck' factor and taboos linked to certain biowaste products
	Aligning with traditional regional farming practices
Farmers and consumers	Resistance to change and established practices
	Local beliefs and practices regarding soil management
	Concerns about safety, quality, and efficacy of biowaste-derived products
	Perceived belief that biowaste-derived products should be cheaper
	Reticence to try new products available on the market
	Reticence to apply experimental products (i.e. bioSOILUTIONS products)
	Understanding competition with established soil improver products and potential resistance from threatened industries
Logistic planners	Navigating competition with other waste management strategies
	Efficient collection, sorting, and processing of raw materials
	Building adequate infrastructure for processing and distribution
Technical research and development	Developing and scaling efficient biowaste transformation processes
Investors	Gather all process information to undergo a due diligence process

In Murcia the challenges landscape appears to be slightly different than the one in Valencia. While some challenges are common, such as for example the concerns about safety, quality and efficacy of

the biowaste-derived products, in the case of Murcia there seems to be a higher priority on addressing challenges within the stakeholder groups of business owners and farmers and consumers. More specifically, the current lack of sustainable business models for biowaste soil improvers that are economically viable, environmentally sustainable and resilient to market dynamics is a hindering factor to moving away from “traditional” mineral fertilizers as it does not provide any incentives to businesses. Similarly, most farmers, or end users in general, are not ready and/or willing to pay more for products deriving from biowaste, requiring very effective and targeted communication activities, showcasing the products’ value proposition and long-term soil benefits and their positive repercussion on productivity. Figure 11 maps the impact that addressing these challenges might have against the effort required to drive a positive change towards the adoption of biowaste derived products.

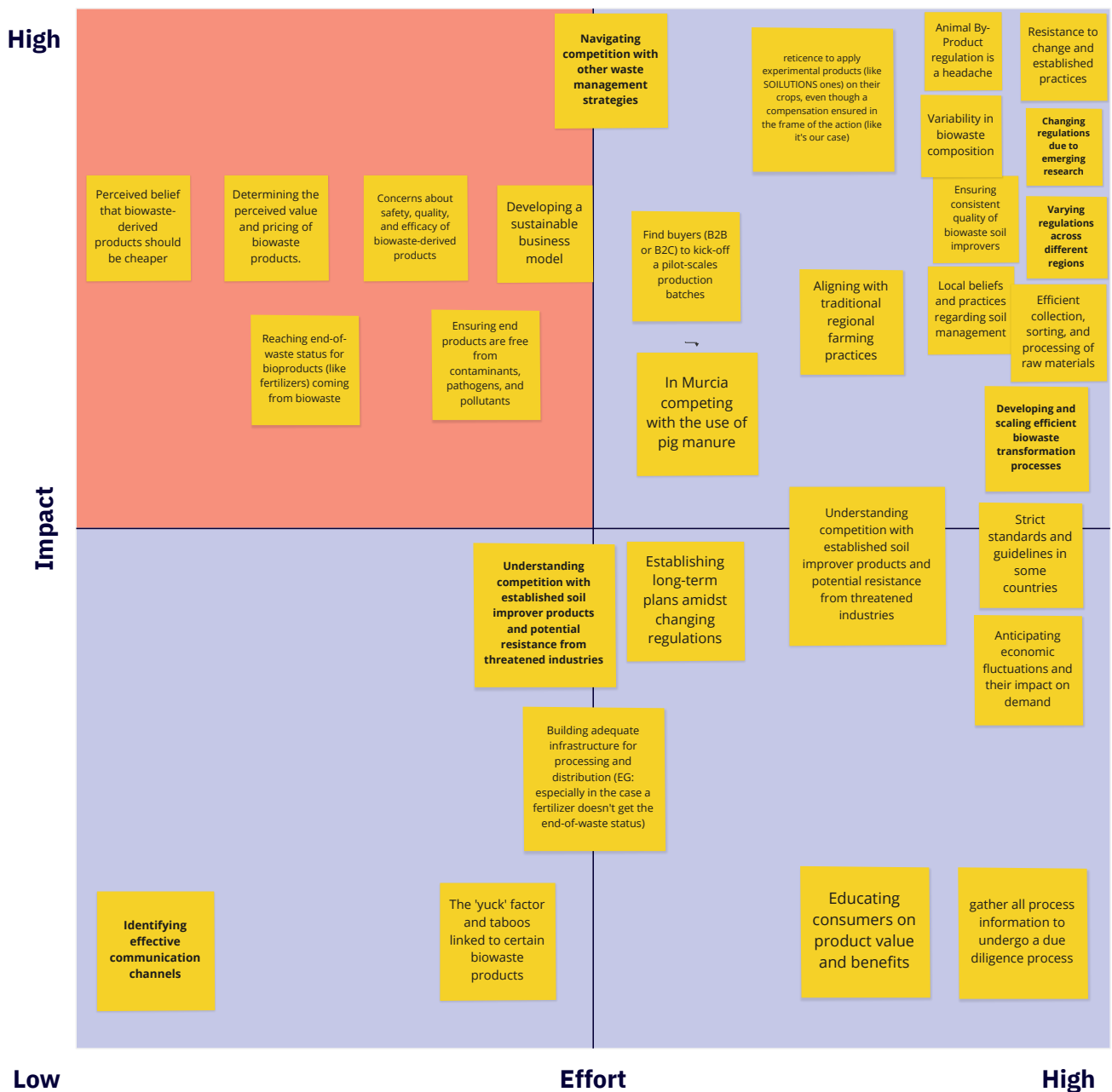


Figure 11 Murcia: Identification of main challenges

Engagement plan

Based on the identified challenges and their prioritization, the Living Lab in Murcia will focus on the following topics (Figure 12).



Figure 12 Murcia: Identified challenges

A critical step in bioSOILUTIONS is addressing farmers’/ end users’ existing scepticism and hesitancy to test and subsequently adopt biowaste-derived soil improvers. BioSOILUTIONS aims to develop safe, high quality products, that will be free from contaminants and pathogens. Thus, our approach will involve transparent communication and rigorous testing processes. Involving stakeholder groups such as businesses, academia, and end-users in a collaborative process that ensures that the quality assurance measures implemented in bioSOILUTIONS will be robust and also informed by a comprehensive understanding of industry standards and scientific best practices.

By addressing safety, quality, and efficacy concerns head-on, and engaging end users in an iterative feedback and validation process, we can ensure that their perspective is accounted for in the development of the soil improvers. This in turn will help foster a willingness to incorporate the bioSOILUTIONS innovations into their agricultural practices.

Additionally, involving stakeholders in the co-creation of a market roadmap and integrating their perspectives will help create a shared vision that ensures the successful integration of biowaste-derived products, taking into account the concerns and expectations of all involved stakeholders.

Understanding the perceived value of biowaste-derived soil improvers and determining appropriate pricing, will also be important focal points of the Living Lab in Murcia. Through the Living Lab interactions with the different stakeholders, it will be possible to understand, gauge and assess stakeholders’ willingness to pay for biowaste soil improvers. The feedback collected on the stakeholders’ expectations (through, for example, surveys, questionnaires and open dialogue) will be used to inform the work conducted in WP4 and the development of the circular business models. Living Labs will also be a crucial place to gather inputs to finetune design of bio-waste soil improvers (WP2).

Based on the current information, in Table 5 we propose a first overview of the Living Lab meetings in Murcia. This plan is subject to change to align with meeting outcomes and follow-ups, as well as project developments.

Table 5 Murcia: Tentative overview of Living Lab meetings

Living Lab No.	Focus	Stakeholders to invite
1	Concerns about safety, quality, and efficacy of biowaste-derived products	End users, agronomers, product developers, companies, municipalities
2	Determining the perceived value of biowaste products. Feedback on pricing of biowaste-derived products	End users, agronomers, product developers, companies
3	Co-development of sustainable business models and integration of stakeholders feedback	End users, agronomers, product developers, companies, biowaste feedstock companies
4	Testing and validation of soil improvers. Iterative feedback process.	End users, agronomers, product developers
5	Testing and validation of soil improvers. Iterative feedback process.	End users, agronomers, product developers
6	Final results and way forward	End users, agronomers, municipalities, biowaste feedstock companies

Reaching stakeholders for the Living Lab in Murcia will be a multifaceted effort leveraging various communication channels and the extensive network of the Living Lab implementer, CETENMA. Initial outreach will involve email communication providing a concise overview of the project, its goals, and the importance of stakeholder involvement. Follow-ups will be employed to establish personal connections, address queries and/or concerns, and emphasize the benefits of participation. CETENMA's existing network in the soil health and biowaste valorization domains will play a crucial role in disseminating information and inviting relevant stakeholders to join the initiative. Social media platforms, might also be utilized for broader dissemination and engagement.

3.3 Flanders Living Lab

Background

Flanders is a region in northern Belgium with a moderate climate and an average yearly rainfall of 800mm. The main crops cultivated in this region, under high chemical fertilizer usage, are cereals, potatoes and sugar beet. As a consequence of the chemical fertilizer employment, erosion, decreasing soil organic matter, compaction, saturation, nutrient losses and eutrophication of waters are pervasive in the region. There are specific policies in place targeting the issue of soil erosion, including financial incentives and certain requirements farmers and municipalities must uphold pertaining to soil control.

The University of Ghent (UGENT) will be responsible for setting up the Living Lab in Flanders. They have extensive knowledge on biowaste valorization and nutrient recovery from biowaste and have

been involved in numerous EU projects on the topic such as NOVAFERT, AGROCYCLE, BIOREFINE and NUTRICYCLE. In several of these, UGENT is the leading partner while in others it contributes to managerial functions such as taking on the leadership of a work package.

Stakeholder analysis

In Flanders the main stakeholders to be targeted are research institutes (including academia, and practice centers), farmers organizations, policy makers and companies looking at sustainable waste management. As user-centric living labs will be implemented in bioSOILUTIONS, the involvement of farmers, the end-users of the soil improvers, is central. In Flanders this will occur through the participation of **Boerenbond and ABS**, the two Flemish farmers' organization who have connections to individual farmers, agricultural cooperatives, agri-businesses, rural entrepreneurs, farm workers, landowners and agricultural industry suppliers. The association has, among others, detailed expertise in soil management and conservation, however their main value for the Flanders Living Lab lies in their ability to directly connect to the end-user. This connection will be used to showcase the benefits of the developed soil improvers and encourage their adoption by farmers and suppliers through workshops and trainings. On site testing of the soil improvers and collection of feedback could also be facilitated by Boerenbond and their extensive stakeholder network. As these two organizations are highly involved in advocating for farmers interests and participating in various agricultural activities, their availability to participate in the Flanders Living Lab will be limited from a time perspective. To ensure their participation nonetheless, additional efforts will be placed in organizing time efficient and productive Living Lab meetings while also highlighting the added value of being able to connect directly with stakeholders involved in the biowaste based soil improvers value chain.

VLACO, VCM and Biogas-E are non-profit-organisations (NPO) promoting sustainable waste management. Waste management companies, composting facilities, industry associations, government and public authorities are connected to these NPOs. In the Living Labs they will apply their knowledge on waste management processes as well as evaluate the feasibility of technologies and contribute knowledge on biowaste valorization. Because these NPOs are based in Belgium, they may be subject to unique legal regulations that limit their capacity to participate fully in cross-border projects. Also, they may already be participating in other projects or initiatives. Competing obligations may limit their capacity to engage in and contribute to your project fully. These NPOs have expertise in waste management and composting; however, their knowledge of broader soil management elements may be inadequate. Bridging the expertise gap may need further efforts which will be covered by the project partners and other invited stakeholders through collaborative knowledge exchanges prior to the respective Living Lab meeting or during the meeting itself.

INAGRO and the **Institute for Agricultural and Fisheries Research (ILVO)** are public research institutions funded by the Flemish Government specializing in agriculture, livestock and fisheries research. They have extensive networks of stakeholders, including farmers, policymakers and industry representatives whom they could activate for the living lab. Their contribution to the Flanders Living Lab is in the form of knowledge on sustainable agricultural practices and soil management techniques that promote soil health. Additionally, they have the ability to disseminate knowledge through workshops or publications while also sharing their own research findings with Living Lab participants. These research institutes are likely already active in a variety of research initiatives. Furthermore, certain communication and project documents may require translation between English and Dutch/Flemish.

The mentioned stakeholders were then placed on the matrix seen in Figure 13, already indicating which stakeholders will be more inclined to join the Living Lab in Flanders.

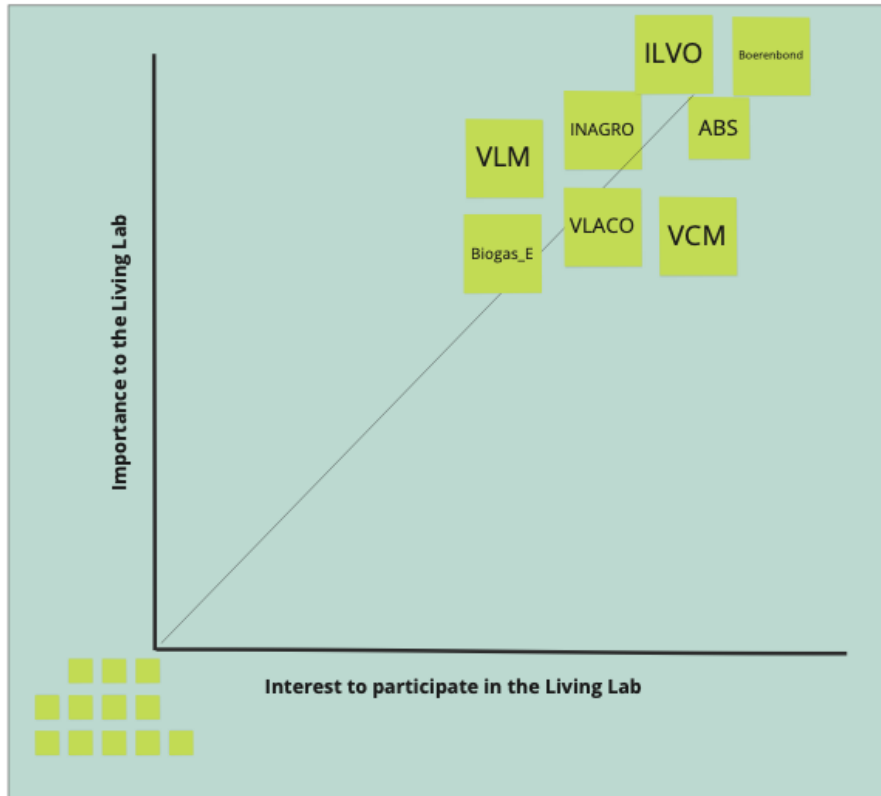


Figure 13 Flanders: Stakeholder matrix

Context-specific challenges & opportunity areas

Following the stakeholder mapping, the previously researched challenges were validated in a workshop and those identified which are within the bioSOILUTIONS scope, Table 6 provides an overview of the challenges.

Table 6 Flanders: Challenges within bioSOILUTION scope

Stakeholders	Challenges
Business Owners	Determining the perceived value and pricing of biowaste products
	Understanding competition with established soil improver products and potential resistance from threatened industries
	Varying regulations across different regions
	Changing regulations due to emerging research
	Developing a sustainable business model
	Anticipating economic fluctuations and their impact on demand
Regulatory, compliance and quality control teams	Variability in biowaste composition
	Definition of “biowaste” or “soil improvers” varying across regulations
	Ensuring consistent quality of biowaste soil improvers

	Ensuring end products are free from contaminants, pathogens and pollutants
	Nutrient content stability in biowaste products vs. mineral fertilizers
	Strict standards and guidelines in some countries
Marketing and sales teams	Overcoming resistance from consumers due to perceived risks
	The “yuck” factor and taboos linked to certain biowaste products
	Countering misinformation spread online
	Identifying effective communication channels
	Aligning with traditional regional farming practices
	Educating consumers on product value benefits
Farmers and consumers	Resistance to change and established practices
	Local beliefs and practices regarding soil management
	Concerns about safety, quality, and efficacy of biowaste-derived products
Environmentalists	Anticipating economic fluctuations and their impact on demand
	Determining the perceived value and pricing of biowaste products
	Understanding competition with established soil improver products and potential resistance from threatened industries
Logistic planners	Handling transport and storage needs
Technical research and development	Overcoming challenges with consistent end products due to varying biowaste composition
	Developing and scaling efficient biowaste transformation processes
	Continuous research for product improvement and innovation
	Handling region-specific technical issues

Using this pre-sorting, the challenges were placed on an impact-effort matrix (Figure 14) through which the engagement of the Flanders Living Lab will be derived below. Those challenges placed in the red quadrant are bold in the table and represent challenges which should be tackled in the Living Lab, resulting in a high impact but requiring low effort. Those challenges having a high impact but also requiring a high effort should not be disregarded during the living labs but rather kept in mind throughout the project to identify, if possible, opportunities to address them.

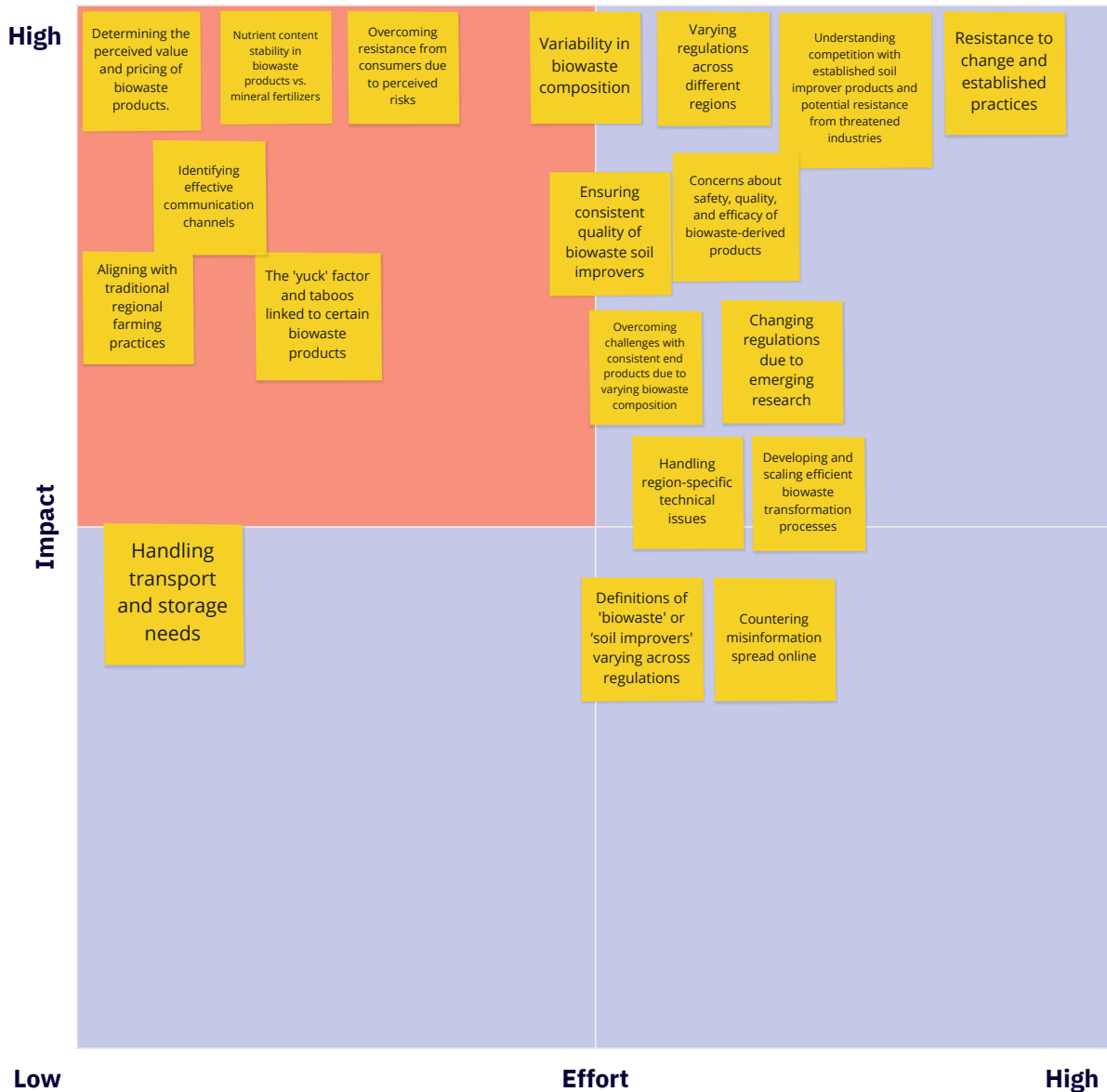


Figure 14 Flanders: Identification of main challenges

The five main challenges situated in the top left corner of the red quadrant will guide the engagement of stakeholders in the living labs. They are related to different stakeholder groups mainly covering consumers, farmers, marketing and sales, regulatory, compliance and control teams as well as business owners. The Living Lab in Flanders will provide the platform for all these stakeholders to exchange with the project partners and soil improver developers on the identified challenges.

In bioSOILUTIONS the economic aspects linked to biowaste products, such as the perceived value of biowaste and biowaste products, are analysed in work package 1. As Flanders has identified this as a key challenge, the living lab is the ideal setting to further explore this with stakeholders such as the soil-improver developers (project internal), biowaste providers and product users (project external) to gain insights as to what influences their value perception of biowaste products. Initiating such a discussion in the living labs will enable the soil improver developers to adequately prepare their business strategies for up-scaling their productions, which is in line with WP 4 activities on creating a roadmap for upscaling the bioSOILUTIONS soil improvers. When discussing this challenge in the Living Lab the inputs of the NPOs VLACO, VCM and Biogas-E will provide insights to the biowaste provider perspective as well as to biowaste valorization.

The stability of the nutrient content in the biowaste products compared to the conventional mineral fertilizers has also been highlighted as a potential challenge in scaling up the biowaste-based soil improvers. SOLUTIONS recognizes that this is a key challenge and aims to address this through a detailed characterization of the biowaste feedstocks in WP 1 and real-life testing and validation of the soil improvers in WP 2 by the University of Gent and SAV. Through the Flanders Living Lab farmers, who are the target end-users, will be involved in the testing and validation of the developed soil improvers in a user-centric co-creation approach, to gather requirements and feedback. Involving not only potential users but also consumers of food products produced with the biowaste based soil improvers in the Flanders Living Lab will also help de-stigmatize the usage of biowaste for making products that are used in the food value chain. The involvement of the research institutes INAGRO and ILVO is paramount in tackling this challenge as they will be able to provide scientific expertise and insights.

Ensuring that the biowaste based soil improvers align with existing practices is fundamental for the successful market uptake of the innovative bioSOILUTIONS products. End users must be willing and open to change their prevailing habits regarding the type of fertilizers they use. Involvement of end users in the living lab and thus in the product design cycle, will ensuring minimal necessary adaptation of existing fertilizing procedures in co-creation processes. For this challenge the involvement of Boerenbond and ABS will be crucial to receive direct feedback of farmers.

The last challenge located in the red quadrant is identifying effective communication channels for the bioSOILUTIONS soil improvers and is also a central activity of work package 6. The Living Lab will be used to gather feedback from diverse engaged stakeholders such as farmers (associations), biowaste providers, gardening companies or municipalities regarding their perspectives on how to best and most effectively disseminate information on the bioSOILUTIONS soil improvers. For dissemination activities the existing network of the University of Ghent, NUTRICYCLE VLAANDEREN, will be valuable and is further outlined in the next sub-section.

Engagement plan

Based on these five challenges a tentative engagement plan can be developed for the 6 Living Lab meetings in Flanders and is outlined in Table 7.

Table 7 Flanders: Tentative overview of Living Lab meetings

Living No.	Lab	Focus	Stakeholders to invite
1		Understanding end-users existing practices with mineral fertilizer utilization and existing approaches they are implementing	End users (farmers, land managers, gardening companies)
2		Perceived value of biowaste based products	Biowaste feedstock companies, end-users, business selling soil improvers
3		Nutrient content of biowaste based soil improvers	End users, Research institutes
4		Testing and validation of soil improvers. Iterative feedback process.	End users, Research institutes

5	Testing and validation of soil improvers. Iterative feedback process.	End users
6	Final results and way forward	End users, municipalities, policymakers

The existence of strong collaborations will be leveraged to engage stakeholders that have already shown interest in the topic, ensuring their willingness to exchange and participate in the Living Labs. The stakeholders to be involved in the Living Lab will mainly be engaged through the existing network of the University of Ghent covering the topics of biowaste valorization which includes researchers, companies and civil society. Among other routes this will mainly occur through the nutrient platform NUTRICYCLE VLAANDEREN which is under the operational management of Ghent University and financially supported by the Flemish Government. Its aim is to support and connect all existing Flemish initiatives regarding nutrient recycling, including facilitative information flow and collaboration between projects. This network wants dynamic interaction between the fine target group through working groups (agriculture, business, knowledge centres, civil society organisations, and Government). Identifying the proper and most effective communication channels will be systematically addressed throughout the Living Lab meetings, ensuring a nuanced and adaptive approach by evaluating existing stakeholder channels.

4 Outlook and next steps

As we navigate the complexities of transforming the soil improver scene through biowaste-derived products within the bioSOILUTIONS project, the road ahead is both challenging and promising. The challenges identified in this report highlight the intricacies of stakeholder engagement and the multifaceted nature of adopting innovative solutions. However, these challenges are not obstacles, but opportunities for innovation, collaboration, and positive change.

The Living Lab Approach as a catalyst: The establishment of Living Labs in Murcia, Valencia, and Ghent represents an important phase in the bioSOILUTIONS project. These Living Labs serve several roles. On the one hand, they will serve as dynamic spaces for experimentation, learning, and co-creation. On the other hand, they will act as “information points” for end-users. Through direct interaction with other stakeholders, but also with the product developers, end-users will be able to address any concerns, questions and hesitations they might have about biowaste-derived soil improvers. The engagement plans developed for each Living Lab will be instrumental in addressing region-specific challenges fostering stakeholder collaboration, and validating the effectiveness of biowaste soil improvers in real-world scenarios.

Fostering Stakeholder Collaboration: going forward, a key focus will be on fostering stakeholder collaboration. Lessons learned from the stakeholder analysis will guide tailored engagement plans to ensure that the specific needs and challenges of each stakeholder group are addressed. Continuous dialogue, feedback mechanisms and loops, and adaptive strategies will be essential to maintain a robust and inclusive engagement process within the bioSOILUTIONS Living Labs.

Linking Challenges to Solutions: The challenges identified in this report will not only guide stakeholder engagement, but will also inform the development of the biowaste soil improvers. Regulatory, technical, and market challenges will be addressed through a combination of innovative product co-development, and collaborative problem-solving. While our primary focus will be on addressing the most pressing challenges as elaborated in section 3, it is important to note that the challenges mentioned in the report also the ones not explicitly prioritized will be on our radar. We

will aim to explore opportunities of combined activities towards effective action. The Living Labs will be key platforms for testing, validating and refining solutions in real-world settings.

Incorporating Lessons from Living Labs: Regular assessments and evaluations of the Living Labs' progress will provide valuable insights. To this end, an Impact Board, composed of selected members of the consortium and key stakeholders of each Living Lab, will be established to monitor the impacts of the implementation processes and share insights and lessons learned. Lessons learned will be incorporated into an adaptive management approach, allowing for continuous improvement and optimization of engagement strategies. The iterative nature of the Living Labs ensures that feedback loops remain open, fostering an environment of continuous learning.

Dissemination and Scaling: The knowledge generated from the Living Labs will be disseminated widely to reach diverse audiences, including policymakers, researchers, businesses, and the public, linking to the work conducted in WP6. Insights gained will contribute to the broader discourse on improving soil health and shifting towards more sustainable agricultural practices. Strategies for scaling successful approaches beyond the project duration will also be explored, linking to the exploitation workshops planned in WP6 aiming to create a lasting impact on the soil improver industry.

In conclusion, the journey ahead is dynamic, and the success of bioSOILUTIONS lies in our collective ability to adapt, collaborate, and innovate. The Living Labs will be the testing grounds for our ideas, and the challenges outlined in this report will serve as signposts for our efforts. As we embark on this transformative journey, the bioSOILUTIONS team is committed to meeting challenges head-on, seizing opportunities, and contributing to a sustainable and resilient agricultural future.

Looking ahead, bioSOILUTIONS partners will begin meeting with key stakeholders to strategically align their activities. In spring 2024, the first group of committed stakeholders will meet in the first of 6 planned Living Lab workshops in each location. These workshops will be instrumental in translating collaborative efforts into tangible outcomes, marking a significant step towards the project's overarching goal.

5 References

- AccountAbility (2015). AA1000 Stakeholder Engagement Standard. URL: <http://www.mas-business.com/docs/AA1000SES%202015.pdf>
- Ayilara, M. S., Olanrewaju, O. S., Babalola, O. O., & Odeyemi, O. (2020). Waste management through composting: Challenges and potentials. *Sustainability*, 12(11), 4456.
- Bolan, N., Sarkar, B., Vithanage, M., Singh, G., Tsang, D. C., Mukhopadhyay, R., ... & Kirkham, M. B. (2021). Distribution, behaviour, bioavailability and remediation of poly-and per-fluoroalkyl substances (PFAS) in solid biowastes and biowaste-treated soil. *Environment international*, 155, 106600.
- Chojnacka, K., Moustakas, K., & Witek-Krowiak (2020) Bio-based fertilizers: A practical approach towards circular economy. *Bioresource Technology*, 295, 122223.
- ENoLL (n.d.). What is the European Network of Living Labs?. Date Accessed: 08.11.2023. URL: <https://enoll.org/about-us/>
- European Environment Agency (2020). Bio-waste in Europe — turning challenges into opportunities. No 04/2020. Retrieved from. <https://www.eea.europa.eu/publications/bio-waste-in-europe>
- Kacprzak, M., Kupich, I., Jasinska, A., & Fijalkowski, K. (2022). Bio-based waste substrates for degraded soil improvement—Advantages and challenges in European context. *Energies*, 15(1), 385.
- Kurniawati, A., Toth, G., Ylivainio, K., & Toth, Z. (2023). Opportunities and challenges of bio-based fertilizers utilization for improving soil health. *Organic Agriculture*, 1-16.
- Leminen, Seppo; Nyström, Anna-Greta (2012). Living Labs as Open-Innovation Networks. *Technology Innovation Management Review*. 2012:6-11.
- Savci, S. (2012). Investigation of effect of chemical fertilizers on environment. *Apcbee Procedia*, 1, 287-292.
- Umweltbundesamt | Für Mensch und Umwelt. (n.d.). https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2018-05-30_texte_40-2018-municipal-waste-management_en.pdf