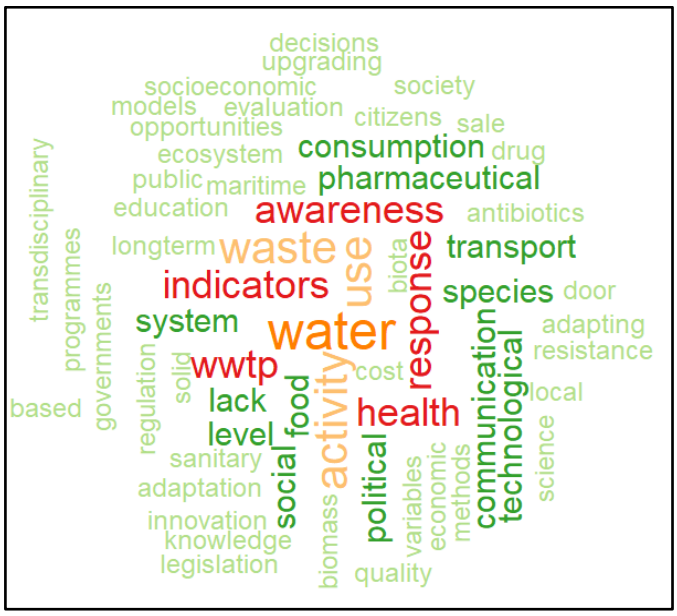
Workshop

Co-design of our One Health Living Lab

Date: 7th November 2024
Place: Plentzia, PiE-UPV/EHU



One Health Observatory Lighthouse Project
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Date: 7th November 2024
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Welcome to the first 'Co-designing our One Health Living Lab' workshop, a collaborative initiative supported by the BlueAdapt and HOBE projects involving researchers from PiE, JRL-EAR and BC3. This workshop brings together researchers from these centres to explore how to address health-related challenges collectively from a broad and interdisciplinary perspective. We aim to co-create a Living Lab (from now on LL) based on the needs and opinions of the participants, laying the foundations for continuing and strengthening multi-, inter- and transdisciplinary work.

Workshop objectives:

This workshop aims to start co-creating a One Health Living Lab (from now on OHLL) as a dynamic platform to foster and explore inter- and transdisciplinary collaboration focused on the health of the socio-ecological system of Plentzia Bay.

Specifically, our objectives are to:

- Understand how researchers' work aligns with and contributes to this interdisciplinary perspective.
- Promote collaborative efforts across disciplines using the LL as a unifying space.
- Design and define innovative, collaborative activities that drive engagement and experimentation within the LL.

Agenda

TIME	ACTIVITY
12:00 – 12:15	Welcome and introduction
12:15 – 13:00	**Talks**
12:15 - 12:25	The history of the One Health approach
12:25 - 12:50	What is a Living Lab? Learnings and experiences
12:50 - 13:00	Next steps: One Health Living Lab
13:00 - 14:00	**LUNCH at PiE-UPV/EHU**
14:00 – 15:00	**2nd World Coffee**
	Presentation of the results of the First World Coffee
	Group preparation and three rounds of questions
15:00-16:00	**One Health Living Lab Co-design**
	Activity explanation and preparation
	Group reflection time
	Co-creation activity
16:00 – 16: 30	**Presentations of co-creation activity** (5' each group)
16:30 - 17:00	**Closure:** Conclusions and next steps

PARTICIPANTS

Organisation	Number of participants
BC3	5
PiE-UPV/EHU, JRL-EAR	3
BC3, JRL-EAR	2
PiE-UPV/EHU	16
Biobizkaia	1
JRL-EAR, Neiker	2
JRL-EAR, UPV/EHU	4
UPV/EHU	4
GAIA	1

WELCOMING

Welcome to the design of the Plentzia OHLL!

The idea of the LL has been initiated through the projects HOBE (led by PiE) and BlueAdapt (led by BC3). HOBE is a joint PiE-BC3 project analysing the Bay of Plentzia from a One Health (from now on OH) perspective attempting to integrate human health, animal health and ecosystem health. It does this from a widest possible approach integrating data on chemistry, microbiology, toxicology, environmental physics, social sciences and economics. BlueAdapt, a Horizon Europe RIA project consisting of 11 partners, analyses the impact of climate change on coastal pathogens in interaction with other drivers such as pollution and antimicrobial resistance. Plentzia Bay is one of the 8 case studies of the project.

The aim of the OHLL is to create an agent network consisting both of scientists and practitioners in view of shared learning, exchange of knowledge and knowledge integration. Aims of the LL include among others: i) demonstrate the value of a OH approach in a local setting, ii) collaboration and co-production across disciplines, iii) promotion of the concept of OH, vi) co-design of adaptation interventions, v) education on OH with a life long learning approach.

The objective of today's workshop is to start co-designing the OHLL together. The initial set of agents includes PiE, BC3 and members of the Joint Research Lab on Environmental Antibiotic Resistance (JRL-EAR). The morning session will start with a talk by BC3 illustrating the historical origins and evolution of the OH approach and its multiple interpretations we find today. Our invite speaker from Gaia will share his best practice experiences regarding what makes a successful LL. BC3 will detail where we currently stand concerning the delivery of the LL related activities and what we foresee to do in the remainder of the projects, and how the LL has a projection well beyond the project horizons. The afternoon, facilitated by PiE- and BC3, will consist of hands-on, collaborative sessions to initiate the design of the LL.

CONCEPTUAL TALKS

Historical perspective of the One Health approach

The OH framework has gained considerable attention recently, evolving from focusing predominantly on the biomedical domain to an increasingly interdisciplinary approach (figure 1). While initially centred on scientific and medical communities, OH is now integrated by social sciences and arts, highlighting its broad applicability and relevance across diverse fields. This expansion is reflected in its frequent appearance in the language of international agencies, research funding programs, and scientific literature, where it has become a common term representing the interconnectedness of human, animal, and environmental health.

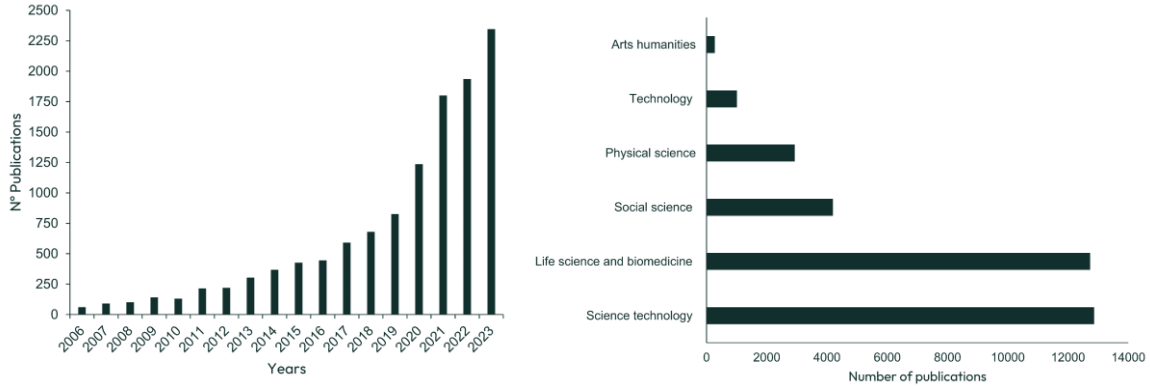


Figure 1. Search results for the entry TS= ("One Health") of publications between 2006-2023 in the Web of Science.

The following questions guide this historical perspective: What does OH mean? Why did it emerge? How has the human-animal-environment relationship evolved?

To understand the current meaning of OH, it is crucial to understand the scientific, political, and health ideas from various historical contexts, from which some of the concepts that shape today's approach have originated (figure 2).

Foundations of Comparative and Veterinary Medicine

- **Zhou Dynasty (approx. 1046–256 BCE):** The earliest foundations of public health were laid with systems that included medical doctors and veterinarians, establishing a precursor to integrated health concepts.
- **Hippocrates (c. 460–370 BCE):** Stressed the importance of considering all aspects of a patient's life, including environmental factors, marking an early appreciation of the environment's influence on health.
- **1761, Claude Bourgelat:** Established the basis of comparative medicine, emphasising cross-species medical insights. A year later, he founded the Veterinary School of Lyon, advancing veterinary science as a discipline.

Emergence of the "One Medicine" Concept

- **1855, Rudolf Virchow:** Coined "zoonosis," emphasising the link between human and veterinary medicine, an early recognition of interspecies health dynamics.
- **1870s, William Osler:** Promoted comparative pathology, often regarded as a forerunner of "One Medicine" by focusing on cross-species disease understanding.
- **1984, Calvin Schwabe:** Formally introduced the term "One Medicine," advocating for an integrated approach to human and veterinary medicine.

Progression Toward the OH Framework

- **1987 Brundtland Report:** Highlighted the importance of sustainable development, which early influenced OH's environmental dimension**.**
- **1995, Conservation Medicine:** An interdisciplinary field emerged, focusing on the health linkages between conservation and medical sciences.
- **2004, Manhattan Principles:** The Wildlife Conservation Society established twelve principles under "One World, OH," aiming to unite human, animal, and ecological health as a single agenda.

Institutionalisation of OH

- **2005, Millennium Ecosystem Assessment:** This publication underscored the link between ecosystem health and human well-being, prompting further integration of environmental science within OH.
- **2006, Establishment of the "OH" Framework:** The modern OH framework was formally articulated, setting the stage for widespread adoption.
- **2007, Pandemic Preparedness:** The OH approach gained attention as a strategy for preparing for pandemics, and the One Health Initiative Task Force (OHITF) was formed to promote its application.

Recent Developments and Global Endorsements

- **2010, United Nations and World Bank Recommendations:** These global entities recommended that OH address complex health issues, solidifying its importance in international policy.
- **2020, COVID-19 Pandemic Declaration:** The WHO's pandemic declaration underscored the need for OH, especially in zoonotic disease control.
- **2022, One Health High-Level Expert Panel (OHHLEP)** gives a new definition of OH.

Human-Animal-Environment Approaches in OH: The OH framework prioritises a holistic approach to health, with integrated attention to human, animal, and environmental aspects. This synergy is essential in addressing climate change, zoonotic diseases, and environmental toxicity. In recent years, the OH framework has been employed in various disciplines, including climate change science, toxicology, anthropology, and veterinary science, indicating its expansive reach.

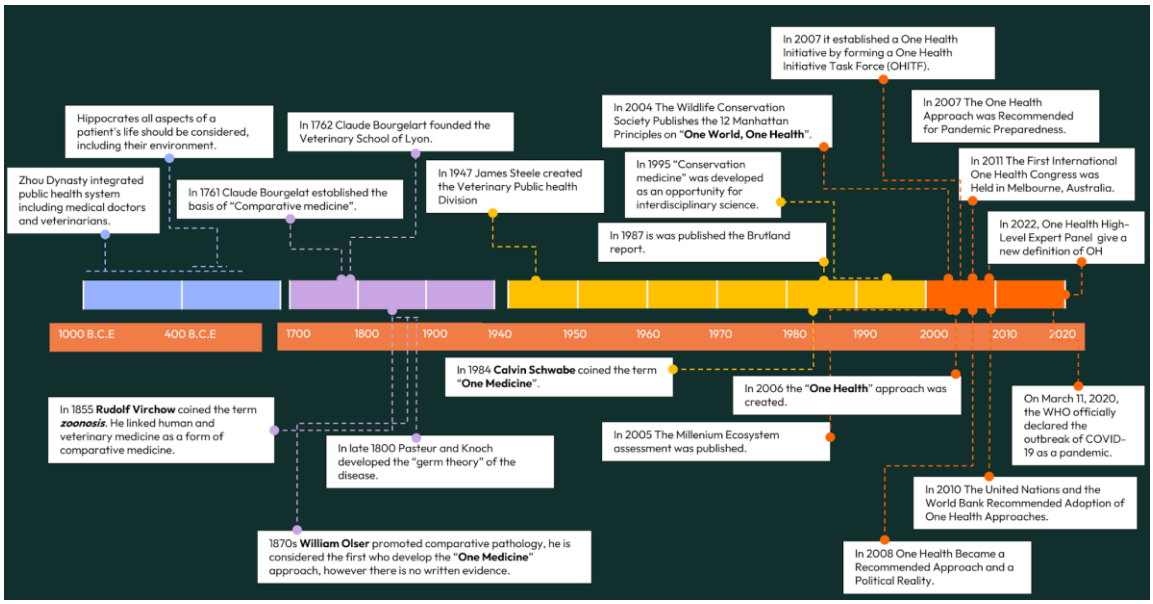


Figure 2. Historical narrative of OH

In alignment with the OH framework, alternative frameworks emerging from diverse disciplines recognise the interconnections between humans, animals, and the environment (e.g. planetary health, EcoHealth, and Ecological Public Health). While these approaches share similar values and principles, they exhibit nuanced differences in their strategies for addressing this interconnectedness (Table 1). Rather than being viewed separately, these approaches are complementary and continue to evolve, enriching our understanding of the complex relationships at play. This is vital in today's globalised world, where health threats transcend individual or species domains.

Table 1. Comparative analysis of health approaches

Framework features	One Health		Planetary Health	EcoHealth	Ecological Public Health
	Early	**Current**			
Focus	Zoonoses & AMR	Infectious diseases, AMR, CC, SDH, environmental justice…	CC, SDG, land use, environmental justice, urban planning…	Biodiversity loss, SES, CC, water quality…	System thinking, biodiversity and human health, CC and health…
Contributing disciplines	Public health Veterinary	Public health, veterinary, human health, environmental health, ecology…	Public health, human medicine, economy, energy, agricultural sciences, urban planning	Public health, economy and social science, environmental sciences, anthropology	Public health, human medicine, environmental sciences, ecology
Target	Human, Animal	Human, animal, environ.	Human, animal, environ.	Human, animal, environ.	Intersection of humans and environment.
Values	Individual health of humans Animals' health (not intrinsic value) Multidisciplinary	**Individual & pop. health of humans-animal-env.** **Animals and env. health (very** little **intrinsic value)** Multi + interdisciplinary	Sustainability (for humans) **The importance of social justice.** Hands-on research **(inter + transdisciplinary)**	Biodiversity & sustainability **(for humans, animals and the environment** **The value of indigenous knowledge.** **Hands-on, trans-disciplinary research.**	Complexity and system dynamics as core values (getting into systems rather than individuals). Non-linearity, interactions, variations of scale and feedback. Health: coexistence of the natural world and social relations. Transdisciplinary research.
Agents	Biomedical scientists	Environmental scientists Biomedical scientists Educators NGOs	Environmental scientist Economics & social scientists Urban planners	Environmental scientists Economics & social scientists	Environmental Scientists Community members

In conclusion, the OH framework represents a significant paradigm shift in understanding and managing health. Its historical roots reflect a gradual convergence of efforts on collaborating between disciplines to address the interconnections between humans, animals, and the environment. OH offers a robust foundation for interdisciplinary research, policy, and practice as global health challenges evolve and emerge. Continued integration of diverse scientific fields will strengthen OH's capacity to address complex, interrelated currents and future health challenges.

The Role and Evolution of Living Labs in Open Innovation and Ecological Sustainability

"Living Labs" are collaborative, open innovation ecosystems focusing on co-design and co-creation with active user participation in real-life settings. LLs were designed to support innovation through cooperative efforts, advocating for experimental environments beyond traditional laboratory settings.

LLs and Open Innovation: LLs serve as open spaces for innovation where various stakeholders—government, industry, academia, and citizens—work together. They contrast traditional, profit-focused research methods by emphasising user-centric design and sustainable solutions, often using local resources and shared goals rather than proprietary outcomes. Open innovation is integral but not universally accepted; certain entities prefer closed or proprietary approaches to research.

Shifting User Paradigms: The "user" in LLs has historically been the individual consumer. However, this concept has expanded to include non-human entities, reflecting a broader ecological perspective. For example, projects related to soil health, ocean ecosystems, and biodiversity are influenced by ecological users (plants, animals, and the environment), underscoring a commitment to sustainability that treats these natural systems as "users" alongside human participants.

Active User Engagement: LLs emphasises co-design and co-creation rather than limiting user involvement to the passive validation of ideas. True LLs engages users, ensuring their feedback directly influences project development. This approach fosters a sense of ownership and long-term commitment among participants, which is crucial for scaling innovations effectively.

Real-Life Testing and Experimental Sites: One defining feature of a LL is that experimentation happens in real-world settings rather than isolated, controlled environments. This setup demands diverse testing sites within the same region to understand how solutions perform under varied conditions. For example, the European Union has increasingly mandated LLs to conduct multi-site experimental research, especially in soil and environmental health projects.

Framework of LLs:

- ✓ *Multi-Stakeholder Participation**:*** LLs rely on broad collaborations across disciplines, sectors, and cultural boundaries.
- ✓ *Methodologies and Approaches*: Techniques such as canvassing—mapping stakeholders, goals, and potential partnerships—are crucial in defining each lab's mission. This helps to clarify roles, establish objectives, and ensure sustainability.
- ✓ *Governance and Sustainability*: LLs can adopt different governance models, from assembly structures to project-specific boards. Sustainability, both financial and operational, is crucial. Labs often balance public funding with efforts to create sustainable revenue streams.

Case Studies:

- ✓ **Ozean LL**: Based in the Urdaibai biosphere reserve, this lab focuses on natural resource management and sustainability in the Basque region. Its stakeholders include local schools, social enterprises, and technology firms. This project has shown the practical integration of diverse community needs with ecological and economic sustainability goals.
- ✓ **Soil Health Projects**: Another LL initiative focuses on soil health related to ocean quality. This project is conducted in wetland regions where soil health directly impacts oceanic conditions, further underscoring the importance of ecological sustainability.

Challenges and Facilitators:

- ❖ Convincing participants, especially local residents, to actively engage is challenging. LLs often employ cultural and artistic methods to foster engagement.
- ❖ Each LL adapts based on local conditions and the stakeholders' varying needs. This requires flexibility in methodologies, governance models, and financial strategies.

Paradigm Shift in User-Centric Design: The expanded definition of the "user" now includes ecological elements, redefining the user-centric paradigm to account for sustainability.

Policy and Environmental Impact: LLs are becoming instrumental in European policies, with a clear focus on addressing global challenges like climate change, soil health, and biodiversity loss.

In conclusion, LLs represent a transformative model for innovation. They offer flexible, real-world spaces for collaboratively addressing ecological and technological challenges. These labs, centring on co-design and co-creation, foster a sustainable and inclusive approach to solving pressing global issues.

NEXT STEPS: ONE HEALTH LIVING LAB

Within the HOBE and BLUEADAPT projects, PiE and BC3 are engaged in several tasks aimed at co-designing a pilot **OHLL** in the case study area, the Bay of Plentzia.

This LL, as stated in HOBE and BLUEADAPT projects, will serve as a collaborative space, in order to collectively and collaboratively address the complexity of various challenges in the case study area: Climate change, pollution, antimicrobial resistance (AMR), and pathogens that affect both human and ecosystem health, as well as the social context dynamics in which these impacts occur. Given the topics addressed within these two projects, we have invited the Joint Research Lab on Antimicrobial Resistance to join the initiative.

The goal is to create a network of key agents, involving industry, associations, citizens, and other relevant actors. The intention is to use the opportunity provided by these two projects to co-design an initiative that can persist beyond the current funding, which runs until 2026. For this reason, we aim to collectively develop a medium- to long-term vision, with activities and topics that can extend beyond the current projects. In the future, this could support the integration of new projects and funding to continue and expand this initiative.

The OHLL is meant to serve also as a learning space where knowledge can be generated, shared and disseminated, about new ways of relating to nature, promoting new values and practices, and encouraging participatory strategies to address current and future risks.

The initial projects' tasks included a literature review of LLs, areas of applications, design and opportunities and barriers. We also explored the steps to achieve European certification for LLs, in case we decide jointly to formalize a structure to this initiative.

This workshop marks the beginning of a series of activities to co-design jointly the LL. The aim is to discuss and decide collectively how we envision this LL, define main activities, key topics, and the role of each participant. We already presented the initiative to the Health Department of the Basque Government, the Hospital of Urduliz and the Bizkaia Provincial Council. Moving forward, we would like to identify jointly among all of us other actors and institutions.

The OHLL will focus specifically on the Bay of Plentzia. This location is significant not only from an environmental and social perspective but also because PiE premises offer a physical space where participants can meet and work together, facilitating activities, collaboration, dissemination activities and exchange of ideas.

We invite you to join this experimental and collaborative process and contribute with your knowledge and perspectives. Together, we can lay the foundations for a sustainable LL that, with luck, will endure and expand beyond the current projects.

LET'S GO BACK TO THE RESULTS OF THE 1st WORLD CAFÉ

On July 7th 2023, we organised a workshop with researchers from BlueAdapt and HOBE, aiming to create a space for conversation, where we could get to know each other and begin discussing topics related to both projects and the coastal areas of the Basque Country.

In this context, the 1st Wold Café PiE & BC3 was developed. A total of 22 researchers participated, coming from multiple and diverse disciplines. Most of them had backgrounds in cell biology and toxicology, as well as in analytical chemistry and microbiology. There were also researchers from ecology, engineering, and economy.

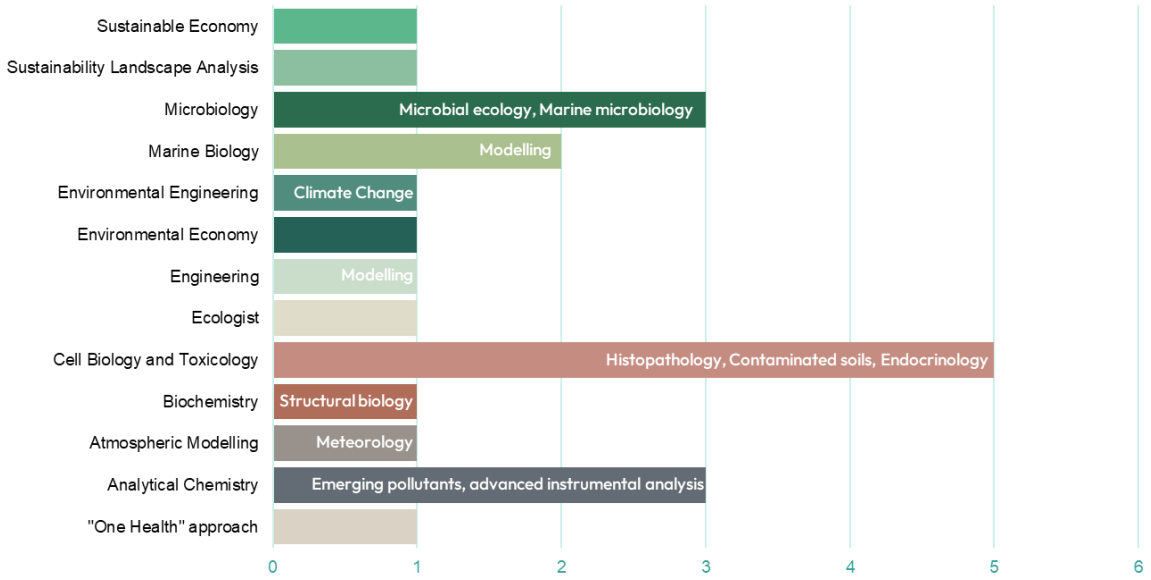


Figure 3. Participants of the 1st Workshop in July 2023 (PiE & BC3 World Café) and their backgrounds.

To steer discussion, four questions were asked to the participants:

1. What are the main health risks/pressures/threats currently on the Basque Coast?
2. The strongest impacts will be experienced by...?
3. Are there any strategies to monitor/control/mitigate these problems? Are there barriers? Are there opportunities? Who would be responsible for these strategies?
4. How to improve interaction and communication between scientists?

In response to the first question on threats, the term "change" emerged most frequently. This included references to global change, climate change, shifts in environmental conditions, and alterations in species composition and resource availability. Socio-economic changes, such as increases in tourism and rising use of medications and pesticides, were also highlighted. Another prominent term was "water," recognized as both a vital resource for all living organisms and a key element linking the socio-ecological system. Lastly, pathogens like *Vibrio* and *Escherichia coli* were mentioned, along with harmful algal bloom events, as notable health threats.

Regarding who is most likely to be affected, responses grouped into three main categories. First, humans were highlighted, particularly vulnerable groups like immunocompromised individuals, people with chronic illnesses, children, and the elderly, as well as those more exposed, such as beach

users and healthcare workers. Second, various species of animals, plants, algae, and microorganisms were identified, along with the potential impacts on biodiversity. Finally, the environment was mentioned from different perspectives: the natural environment itself, impacts on natural resources, the economy, and the healthcare system, and finally, the effects on infrastructure.

In terms of strategies currently in place or those that could be implemented, water emerged as the primary focus. Discussions covered water quality monitoring and the various indicators used, as well as the role of WWTPs and new technologies that could enhance wastewater treatment. Regulations at multiple levels were also highlighted, from local councils to the Basque government and the Spanish state. Finally, the critical role of environmental education and awareness was emphasised, including the need for participation from stakeholders across different social and political spheres.

The final question focused on what scientists can do to address these challenges. The discussion underscored the importance of inter-, multi-, and transdisciplinary approaches to tackle complex issues, alongside strong coordination and collaboration between groups. Open science was highlighted, including shared databases, innovative knowledge-transfer strategies, and improved communication with non-academic audiences. While scientific output through projects and papers remains crucial, the value of informal spaces with relaxed atmospheres was also mentioned, as these can foster learning, knowledge exchange, and the generation of new ideas.

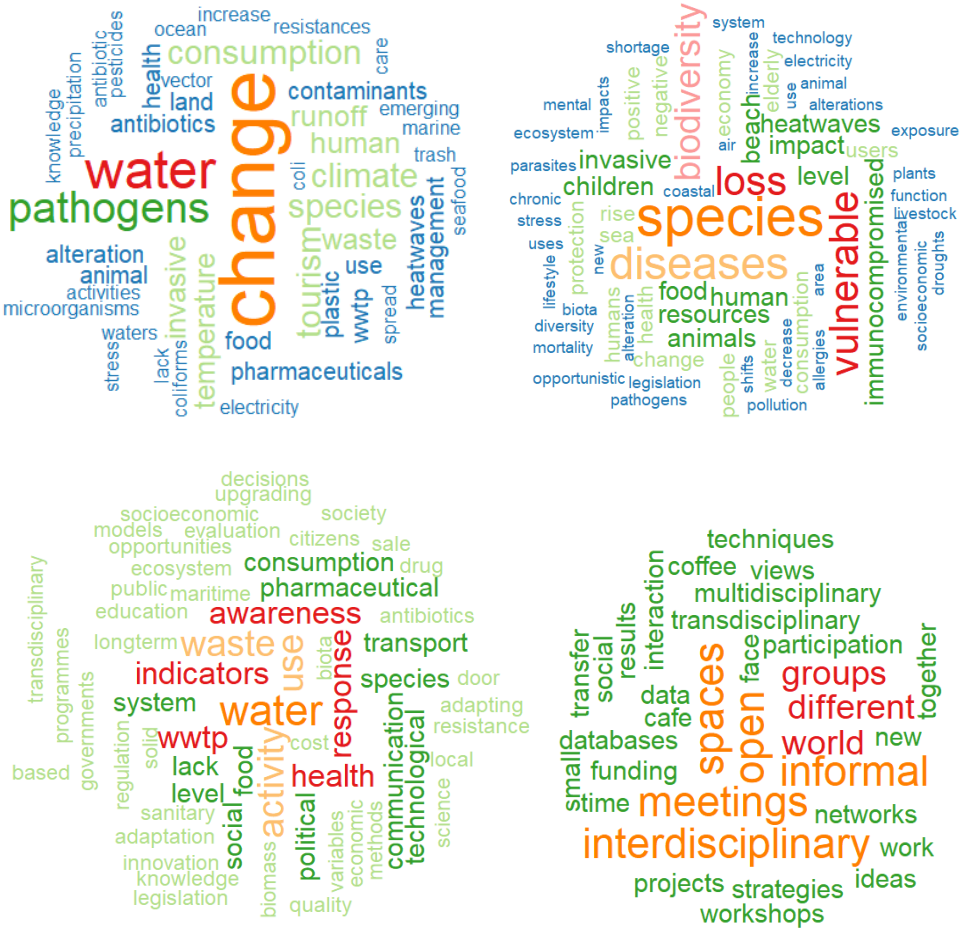


Figure 4. Word clouds obtained from the PiE and BC3 World Café

2nd WORLD CAFÉ

First question: How/Where does your work/research fit into a One Health approach?

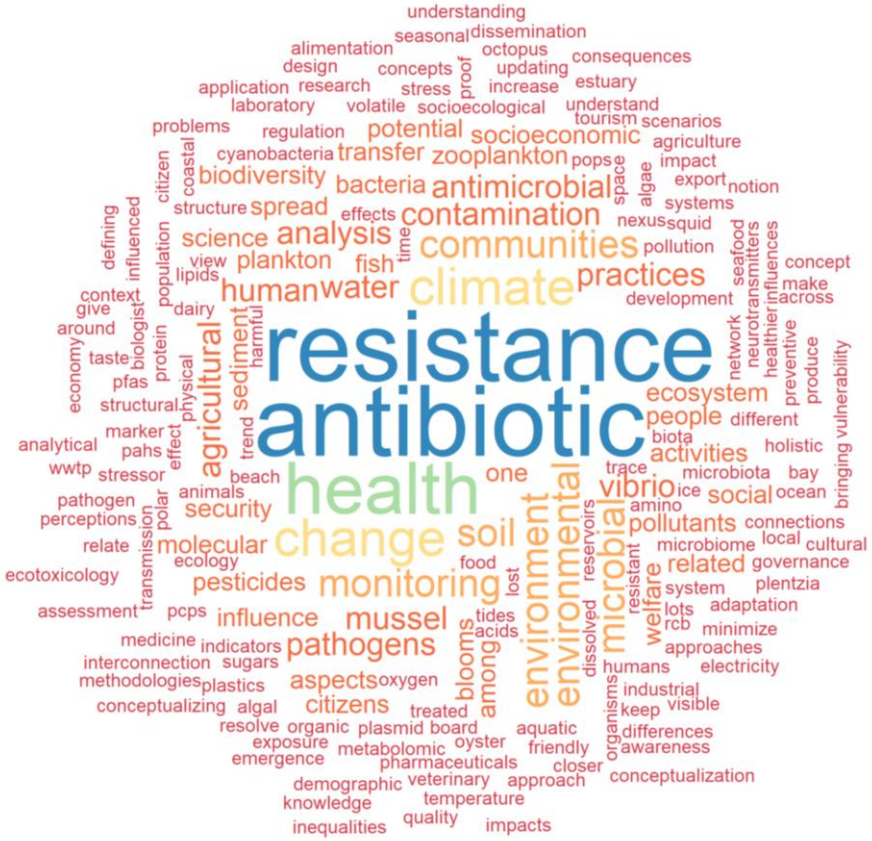


Figure 5. Word cloud generated with the responses to the first question.

To answer this question, many researchers and students gathered at tables. These researchers work across various areas within the OH framework, exploring connections between **environmental**, ecosystem, and human **health**. Topics included studies on cyanobacteria and its role in harmful algae blooms and environmental resistance, as well as investigations into *Vibrio* and its adaptation to **climate** stress, which has implications for disease spread. Participants also explored the adaptation of pathogens and debated their role in ecosystems, noting that some may contribute to ecosystem balance rather than solely harm. Other research focused on **antibiotic resistance**, emerging anthropogenic pollutants' impact on ecosystem health, and the exposome concept, which considers diseases linked to environmental exposures. Additionally, seafood research examined the link between marine ecosystems and human health. Following these presentations, a discussion underscored the importance of keeping technical research connected to its broader, integrative context within OH.

Other tables consisting of senior researchers, doctoral students, and an Erasmus student, worked within diverse areas of OH, especially in microbiology and **antimicrobial resistance (AMR)**. Several participants focused on AMR, with one examining gene transfer between bacteria and potential inhibition methods, others studying AMR's spread through agricultural land use and its impact on food safety via vegetables, in fermented foods (dairy industry), and other analyzing *Vibrio* species in coastal areas. Another participant focused on local ocean governance, particularly in managing fisheries and tourism's socio-economic impact. Additionally, research on environmental changes

included studying how temperature increases affect octopuses' metabolism, potentially leading to food safety risks due to toxic compounds.

In some tables, a discussion emerged among participants on whether sharing scientific knowledge with the public constitutes OH research. One participant viewed OH strictly as a technical field focused on empirical research involving animals, humans, and the environment, excluding public dissemination and citizen science. In contrast, another argued that communicating knowledge across disciplines and with the public is integral to OH. Participants also debated whether OH should be compartmentalized into "spheres" (e.g., environment or animals) or viewed as interconnected. One participant advocated for broadening OH to incorporate planetary boundaries, while another criticized OH as overly anthropocentric, noting that ongoing debate on definitions consumes time. Additionally, local perspectives were discussed, with one participant observing that Plentzia residents see no ecological issues in their bay, perceiving high quality of life.

Main conclusions from the ideas of all tables

This interdisciplinary group of researchers and students shared projects within the OH framework, covering topics from microbial resistance to environmental changes, and linking ecosystem, animal, and human health. Key research included cyanobacteria and *Vibrio* studies on pathogen adaptation and disease spread, antibiotic resistance, and seafood safety under climate stress. Other work focused on managing local ocean resources and the impact of emerging contaminants on ecosystems. Participants debated whether OH should include knowledge dissemination and public engagement or remain a strictly empirical domain. While some conceptualized OH as separate spheres, others saw it as interconnected, with one proposing a planetary perspective. Overall, the group highlighted OH's broad scope while noting the complexities in defining and integrating it as a unified scientific approach.

Second question: How could your research/work contribute to the One Health Living Lab?

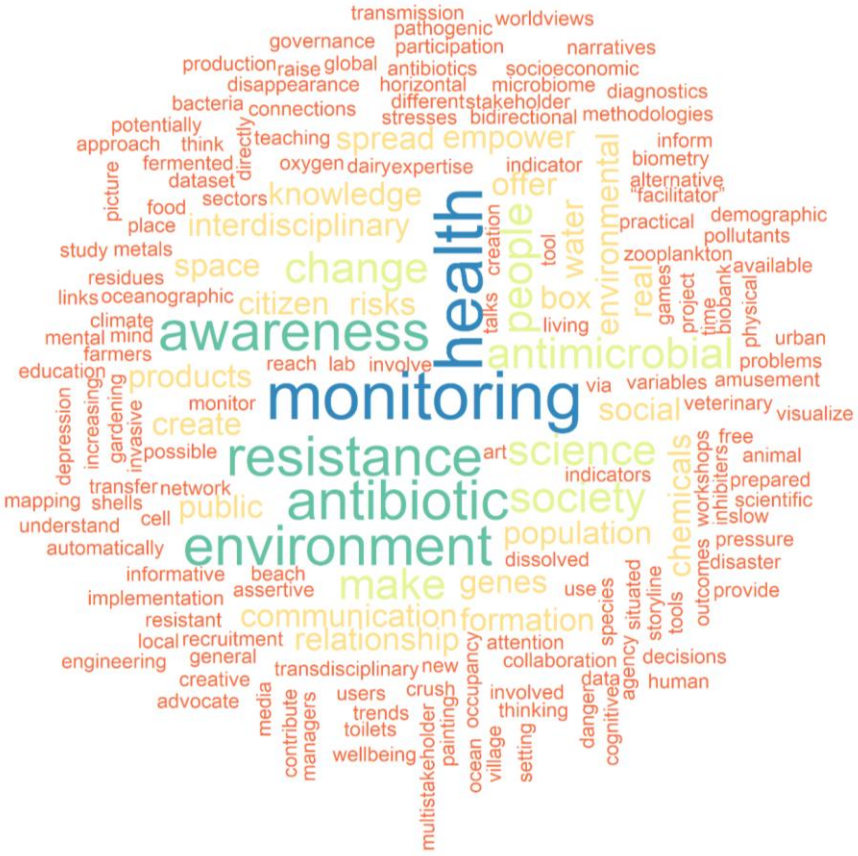


Figure 6. Word cloud generated with the responses to the second question.

Several participants reiterated earlier ideas in response to this question, focusing on how the LL could improve public and political awareness around health and environmental issues. One participant suggested using new microbiome monitoring systems, like detecting microbiome changes in samples collected from household toilets, to track regional population health. Another emphasised the role of the LL in educating policymakers on scientific issues advocating for coordinated actions on environmental challenges, including emerging contaminants. Others expressed interest in outreach activities to engage citizens, promote health agencies and encourage proactive lifestyle and wellness choices. Additionally, participants highlighted the need to focus on vulnerable populations, like the young and elderly, advocating for projects in mental health, social wellbeing, and lifestyle improvement. This included plans for citizen science projects and courses involving multidisciplinary experts. Several researchers discussed their access to young people through their numerous activities in presentations to schools.

In discussing the LL, participants found overlap with prior conversations and agreed their research could support LL activities, though they were uncertain about the primary users (e.g., beachgoers or general citizens). They emphasised scientists' roles in informing and empowering the public to make health-conscious choices, such as reducing beach pollution. Participants saw the LL as a vital tool for building public awareness and prompting political action but recognised that scientists often lack communication skills. Thus, they suggested working with communication experts to convey scientific insights within the LL framework effectively.

The participants emphasised the importance of accurate scientific information and proposed viewing the LL through a socio-ecological complex system lens, which would support a

multidisciplinary, multistakeholder approach to problem-solving. Some saw governance discussions as integral to LL design, with research supporting environmental consultancy for stakeholders. While some urged focusing on tangible actions rather than theory, others stressed the need for open data sharing among LL partners. Participants identified language and communication as key barriers in engaging diverse groups, advocating for a "common language" to unite people across backgrounds. The LL was also seen as a space to observe varied reactions to scientific input. However, concerns were raised about insufficient citizen and stakeholder involvement in the LL's co-design, warning against a top-down, academic approach.

Main conclusions from the ideas of all tables

The researchers discussed how the LL could bridge science and public engagement, leveraging awareness programs and strategic outreach to influence citizen and policymaker health literacy. They highlighted the LL's potential to empower communities in Plentzia, particularly the young and elderly, through activities led by diverse experts. However, uncertainties emerged around intended LL users and effective roles for scientists, with a need for communication specialists to aid public messaging. Participants stressed a socio-ecological approach, advocating open data and shared language to address complex issues across diverse groups. Some expressed concern over insufficient stakeholder inclusion in the LL's co-design, cautioning against a top-down academic model. Overall, the LL was envisioned as a collaborative platform for multidisciplinary health promotion and community-driven change, albeit with critical attention needed on inclusive, accessible design.

Third question: Who else would you like to invite to participate in this Living Lab?

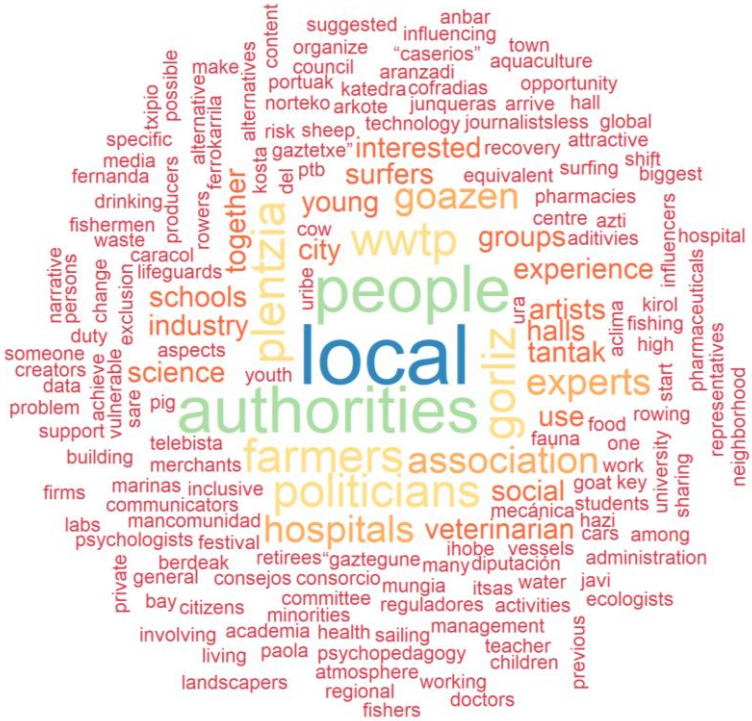


Figure 7. Word cloud generated with the responses to the third question.

In one of the tables, one participant emphasized the need to engage people outside of science and academia, including farmers, fishermen, local businesses, and institutions like pharmacies, schools,

and families. They recognized that reaching these groups would be challenging and discussed the importance of finding specific entry points, such as hosting community activities like popular lunches or cooking events, to attract diverse stakeholders. The involvement of administrations was also seen as crucial, though some participants shared frustrations with past experiences, noting that collaboration with government bodies can be difficult due to bureaucratic hurdles.

In other groups, they discussed the importance of involving a broad range of stakeholders, including hospital representatives, local governance, and community organizations, in related projects. For long-term impact, they agreed that future initiatives should expand to include regional, national, and even global governance bodies, particularly to tackle larger challenges like antimicrobial resistance (AMR) more effectively.

It was emphasized among various groups the need for social science researchers, such as sociologists and anthropologists, to create a truly multidisciplinary and transdisciplinary research team, as most members come from biomedical and technological backgrounds. They highlighted the importance of involving citizen collectives and agents, such as Ambar and Txipiobai, in the process. Participants also discussed the need for researchers to develop skills for effective interdisciplinary communication and the importance of involving experts in participatory and facilitation methodologies. One researcher stressed the value of physical proximity, suggesting that being in the same space with researchers from different disciplines fosters collaboration and shared understanding.

Main conclusions from the ideas of all tables

The group explored strategies to engage a broad range of stakeholders, from local communities and businesses to government bodies, in the LL. They discussed the challenges of reaching non-academic audiences, emphasizing the need for targeted entry points such as community events. While involving administrations was seen as crucial, bureaucratic barriers were acknowledged. Looking to the future, participants recognized the importance of expanding the network to include regional, national, and global stakeholders, particularly for addressing large-scale issues like antimicrobial resistance (AMR). They also stressed the necessity of incorporating social science expertise and participatory methodologies to ensure a truly multidisciplinary approach. Additionally, the importance of physical space for fostering collaboration among researchers from diverse fields was highlighted.

ONE HEALTH LIVING LAB CO-DESIGN

What is co-design? Learning by doing

Participants were gathered around tables in groups of 6 to 7. Everyone had a piece of paper and a colour marker pen for the exercise. They were asked to draw whatever they wanted which made them happy with their non-dominant hand. They were given one minute, and music played in the background. Then, they were asked to give their drawing to their neighbour on the right and continue drawing. The activity continued until the paper reached its original owner.

The results are organised in a drawing mosaic.



Figure 8. Mosaic of the collective drawings elaborated during the initial activity.

With this activity, participants co-created the drawings. It is an example of how co-design is not an individual activity but a collective work, where the resulting outcomes might be very different to the personal expectations each participant had at the beginning. Using the non-dominant hand to draw took participants out of their comfort zones and levelled the playing field. Although challenging, drawing with the non-dominant hand sparked creativity. It encouraged imaginative thinking, often resulting in outcomes they hadn't anticipated when they started, and that would not have appeared if using their dominant hand.

Co-Design One Health Living Lab

After the introductory co-design activity, participants were invited to conceptualise the OHLL maintaining five groups (the same as the last World Café round). To steer the discussions, three questions were projected on the screen:

1. Design your own OHLL: how do you imagine it?
2. Which activities/themes would you suggest as part of the OHLL?
3. Who do you think this LL could serve or be useful to?

Participants had then 20 minutes to collectively reflect on their OHLL, and later on, 40 minutes to build it together using the materials provided (plasticine, lego, marker pens, cardboards). The activity resulted in five group presentations, each offering five different conceptualizations of the OHLL (Table 2). Each collective creation was different, however some main themes and commonalities emerged from the group's discussions.

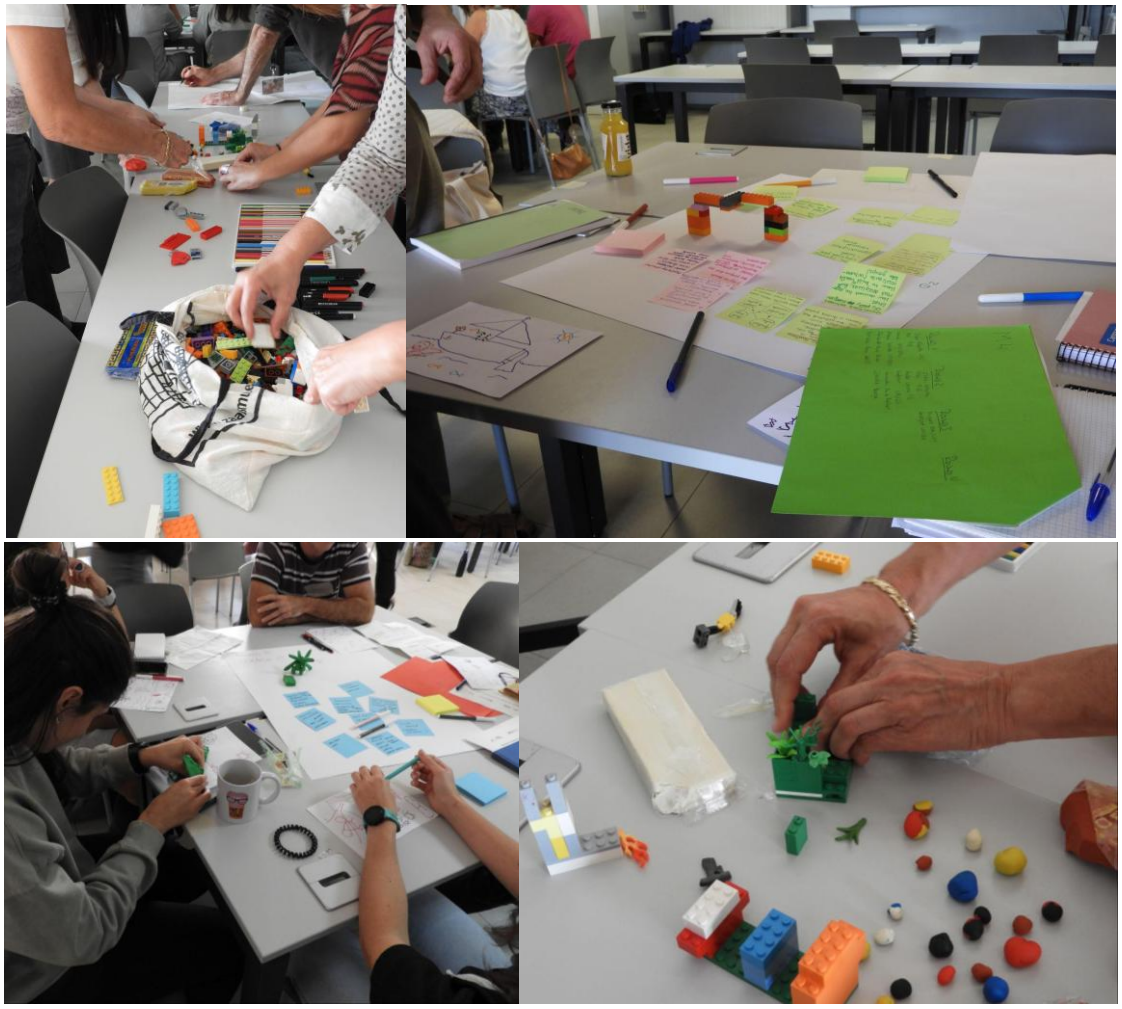


Figure 9. Co-design activity. Materials were made available for the participants.

All groups emphasized the importance of making the LL open and **accessible** to diverse stakeholders, including researchers, citizens, and institutions. It is envisioned as a platform to make experts –such as those who conduct detailed analyses of pollutants in local systems or quantify beachgoers in specific areas– more accessible. These experts would provide valuable insights into the scope of various issues and regularly engage through lectures, presentations or workshops. Ideas like open doors and hotlines (Group 2), open and reference spaces (Group 3 and 5), inclusiveness for all ages and future generations (Group 2 and 4) reflect this theme. The LL was frequently described

as a hub for **collaboration** among diverse entities such as academia, local authorities and citizens. Potential participants of standard industry practices that have not been considered before, can provide surprising knowledge that could have direct impacts to health (e.g. AMR bacteria commonly found in fermented foods like yogurt because only the original starter cultures are regulated by authorities). This collaboration was envisioned by the groups with structures like lighthouses (Group 1), bridges (Group 4), Greek theaters (Group 3), and nodes (Group 5) to symbolize connections. Groups consistently emphasized the LL's need for **dynamism** and **flexibility**. Concepts like mobile, transportable structure (Group 5), a sailboat to represent continual activity (Group 2), shaking of the Greek theater (Group 3), and sustainability across time (Group 4 and 5) highlighted the importance of evolving and adapting to changing contexts. Finally, all groups also highlighted the need for citizen **engagement** and interactive activities. Suggestions included workshops, educational games, escape rooms, and creative spaces to inspire and involve stakeholders meaningfully (Groups 2 and 3), and promote the creation of new narratives (Group 1).

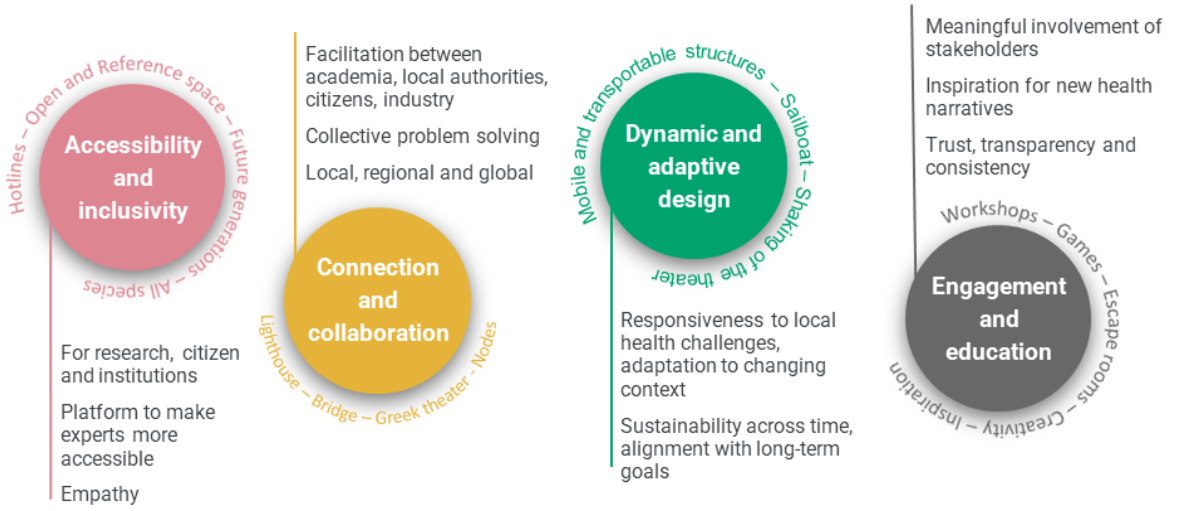


Figure 10. Key characteristics emerged during the co-design activity of the One Health Living Lab.

Additionally, each group had unique contributions that incorporated nuances to the OH LL co-design:

- **Group 1** highlighted the need to include species, pollutants, and the sea, emphasizing a shift in narratives toward environmental health.
- **Group 2** proposed tangible mechanisms like a hotline for open communication and focused on inclusivity across age groups, ensuring the LL remains inspiring and fun for all.
- **Group 3** introduced the idea of a dynamic model where citizens and stakeholders gather in the LL to solve problems. Simulating real-world interactions.
- **Group 4** suggested that the LL should have a paper of facilitator, connecting various agents to tackle health challenges. They also highlight the need of the LL's design aligning with long-term goals.
- **Group 5** emphasised mobility and global connectivity, imagining the LL as a network of interconnected nodes across a wider scale. They also included the perspective of time.

The LL is envisioned as a dynamic, inclusive, and collaborative space that serves as a central hub for addressing health challenges. It would function both physically and symbolically, fostering connections among academia, authorities, and citizens. With sustainability and adaptability at its core, the LL could incorporate creative storytelling, interactive activities, and global connectivity to remain relevant across time and contexts.

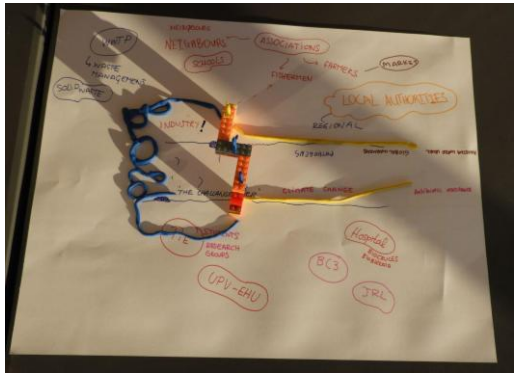
Key elements include:

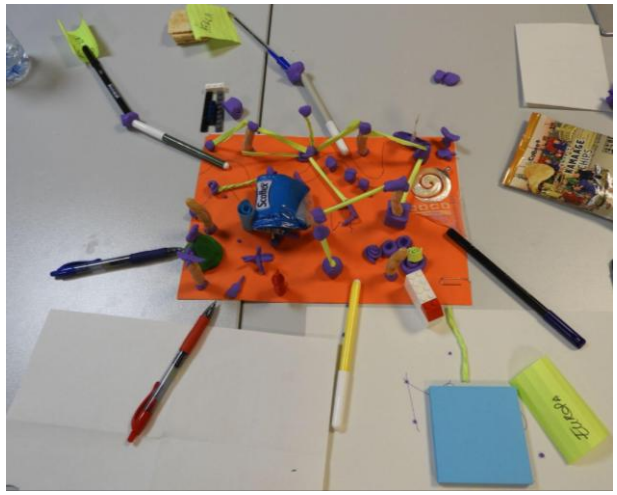
- **Physical and symbolic spaces** (e.g., a hotline, lighthouse, Greek theater, or bridge) to engage diverse audiences.
- **Activities and tools** such as workshops and educational games to inspire and involve stakeholders.
- **A network of nodes**, local, regional, and global, connecting the LL to other institutions for broader impact.
- **Creative narratives and symbolism**, using poems, art, and imagination to convey its purpose and engage participants.

By integrating these diverse contributions, the LL can become a vibrant and inclusive platform for advancing the principles of OH while addressing environmental and societal challenges.

Table 2. Results of each group. Pictures of the OHLLs co-designed by each group.

Table	***Creative Process***	***OHLLs***
1	Brainstorming Ideas: ● Envisioned the LL as a **Lighthouse** ● Include a **poem** (e.g., a Haiku) ● Include **species** and **pollutants** ● We need to **change narratives** Design Process: ● Use an **upside-down bottle** as a **lighthouse** ● Include a **message** (a poem) **in a bottle:** *"Manchamos* *Quién limpia?* *Ello muere* *Enciendate!"* ● Pieces of plasticine and bottle lids as **pollutants** ● **Animals** and **plants,** the **sea** ● Use the **drawings** on the table from the warm-up exercise; they already include many **OH themes**.	 
2	Brainstorming Ideas: ● **Hotline** open to anyone to ask for information ● **Dynamic** - have continual activities so doesn't become stagnant ● **Open door** - access to everyone all the time. ● **Inclusive** - open to all ages, kids, adults, elderly ● Activities that are **fun** and **educational** and **inspiring** Design Process: ● Hotline = **phone** ● Dynamic = **sailboat** ● Open door = **actual open door** ● Inclusive = figure with **various extensions representing different age groups** ● Fun/educational activities = **pint of science mug**	

3	Brainstorming Ideas: ● Envisioned the LL as a **reference point** for addressing problems, a **physical space** for study, meetings, and activities. ● Designed as an **open space** resembling a Greek theatre, with: ○ A **public stage** for citizen engagement. ○ **Backstage** for institutions like the hospital, WWTP, and city council. ● Included **engagement activities**: workshops, room escape games, and healthy leisure events, with research and education as key components. Design Process: ● Created a **Greek theatre model** with LEGO-built institutions backstage and plasticine/paper balls representing diverse citizens/stakeholders, distributed over all the paper surface. ● Conceptualisation in a dynamic model: Folded the map to create a central stage (central concavity) where citizens/stakeholders gather during problems (shaking the paper), simulating the LL as a **meeting point** and **problem-solving hub**.	
4	Brainstorming Ideas: ● Envisioned the LL as a **platform/structure for connecting** academia, local/regional authorities and other types of agents that could help to better address the health challenges. ● Reflections included designing the LL with the **future generations in mind**, ensuring sustainability and long-term relevance. Design process: ● The LL was visualised as the **bridge crossing a river** symbolising the connections between various agents involved in the health of the Bay. ○ **Agents** included: hospitals, UPV, PIE, JRL, WWTPs, solid waste management agencies, and neighbour associations. ○ The river represented the various **pressures** threatening the	

	area. ○ The bridge was envisioned as mobile, connecting the two riverbanks. ● Only the facilitators could cross the bridge of the LL and were imagined as **enablers of interaction** between the different agents.	
5	Brainstorming Ideas: ● As a communal gathering place. **Reference place**. ● As a **mobile** thing. That it can be transported and materialized in many places. ● As a place that will **connect** to other nodes in many places of the world ● **Durable in space and time** Design Process: ● To create a central piece representing the **bay of Plentzia** and the **PiE**. ● Create an elevation of the pieces to show the dimension of **time** and connect them to show the nodes of **connection** with other parts of the **world** and other **institutions** that represent the LL.	

Challenges and barriers

Several challenges and barriers were observed throughout the co-design process for the OHLL. These stemmed from the complexity of introducing inter and transdisciplinary frameworks to researchers, as well as practical issues related to governance and engagement of the citizens. Identified challenges included:

- **Hesitancy of some researchers**. Some participants perceived that the OHLL adds more tasks than opportunities, leading to hesitancy about engaging fully. Additionally, some researchers feel reluctant to step outside the familiar scope of their research, with some participants expressing difficulty rethinking concepts, exploring nexus topics, or adopting new methodologies. On the other hand, some researchers showed more interest than in the first workshop, now seeing more ways to contribute actively to the OHLL.
- **Uncertainty about purpose and roles**. A lack of clarity regarding OHLL's aims and target users has made it challenging for some participants to envision its potential. Some researchers prefer to focus on their work and suggest that external facilitators should take on roles such as connecting research centres and stakeholders, coordinating activities, and developing new narratives for wider audiences.
- **Sustainability of engagement**. Some participants are involved due to current project requirements but may withdraw once the project ends. Ensuring continuity of momentum is critical, as initial scepticism (e.g., during PiE seminars) shifted to enthusiasm following the workshop. Maintaining this progress will require sustained efforts and active engagement of participants through their own proposals of activities.
- **Diffusion and communication challenges**. To generate internal and external communication strategies. Dissemination methods for events and activities must be reconsidered to maximise participation and engagement. Managing the involvement of interested individuals who are not yet part of the project requires thoughtful planning to leverage the current momentum.
- **Governance and facilitation structure**. A clear governance structure for the OHLL has not yet been established, raising questions about who will facilitate and sustain processes such as inviting external institutions and maintaining collaborations. A "technical secretariat"-coordination—not leading—team is needed to manage invitations and keep the process alive.

While these challenges highlight significant barriers, the workshop demonstrated the potential for overcoming them through sustained engagement and creative collaboration. Many participants who initially doubted their ability to contribute recognised the value of the process after the workshop, signalling the importance of continuity and support as the OHLL evolves.

CONCLUSIONS

Today's workshop fostered a rich exploration of collaborative innovation and the integration of diverse concepts, laying the groundwork for continued co-creation and interdisciplinary collaboration. During the welcoming, the significance of "co-creation" was emphasised, a term that resonated throughout the day's activities and underscored our shared mission. The outcome—a meaningful first step in envisioning collaborative initiatives—suggests that the promise of co-creation was fulfilled.

One of the day's highlights was on the evolving concept of OH. There, OH was reframed as not merely a recent concept but a rediscovery of a holistic approach inherent in ancient cultures, where human, animal, and environmental health were seen as interconnected. This perspective reminded us of the interdependence of ecosystems and resonated deeply, hinting at an opportunity to revisit and adapt these ancient, integrative insights to address current challenges.

During the second talk, the concept of OH was introduced, sparking curiosity and reflection among participants. While new to many, this concept offered a forward-looking model focused on real-world, experimental spaces designed to tackle complex problems through user-centred, community-engaged solutions. However, as was noted, several aspects of the LL remain to be clarified, particularly around the scope, stakeholder roles, and integration within the One Health framework. This dialogue highlighted a need for further engagement to deepen our understanding and operationalisation of LL in collaborative networks.

The following discussion reinforced the importance of institutional networks, with examples of how collaborations like those between JRL-EAR, PIE, BC3, and UPV can secure resources and drive impactful projects. Participants were challenged to think beyond the timelines of existing projects, considering how we might sustain momentum and extend our impact beyond 2026.

In the afternoon, the World Café sessions enabled participants to exchange insights in a structured but creative way. The organizing team's facilitation provided a framework for capturing the key themes, ideas, and issues raised, allowing for a meaningful synthesis of ideas. This thoughtful consolidation of discussions offered valuable insights that will inform our ongoing work. The World Café format proved a productive model for generating actionable insights, and it was gratifying to see the group's collective imagination sparked as participants envisioned potential futures for the LL.

The day concluded with open-ended envisioning exercises that encouraged us to think boldly about the future of the LL. The discussions evoked a shared sense of curiosity and anticipation for what we can achieve collectively despite the uncertainties inherent in such an ambitious undertaking. This workshop provided a dynamic and inspiring foundation, with evident enthusiasm and a spirit of discovery that will fuel our continued efforts.

We aim to build on these discussions, using monthly seminars to maintain continuity and track progress. The insights gathered today mark only the beginning of our journey; they will be compiled, disseminated, and further developed in future sessions. We are committed to an

iterative approach that allows for learning, feedback, and adaptation, ensuring that this initiative remains responsive, inclusive, and impactful.

Acknowledgements and Participant Reflections

First, we want to congratulate everyone. We genuinely want to thank you all because we know this process isn't easy. Stepping out of the rigid framework of scientific research, which we are so accustomed to, and entering a different space can be challenging. Exploring the artistic side isn't easy for everyone—it comes more naturally to some than others. But I sincerely appreciate the effort, the energy, and the smiles you've all brought today. We hope we take something valuable home with us, as this marks the beginning of something new. As we've seen throughout our discussions, we don't know exactly what this will become, but this is the first step—and we're taking it together. Thank you so much! We hope to share some surprises and results from this workshop by the end of November. We'll provide them in two ways: a document or link for reference and a discussion during our upcoming meetings to wrap up the year.

> "*The main reflection I took from today is that whatever shape the LL takes, it will be something we've built together. Having these initial conversations is valuable because it puts everyone on the same page. I feel very positive about this workshop, as it has laid a solid foundation for our collective efforts*"

> "*I also reflect on the complexity of building this LL. While I was already familiar with the initiative, I had previously viewed it from a scientific perspective, focusing on data like chemical, toxicological, microbial ecology, and ecosystem services. However, the involvement of all these additional stakeholders is eye-opening. Engaging local governments, associations, and community groups transforms this into something more than a traditional interdisciplinary project—it's truly a LL. The challenge lies in shifting from merely informing stakeholders to actively involving them, moving beyond outreach to real collaboration. While we are accustomed to gathering scientific data and sharing results, encouraging genuine, participatory engagement is a complex but vital next step. This realisation has highlighted the unique and intricate nature of what we aim to build.*"

ANNEXES

Living Lab Activities

List of suggested activities that were mentioned during the workshop.

Education and awareness:

- Activities to reduce the use of private cars
- Awareness about health risks for people and public managers
- Awareness for all society
- Be prepared for disaster
- Bidirectional Talks for Awareness
- Collaboration with communication experts
- Combating misinformation
- Cooking activity
- Courses for students
- Courses for the general public
- Increase awareness on climate change and health outcomes
- Increase awareness on pred of antibiotic resistance genes
- Increase people's and politician's awareness on environmental issues
- Increase politicians' literacy in science
- Outreach talks about research
- Social media
- Strategies for Assertive Communication
- Think of a common language to communicate with different stakeholders
- Trainings
- Workshops

Environmental monitoring and research

- Biobak Dataset
- Generation of Situated Knowledge
- Internships
- Monitoring of Antibiotic Contamination
- Monitoring of Antibiotic Residues in Food
- Monitoring of Beach Occupancy
- Monitoring of Environmental Contaminants
- Monitoring of Environmental Indicators
- Monitoring of Invasive Species
- Monitoring of Oceanographic Variables
- Monitoring of the Microbiome
- Monitoring of Vibrio and pathogenic bacteria
- Monitoring of Zooplankton
- Provide tools for the diagnosis of human, animal health and health of the environment
- Publish open data sources
- Research the consequences of veterinary antibiotic use

- Share data among experts
- Time for research

Health and well-being promotion

- Collaboration with environmental consultancies for the health of the environment
- Empower people in their own health
- Enhance citizens' agency on health issues
- Enhance psychological health, sexual education and lifestyle habits of young people
- Promote mental health
- Promote social well being

Public engagement and participation

- Amusement
- Citizen science
- Collaboration Network
- Collaboration with facilitators
- Create an attractive atmosphere
- Creative methodologies
- Empower people to make behavioural change in response to beach pollution
- Establish connections with farmers
- Exchange of experiences with other LLs
- Facilitation role
- Gardening
- Global village
- Incentivize people's participation and agency
- Inter- and trans-disciplinar experiences
- Involve the project "i*Atención! ¡No me aplastes*!"
- Meeting space for different people with diverse backgrounds to react to the same scientific input
- Out of the box thinking
- Painting sessions
- Popular lunch
- Recruitment from Different Citizens Sectors
- Understand each other
- Understand why people might not be interested in science and academia

Living Lab Agents

List of suggested agents that were mentioned during the workshop.

Artists and Creative Professionals	
Local artists	
Business and Enterprises	
Local Business and Industry	Business persons
	Gorliz WWTP
	Industry
	Industry of Fermented Products
	Merchant's Association
	Mungia WWTP
Regulatory Bodies	Regulatory Councils of Fermented Products Industry
Community Groups and Civil Society	
Associations and Organizations	AMBAR
	Citizens associations
	Community organizations
	Environmentalists
	Gaztetxe
	Goazen-UP
	Neighborhood Association of Plentzia
	Sare Berdeak
	Social organizations
	Staff from a nearby LL with prior experience
	TANTAK
	Txipio Bai
Key Individuals	Key people with influence in Plentzia
Specific Community Groups	Rowing teams (e.g. Arkote arraun taldea)
	Rowers
	Beach users
	Children
	Citizens
	Elderly
	Families
	Inclusive groups
	Minorities
	People not interested in science
	Project "*¡Atención! ¡No me aplastes!*"
	Sport fishermen
	Surfers
	Vulnerable people
	Young People
Educational Institutions	

Gaztegune	
High schools	
Schools	
Tutor in Gorliz school	

Farmers, Fishermen, and Related Professionals

Agricultural Sector	Caserios
	Farmers
	Agricultors
Fishing Sector	Aquaculture
	Professional fishermen
	Sailors
	Fishermen's Guild
	Vessels

Governance and Institutions

Global Governance	Global governance bodies
Local Governance	Gorliz City Hall
	Local administrations
	Local authorities
	Municipal Cleaning Brigade
	Plentzia City Hall
	Politicians from Plentzia and Gorliz
	Technicians
	Waste Management service
Regional and National Governance	Diputación Foral de Vizcaia
	Mancomunidad de Uribe Kosta
	National governance bodies
	Regional governance bodies
Specialized Bodies and Programs	Aclima
	Aranzadi
	Feral Farm of Gorliz (Biscay)
	GAIA
	Hazi
	Ihobe
	URA
	Wildlife Recovery Centre (Biscay)

Health Sector

Healthcare Professionals and Facilities	Doctors
	Hospital representatives
	Hospitals
	Lifeguards
	Pharmacies
	Psychologists
	Psychopedagogist from Gorliz
	Veterinaries

Media and Communication	
Communicators	
Influencers from Plentzia and Gorliz	
Journalists	
Media Outlets	Hiruka news paper
	La mecánica del Caracol
	Norteko Ferrokarila
	Plentzia Telebista
Scientific and Academic Institutions	
Research Organizations	Azti
	Katedra
Specialized Experts	Anthropologists
	Experts from other fields of knowledge
	Experts in mental and social well-being
	Experts in participative and facilitation methodologies
	Landscape Architects
	Social science experts
	Sociologists
Universities	
Tourism and Cultural Activities	
Cultural Events	"Aula de cultura"
	Festival Committee of Plentzia and Gorliz
Tourism and Hospitality	Kirol Portuak
	Marinas
	Tourism sector